HAMDARD Imtihani

BIOLOGY

QUESTIONS DEVELOPED ACCORDING TO THE NEW EXAMINATION TECHNIQUES: KNOWLEDGE, UNDERSTANDING, ANALYTICAL AND CONCEPTUAL

NEW SYLLABUS

ACCORDING TO NEW SYLLABUS AND PAPER PATTERN OF PECTAA

10

PERFECT SOLUTION OF ANNUAL PAPER

- TOPIC WISE SUBJECTIVE TYPE QUESTIONS
- OBJECTIVE TYPE QUESTIONS
  (i) TOPIC WISE MCQ's (ii) TOPIC WISE SHORT ANSWER QUESTIONS
- COMPLETE SOLUTION OF EXERCISE QUESTIONS
- SOLUTION OF ADDITIONAL KNOWLEDGE BASED QUESTIONS

DUE TO ITS COMPREHENSIVE AND TO THE POINT MATTER FIRST CHOICE OF TEACHERS AND STUDENTS

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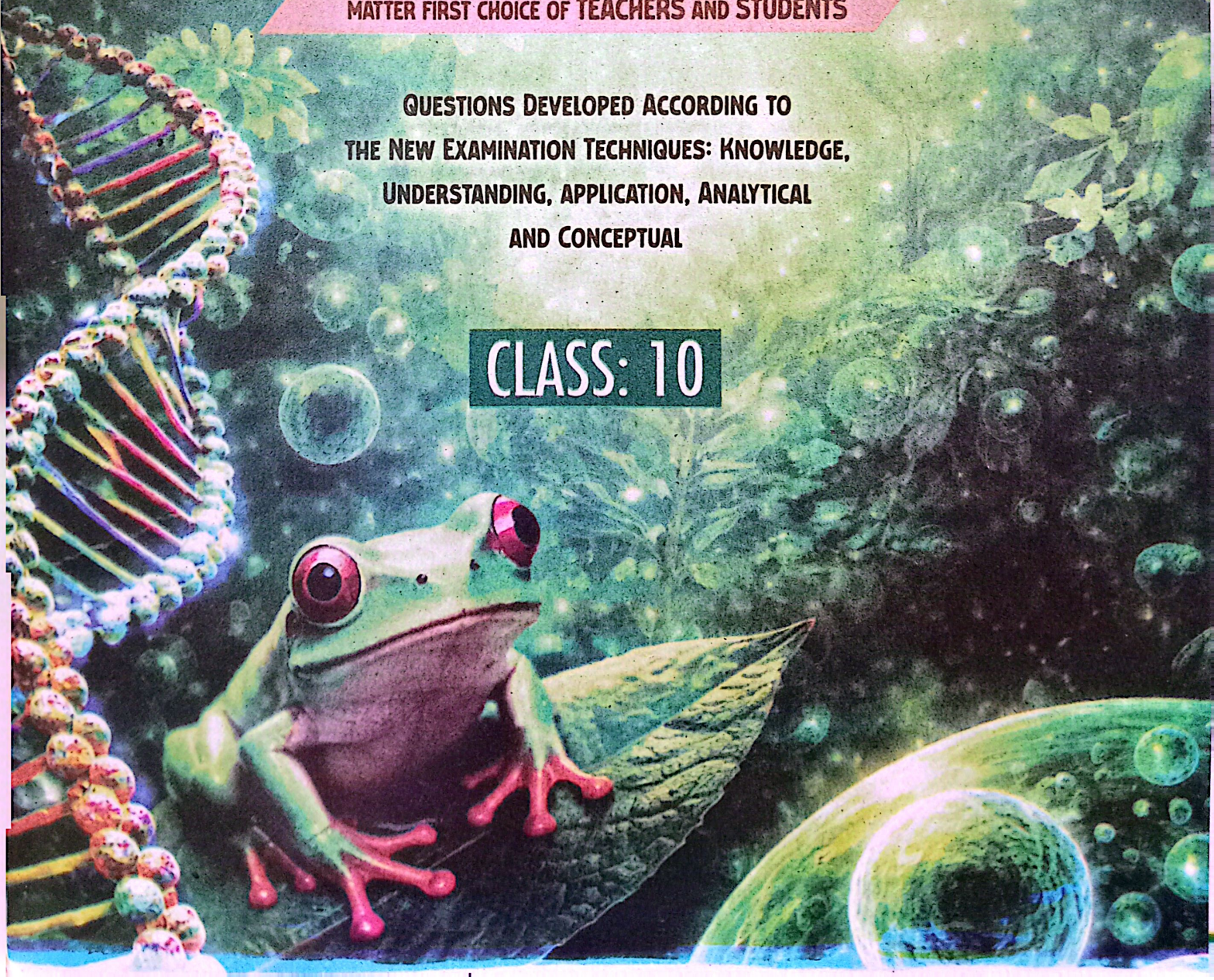
CLASS: 10



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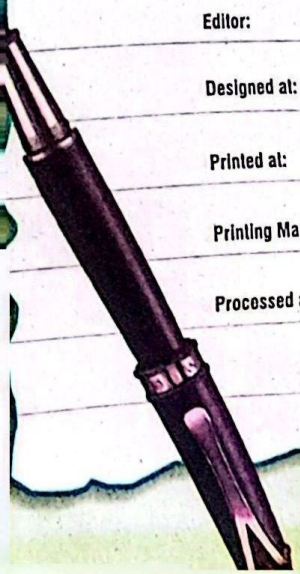

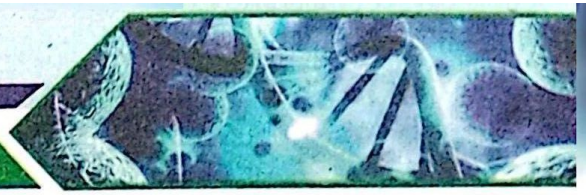

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CHAPTER 1 Human Digestive System

Students Learning Outcomes

After Studying this chapter, students will be able to:

- Describe the needs of ingestion, digestion, absorption, assimilation and egestion.
- Identify and describe the structures of the main regions of the alimentary canal and the associated organs.
- Describe swallowing and peristalsis.
- Sort out the action of enzymes in specific regions of alimentary canal, with respect to their substrates and products.
- State the role of the liver.
- Describe the structure of a villus, including the roles of capillaries and lacteals.
- State the signs and symptoms, causes, treatments and preventions of the disorders of gut i.e., diarrhoea, constipation, and ulcer.

Subjective Type Questions

Long Questions prepared in the light of new Examination Techniques (Knowledge, Understanding, Application, Analytical & Conceptual)

1.1 Nutrition and its Importance

Q.1: Why is nutrition essential for living organisms also describe the main steps involved in nutrition?

OR Explain nutrition and discuss its importance for growth, energy and maintenance of the human body.

Ans. Nutrition:

Nutrition is the process by which living organisms take in food and utilize it.

Nutrients: Nutrients are the chemical substances present in food that provides energy, support, growth and repair.

Importance of nutrition:

Nutrition is essential for proper growth, stay healthy and repair the body.

Steps involved in nutrition:

In animals, nutrition takes place in the following main steps:

(i) **Ingestion:** Ingestion is the process of taking in food and drinks through the mouth.

(ii) **Digestion:** Digestion is breaking food into smallest parts which the body can absorb.

Q. Differentiate between autotrophic and heterotrophic nutrition.

Ans. Autotrophic nutrition is a mode of nutrition in which organisms produce their own food from inorganic substances using light or chemical energy.

Heterotrophic nutrition is a mode of nutrition in which organisms obtain their food by consuming other organisms or organic matter.

(iii) **Absorption:** Absorption is the process of moving nutrients from the digested food into the blood or lymph.

(iv) **Assimilation:** Assimilation is the process of using the absorbed nutrients in cells and tissues.

(v) **Egestion:** The process of removing undigested food and waste from the body.

Q.2: What is meant by digestion? Briefly explain.

Ans. The process of breaking up complex substances into simpler substances is called digestion. The food we eat consists of polymers i.e., large molecules like carbohydrates, proteins, and fats. They cannot pass through cell membranes. These polymers must be broken down into smaller, soluble parts called monomers - like sugars, amino acids, and fatty acids. These small molecules can enter the cells.

1.2 Human Digestive System

Q.3: What is oral cavity. Explain how both mechanical and chemical digestion are initiated here?

OR Explain the role of oral cavity in digestive system.

Ans. Oral Cavity:

The space behind mouth is called oral cavity or mouth cavity. It consists of taste buds on the surface of tongue for the taste of food.

Mechanical digestion:

The mechanical digestion of food begins in oral cavity. During mechanical digestion, the teeth cut and grind food into smaller pieces.

Chemical digestion:

In oral cavity, partial chemical digestion of carbohydrates is done by three pairs of salivary glands. These glands are attached with oral cavity and secrete saliva. Saliva is the mixture of water, mucus and a digestive enzyme called salivary amylase.

Q. What is the role of tongue during grinding?
Ans. During this grinding, tongue keeps the food between the teeth.

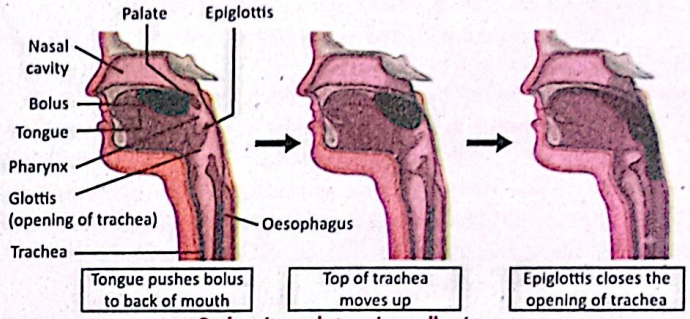
Q. Differentiate between starch and maltose.
Ans. Starch is a polysaccharide (made up of many sugar molecules). Maltose is a disaccharide (made of two sugar molecules).

Q. How opening of nasal cavity closed during swallowing?
Ans. During swallowing, the palate (roof of oral cavity) moves upward to close the opening of the nasal cavity.

Water and mucous moisten the food pieces. Salivary amylase breaks down the starch present in food into maltose.

Swallowing:

After the physical and partial chemical digestion, the food mass in oral cavity is called bolus. It is swallowed by pushing it into the pharynx. For swallowing, the tongue moves the bolus to the back of the oral cavity. The swallowed food enters the pharynx.



Oral cavity and steps in swallowing

Q.4: What is alimentary canal? Describe the structure and function of pharynx.

Ans. Alimentary Canal: The human digestive system consist of a long tube and some other helper organs. This is called alimentary canal.

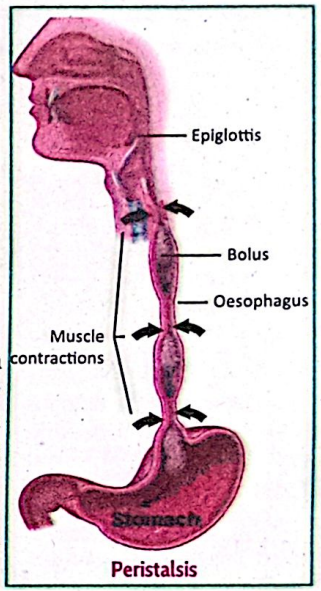
Pharynx: Pharynx is a short tube-like part behind oral cavity. It connects oral cavity to oesophagus and also connects nose to windpipe (trachea).

Functions of pharynx:

(i) The process of chemical digestion that started in oral cavity continues in pharynx.

(ii) Pharynx prevents the entry of food particles into lungs. It is done with the help of an elastic cartilage tissue called epiglottis.

(iii) When swallowed food passes through pharynx, the top of trachea (windpipe) is pushed up against epiglottis. In this way, the opening of trachea (glottis) closes and the swallowed food passes over it.



Peristalsis

Q.5: How food moves from oesophagus to stomach?

Ans. Oesophagus: Oesophagus is a long tube (about 25cm long).

Functions of Oesophagus: Oesophagus connects the pharynx to the stomach. When food enters oesophagus, successive waves of contraction are generated in its muscular walls. These waves of contractions move food along oesophagus to the stomach. These waves of muscular contraction are called peristalsis.

Q.6: Describe the anatomical structure of the stomach and explain in detail its role in digestion of food.

OR Explain the structure and function of stomach.

Ans. Structure of stomach:

Stomach is J-shaped organ located in the upper left side of abdominal cavity, below the diaphragm. The part of stomach immediately after oesophagus is called cardiac end

while the part before small intestine is called pyloric end.

Cardiac Sphincter: At the junction of the oesophagus and stomach, there is sphincter (ring of muscles) called cardiac sphincter.

- It prevents food from flowing back from stomach into oesophagus.

Pyloric Sphincter: Pyloric sphincter is present between stomach and small intestine.

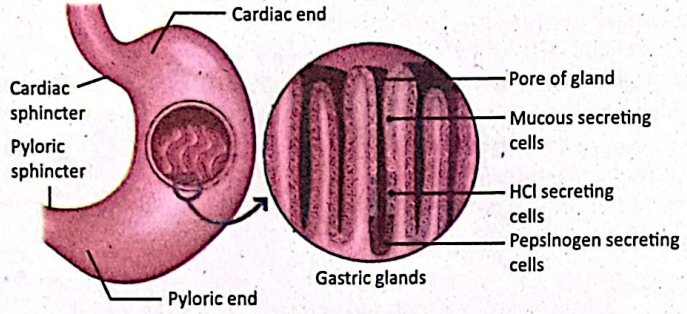
Mechanical Digestion of food: Stomach stores food. The walls of stomach are made of thick smooth muscles. When food arrives in stomach, these muscles contract rigorously. Their contractions helps in the churning (breaking down) of food into smaller particles. Heat is also produced due to this churning. This heat helps to melt the lipids.

Gastric juice secretion: Many small gastric glands present in the inner walls of stomach secrete gastric juice. It contains:

Q. How our stomach is protected from HCl?
Ans. The stomach's HCl is so strong it can dissolve metal But your stomach is protected by the thick mucus lining that keeps it safe from its own acid.

(i) Hydrochloric acid (ii) Pepsinogen (iii) Mucus

Chemical Digestion of food: Hydrochloric acid converts pepsinogen into an active enzyme pepsin. Pepsin breaks large proteins into shorter chains of amino acids called peptides. Hydrochloric acid also kills pathogenic bacteria present in food. Mucus forms a protective layer on the inner walls of stomach. Where it neutralizes the HCl.



Structure of stomach

Food usually remains in stomach for three to four hours. Due to the actions in stomach, the food becomes a soup-like mixture called chyme. The pyloric sphincter controls the flow of chyme. Each time the pyloric sphincter opens about 5 to 15ml of chyme moves into the small intestine.

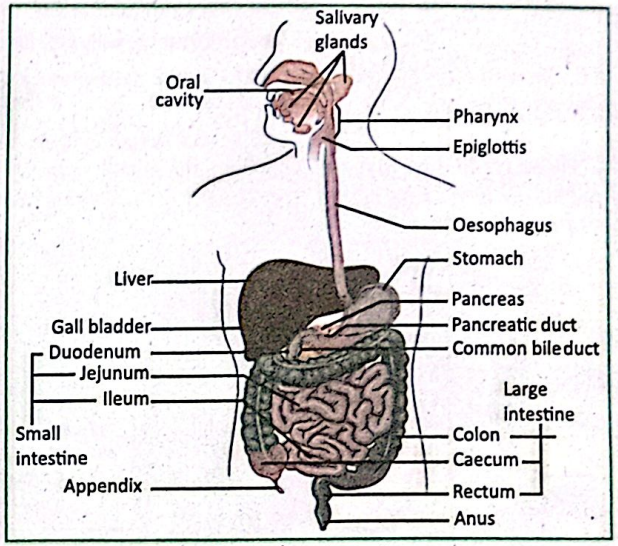
Q.7: Describe the structure of the small intestine and explains how its various parts contribute to the complete digestion.

Ans. Small Intestine: Small intestine is highly coiled tube and is nearly 7m long. Where the majority of digestion and nutrient absorption occurs.

Parts of small intestine: Small intestine consists of three parts:

(i) **Duodenum:** It is the first part. It is about 25cm long.
(ii) **Jejunum:** It is the middle part. It is about 2.5m long.
(iii) **Ileum:** It is the last part. It is about 4m(about 13 feet) long.

- **Secretion of liver:** The secretion of liver i.e., bile enters duodenum through common bile duct. It contains salt which break large fats into smaller droplets. In this way, a milky fluid is formed in which fat droplets are kept separate.



Human digestive system

- **Secretion of pancreas:** The secretion of pancreas i.e. pancreatic juice enters duodenum through pancreatic duct, which joins the common bile duct before entering duodenum.
- **Enzymes of pancreatic juice:** Pancreatic juice contains many enzymes e.g.

(i) Trypsin (ii) Pancreatic amylase (iii) Lipase

These enzymes digest proteins, carbohydrates and lipids respectively. Pancreatic juice also contains sodium bicarbonate that neutralizes the acidity of chyme. The glands present in the walls of small intestine also secrete enzymes for the complete digestion of all types of food.

Q.8: Describe the absorption of food in small intestine.

Ans. The absorption of food in the small intestine is the process by which the final products of digestion pass through the intestinal mucosa into the blood or lymph. This is the most critical stage of the digestive process. The end products i.e. amino acids, simple sugars, glycerol and fatty acids etc move from alimentary canal into the circulatory system.

Villi: The inner walls of small intestine are highly folded. These folds have millions of finger like projections called villi. The wall of villus is made of a single layer of cells. Inside the villus, there are blood capillaries and a lymph vessel called lacteal.

Role of villi:

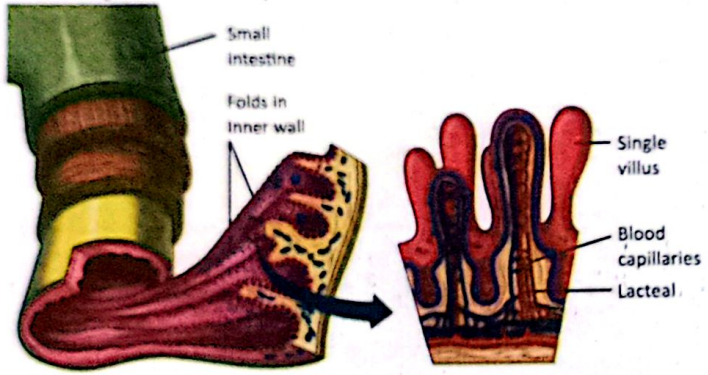
- Villi provide a large surface area for the absorption of food.
- Food molecules are absorbed through diffusion and active transport.

Lacteal: Lacteal is a lymph vessel present inside the villi. The glycerol and fatty acids present in small intestine enter the lacteals of villi.

> **Q. How pigments are removed?**
> **Ans.** Bile also contains pigments that are formed when RBCs are broken in liver. These pigments are removed from the body with faeces.

Role of Lacteal: The lacteal carry glycerol and fatty acids to the main lymph vessels, which empty into the blood vessels.

Absorption in liver and all body parts: Amino acids and simple sugars enter the blood capillaries of villi. These capillaries join to make hepatic portal vein which carries the amino acids and sugars to liver. From liver, the hepatic vein carries these nutrients to heart and then to all parts of the body.



Small intestine and Villi

Q.9: Explain the structure and primary functions of the large intestine.

Ans. Large Intestine: After the absorption of digested food material and some water, the undigested material and water moves to large intestine by peristalsis.

Parts of large intestine: Large intestine has three parts:

(i) **Caecum:** A pouch that forms junction with small intestine.

(ii) **Colon:** Absorb remaining water and salts from undigested food material and solidifying it.

(iii) **Rectum:** Act as storage site for faeces.

> **Q. Write short note on appendix.**
> **Ans.** There is a small finger-like appendix at the blind end of caecum. It may seem like an unimportant organ, but it actually plays a role in your immune system.
> Infection in appendix causes severe pain. If infected appendix is not removed surgically, it can burst and infection may spread in abdomen.
> **Q. What do you know about carotene?**
> **Ans.** Carotene is a natural organic pigment found in fruits and vegetables e.g. carrots and mangoes which are essential for vision, growth and immunity.

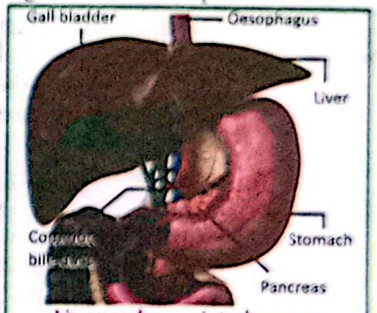
Functions of Large Intestine: Absorption of more water occurs in large intestine. Due to it, the undigested material solidifies and is now called faeces. The faeces contain the undigested material, large number of bacteria, broken cells of alimentary canal, bile pigments and water. Faeces are temporarily stored in the rectum. During ejestion, faeces are expelled out through anus.

Q.10: Justify the importance of liver in digestion.

Ans. Liver: Liver is a large organ located on the right of stomach. In an adult human it weighs about 1.5kg. There is a sac-like organ, called gall bladder on the ventral side of liver.

Role of bile in digestion: The liver's primary contribution to digestion in the secretion of bile, which is stored in the gall bladder.

- **Transportation:** Bile travels from the gall bladder through the common bile duct into the duodenum. While bile does not contains enzymes, it contains bile salts that break fats into small droplets (emulsification).
- **Efficiency:** By keeping fat droplets separate, bile salts make it easier for enzymes to attack and break down lipids.
- **Metabolic and Regulatory functions:** Liver also performs many other functions in the body which are as follows:
- Stores glucose as glycogen and breaks glycogen to glucose when required.
- Stores of fat-soluble vitamins.
- Breaks amino acids. In this process, harmful ammonia is produced.
- Converts ammonia into less toxic urea for excretion through urine.
- Breaks toxic substances e.g., alcohol.
- Breaks the RBCs which have completed their life spans.
- Prepares vitamin A from carotene.
- Produces heat in cold temperatures by speeding up metabolism.



Liver and associated organs

Q.11: Describe the action of different enzymes in the regions of alimentary canal.

Ans.

The action of enzymes in the regions of alimentary canal

Region	Enzyme	Substrate	Product
Oral Cavity	Salivary Amylase	Starch	Maltose
Stomach	Pepsin	Proteins	Peptides
	Pancreatic Amylase	Starch	Maltose
Small Intestine	Trypsin	Proteins	Peptides
	Chymotrypsin	Proteins	Peptides
	Peptidase	Peptides	Amino acids and peptides
	Lipase	Fats	Fatty acids glycerol
	Nucleases	Nucleic acids	Nucleotides
	Maltase	Maltose	Glucose
	Sucrase	Sucrose	Glucose and Fructose
	Lactase	Lactose	Glucose and Galactose
	Dipeptidases	Dipeptides	Amino acids

1.3 Disorders of the Digestive System

Q.12: What is diarrhoea? Write its causes and symptoms.

Ans. Diarrhoea: Diarrhoea is characterized by frequent, loose, or watery stools. . Diarrhoea can lead to dehydration, especially in children and the elderly.

- **Symptoms of diarrhoea:** Abdominal cramps or pain, bloating, and dehydration (thirst, dry mouth, dark urine).
- **Causes of diarrhoea:** Infections (bacterial, viral, or parasitic), food allergies, stress, certain medications (e.g., antibiotics).
- **Treatment:** Drinking plenty of fluids, use of ORS, eating a soft diet, using anti-diarrheal medications, taking antibiotics or other treatments (in severe cases).
- **Prevention:** Washing hands regularly, especially before eating or after using the bathroom, avoiding contaminated food or water, avoid stress

Q13. What do you know about constipation? Also write causes and symptoms.

Constipation: Constipation is a condition in which faeces are not eliminated from the body at regular intervals.

- **Signs and Symptoms:** Infrequent or difficult bowel movements (less than 3 times a week), hard and dry stools, abdominal discomfort or bloating.
- **Causes of constipation:** Lack of fibre in diet, dehydration, lack of physical activity, certain medicines (e.g., painkillers, iron supplements), other diseases (e.g., diabetes).
- **Treatment:** Increasing fibre intake (fruits, vegetables, whole grains), drinking plenty of water, regular exercise, use medicines as prescribed by the doctor.
- **Prevention:** Eating a high-fibre diet, drinking plenty of fluids.

Q.14: Write a note on Ulcer.

Ans. Ulcers:

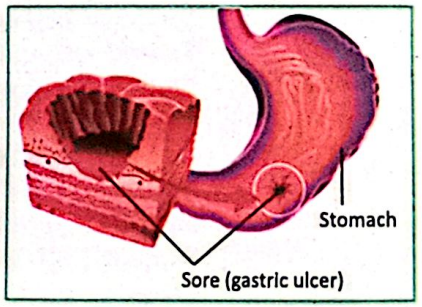
Peptic ulcers are sores that develop in the walls of alimentary canal. Ulcer usually develops in the walls of stomach and is called gastric ulcer. However ulcers may also develop in duodenum (duodenal ulcer) or oesophagus (oesophageal ulcer).

Signs and Symptoms: Burning stomach pain, rush of saliva after regurgitation, loss of appetite, weight loss, blood vomiting (in severe cases) are the major signs and symptoms of ulcers.

Causes: Infection due to Helicobacter pylori bacteria, long term use of non steroidal anti-inflammatory drugs (NSAIDs), excessive alcohol consumption, smoking, stress (though not a direct cause, it can make symptoms worse) are the causes of ulcers.

Treatment: Antibiotics to clear H.Pylori infection, medicines called antacids and proton pump inhibitors.

Prevention: Avoiding excessive use of painkillers (NSAIDS), avoiding spicy foods, eating a balanced diet.



Gastric ulcer

Objective Type Questions

Additional MCQ's

Multiple Choice Questions prepared in the light of new Examination Techniques
(Knowledge, Understanding, Application, Analytical & Conceptual)

1.1 Nutrition and Its Importance

1. Everything in our body like moving, growing and staying healthy depends upon:
   (a) Digestion (b) Excretion (c) Nutrition (d) Respiration
2. Which process is responsible for turning food into usable nutrients for body cells?
   (a) Guttation (b) Transpiration (c) Circulation (d) Digestion
3. In which process organisms get and use nutrients?
   (a) Digestion (b) Assimilation (c) Ingestion (d) Nutrition
4. "Taking in food and drinks through the mouth" defines which step?
   (a) Assimilation (b) Absorption (c) Ingestion (d) Digestion
5. The process of using absorbed nutrients in cells and tissues is called:
   (a) Digestion (b) Assimilation (c) Egestion (d) Absorption
6. Removing undigested food and waste from the body is known as:
   (a) Absorption (b) Egestion (c) Secretion (d) Ingestion
7. Large molecules like carbohydrates, proteins and fats are scientifically referred as:
   (a) Monomers (b) Enzymes (c) Polymers (d) Hormones
8. Polymers cannot pass through:
   (a) Cell wall (b) Cell membrane (c) Protoplasm (d) Cytoplasm
9. Monomers are:
   (a) Sugars (b) Amino Acids (c) Fatty acids (d) All of these

1.2 Human Digestive System

10. The human digestive system consists of:
    (a) Alimentary canal (b) Accessory organs
    (c) Stomach (d) All of these
11. From where alimentary canal starts:
    (a) Esophagus (b) Mouth (c) Stomach (d) Anus
12. Alimentary canal ends at:
    (a) Small intestine (b) Anus (c) Mouth (d) Large Intestine
13. Which of the following is considered an "accessory" (helper) organ of the digestive system?
    (a) Heart (b) Liver (c) Lungs (d) Kidney

14. **The space behind the mouth is called:**
(a) Nasal cavity (b) Oral cavity
(c) Chest cavity (d) Abdominal cavity

15. **Taste buds are located on the surface of the:**
(a) Teeth (b) Gums (c) Tongue (d) Palate

16. **Mechanical digestion of food begins in:**
(a) Stomach (b) Oesophagus (c) Oral cavity (d) Small intestine

17. **During mechanical digestion in the mouth, what is the primary role of the teeth?**
(a) To absorb nutrients (b) To cut and grind food
(c) To produce saliva (d) To taste the food

18. **How many pairs of salivary glands are attached to the oral cavity?**
(a) One (b) Two (c) Three (d) Four

19. **Saliva is a mixture of:**
(a) Water (b) Mucus
(c) Digestive enzyme (d) All of these

20. **Which digestive enzyme is found in saliva?**
(a) Pepsin (b) Lipase (c) Salivary amylase (d) Protease

21. **After physical and partial chemical digestion, the food mass in the oral cavity is called:**
(a) Chyme (b) Bolus (c) Monomer (d) Polymer

22. **To which part of the digestive tract is the bolus pushed during swallowing?**
(a) Stomach (b) Trachea (c) Pharynx (d) Small intestine

23. **During swallowing, which structure moves upward to close the opening of the nasal cavity?**
(a) Tongue (b) Epiglottis (c) Palate (d) Glottis

24. **A short tube-like part after oral cavity is:**
(a) Stomach (b) Larynx (c) Pharynx (d) Mouth

25. **Pharynx connects the oral cavity with the:**
(a) Small intestine (b) Heart (c) Lungs (d) Oesophagus

26. **The elastic cartilage tissue present in the pharynx is called:**
(a) Palate (b) Glottis (c) Epiglottis (d) Pharynx

27. **The opening of the trachea (wind pipe) is called:**
(a) Pharynx (b) Bolus (c) Glottis (d) Oesophagus

28. **Approximately how long is the oesophagus?**
(a) 10cm (b) 25cm (c) 50cm (d) 100cm

29. **Oesophagus connects the pharynx to the:**
(a) Small intestine (b) Stomach (c) Oral cavity (d) Large intestine

30. **What is the shape of stomach?**
(a) C-shaped (b) U-shaped (c) J-shaped (d) S-shaped

31. **The part of the stomach immediately after the oesophagus is the:**
(a) Pyloric end (b) Cardiac end (c) Sphincter (d) None of these

32. **The part of the stomach before the small intestine:**
(a) Pyloric end (b) Cardiac end (c) Body (d) Peristalsis

33. **Pyloric sphincter is present between:**
(a) Oral cavity and pharynx (b) Stomach and pharynx
(c) Stomach and small intestine (d) Small intestine and pharynx

34. **Which of the following organ stores food?**
(a) Pharynx (b) Oral cavity (c) Small intestine (d) Stomach

35. **Gastric glands are present in:**
(a) Inner walls of stomach (b) Outer walls of stomach
(c) Central walls of stomach (d) None of these

36. **Gastric juice contains:**
(a) Hydrochloric acid (b) Pepsinogen
(c) Mucus (d) All of these

37. **HCl in the stomach converts inactive pepsinogen into:**
(a) Maltose (b) Peptides (c) Pepsin (d) Amino acids

38. **What does the enzyme pepsin break proteins into:**
(a) Sugars (b) Fatty acids (c) Peptides (d) Starch

39. **What is the primary role of mucus in the stomach?**
(a) To digest proteins (b) To kill bacteria
(c) To form protective layer (d) To melt lipids

40. **For how much duration food usually remains in stomach?**
(a) Three to four hours (b) Three to five hours
(c) Two to three hours (d) Five to six hours

41. **In stomach, the soup-like mixture of food is called:**
(a) Bolus (b) Chyme (c) Matrix (d) Cristae

42. **What is the approximate total length of the small intestine?**
(a) 3m (b) 5m (c) 7m (d) 10m

43. **The shortest part of the small intestine is:**
(a) Jejunum (b) Ileum (c) Duodenum (d) Colon

44. **How much long duodenum is:**
(a) 10cm (b) 15cm (c) 20cm (d) 25cm

45. **The middle part of the small intestine is:**
(a) Duodenum (b) Ileum (c) Jejunum (d) Colon

46. **The length of ileum is:**
(a) 25cm (b) 2.5cm (c) 2m (d) 4m

47. **The secretion of liver is called:**
(a) Colon (b) Bile (c) Bolus (d) Matrix

48. **Bile contains:**
(a) HCl (b) Pepsin (c) Salts (d) Pepsinogen

49. **The secretion of pancreas is known as:**
(a) Bile (b) Chyme (c) Gastric juice (d) Pancreatic juice

50. Which enzymes are present in pancreatic juice?
(a) Trypsin (b) Pancreatic amylase
(c) Lipase (d) All of these

51. Which enzyme in pancreatic juice digests lipids (fats)?
(a) Trypsin (b) Amylase (c) Lipase (d) Mucus

52. Which enzyme in pancreatic juice digests proteins?
(a) Lipase (b) Trypsin (c) Amylase (d) Pepsin

53. Pancreatic amylase is responsible for digesting:
(a) Proteins (b) Carbohydrates (c) Fats (d) Vitamins

54. After the complete digestion of food the end products move from alimentary canal into the:
(a) Respiratory system (b) Circulatory system
(c) Digestive system (d) Heart

55. The inner walls of small intestine form finger-like projections called:
(a) Bolus (b) Chyme (c) Villi (d) Veins

56. Villi provide:
(a) Support (b) Protection
(c) Large surface area (d) Locomotion

57. Food molecules are absorbed through the surface of villi through:
(a) Active transport (b) Diffusion
(c) Passive transport (d) Both (a) and (b)

58. The wall of villi is made of a:
(a) Single layer of cells (b) Double layer of cells
(c) Multiple layer of cells (d) None of these

59. Which structures inside the villi are responsible for absorbing glycerol and fatty acids?
(a) Blood capillaries (b) Lacteals
(c) Hepatic portal vein (d) Peptidases

60. Amino acids and simple sugars enter which part of the villi?
(a) Lacteals (b) Folds in the inner wall
(c) Blood capillaries (d) Caecum

61. The hepatic portal vein carries nutrients directly from the small intestine to the:
(a) Heart (b) Liver (c) Stomach (d) Kidneys

62. Which enzyme is responsible for breaking down starch in the oral cavity?
(a) Pepsin (b) Salivary amylase (c) Trypsin (d) Lipase

63. Which of the following enzyme is produced by the pancreas to digest proteins in the small intestine?
(a) Pancreatic amylase (b) Chymotrypsin
(c) Peptidase (d) Salivary amylase

64. **The main purpose of large intestine is:**
(a) Digestion of proteins (b) Absorption of more water
(c) Secretion of bile (d) Breaking down amino acids

65. **Undigested material that solidified after water absorption is called:**
(a) Chyme (b) Bile (c) Faeces (d) Glycogen

66. **Faeces are temporarily stored in:**
(a) Liver (b) Larynx (c) Rectum (d) Gall bladder

67. **Where is liver located in an adult human?**
(a) To the left of the stomach (b) Behind the pancreas
(c) To the right of the stomach (d) Inside the large intestine

68. **What is the approximate weight of Liver in an adult human?**
(a) 0.5kg (b) 1.0kg (c) 1.5kg (d) 2.5kg

69. **On the ventral side of liver sac-like organ is called:**
(a) Pancreas (b) Rectum (c) Stomach (d) Gall bladder

70. **Bile is produced by:**
(a) Gall bladder (b) Liver (c) Pancreas (d) Rectum

71. **Bile is stored in:**
(a) Liver (b) Pancreas (c) Gall bladder (d) Rectum

72. **What is the function of bile salts?**
(a) To digest proteins (b) To break fats
(c) To convert glucose (d) To neutralize stomach

73. **Liver stores:**
(a) Fat-soluble vitamins (b) Water-soluble vitamins
(c) Fatty acids (d) Minerals

74. **Which harmful substance is produced when the liver breaks down amino acids?**
(a) Urea (b) Ammonia (c) Alcohol (d) Carbon dioxide

75. **The liver converts toxic ammonia into:**
(a) Carotene (b) Urea (c) Bile (d) Glycogen

1.3 Disorders of the Digestive System

76. **Which disease is characterized by frequent, loose or watery stools?**
(a) Constipation (b) Ulcer (c) Asthma (d) Diarrhoea

77. **Drinking plenty of fluids, eating a blend diet, using anti-diarrheal medications are the treatments for:**
(a) Ulcers (b) Constipation (c) Diarrhoea (d) Asthma

78. **A condition in which faeces are not eliminated from the body at regular intervals is:**
(a) Diarrhoea (b) Constipation (c) Ulcer (d) Dengue

79. **Lack of fiber in diet, dehydration, lack of physical activity are the causes of:**
(a) Pneumonia (b) Emphysema (c) Diarrhoea (d) Constipation

80. **A "gastric ulcer" specifically refers to a sore that develops in:**
(a) Walls of the stomach (b) Duodenum
(c) Oesophagus (d) Large intestine

81. **Common symptoms of ulcer are:**
(a) Dark urine and thirst.
(b) Burning stomach pain and less appetite
(c) Frequent watery stools (d) dry mouth

Answers

1.	(c)	2.	(d)	3.	(d)	4.	(c)	5.	(b)	6.	(b)	7.	(c)
8.	(b)	9.	(d)	10.	(c)	11.	(b)	12.	(b)	13.	(b)	14.	(b)
15.	(c)	16.	(c)	17.	(b)	18.	(c)	19.	(d)	20.	(c)	21.	(b)
22.	(c)	23.	(c)	24.	(c)	25.	(d)	26.	(c)	27.	(c)	28.	(b)
29.	(b)	30.	(c)	31.	(b)	32.	(a)	33.	(c)	34.	(d)	35.	(a)
36.	(b)	37.	(c)	38.	(c)	39.	(c)	40.	(a)	41.	(b)	42.	(c)
43.	(c)	44.	(d)	45.	(c)	46.	(d)	47.	(b)	48.	(c)	49.	(d)
50.	(d)	51.	(c)	52.	(b)	53.	(b)	54.	(b)	55.	(c)	56.	(c)
57.	(d)	58.	(a)	59.	(b)	60.	(c)	61.	(b)	62.	(b)	63.	(b)
64.	(b)	65.	(c)	66.	(c)	67.	(c)	68.	(c)	69.	(d)	70.	(b)
71.	(c)	72.	(b)	73.	(a)	74.	(b)	75.	(b)	76.	(d)	77.	(c)
78.	(b)	79.	(d)	80.	(a)	81.	(b)						

Additional Short Questions

Short Answer Questions prepared in the light of new Examination Techniques (Knowledge, Understanding, Application, Analytical & Conceptual)

1.1 Nutrition and its Importance

1. **How our body get nutrients?**
Ans. In order to get nutrients our body first broken down the food into simpler parts so the body cells can absorb them. This process happens inside our digestive system.
2. **What do you know about nutrition and nutrients?**
Ans. **Nutrition:** Nutrition is a process by which living organisms take in food and utilize it.
Nutrients: Nutrients are the chemical substances present in the food that provide energy, support, growth and repair.
3. **Why nutrition is important?**
Ans. Nutrition helps the organisms to grow, stay healthy and repair their bodies.
4. **Name the steps involved in nutrition.**
Ans. Nutrition takes place in the following main steps:
i. Ingestion ii. Digestion iii. Absorption
iv. Assimilation v. Egestion

5. **Define the process ingestion.**
Ans. **Ingestion:** Taking in food and drinks through the mouth is called ingestion.
6. **What is meant by digestion?**
Ans. **Digestion:** Digestion is the process of breaking food into smaller parts so that the body can absorb.
7. **Define absorption.**
Ans. **Absorption:** Absorption is the process of moving nutrients from the digested food into the blood or lymph.
8. **What do you know about assimilation and egestion?**
Ans. **Assimilation:** Assimilation is using the absorbed nutrients in cells and tissues.
Egestion: Egestion is the process of removing undigested food and waste from the body.
9. **Differentiate between polymers and monomers.**
Ans. **Polymers:** Polymers are the larger molecules make up of many repeating monomers linked together.
Examples: Carbohydrates, Proteins and Fats.
Monomers: Monomers is a small, simple molecule that acts as a basic "building block".
Examples: Sugars, amino acids and fatty acids.

1.2 Human Digestive System

10. **What is meant by alimentary canal?**
Ans. **Alimentary canal:** The human digestive system consists of a long tube called alimentary canal. It starts at the mouth and ends at anus.
11. **How accessory organs play their role in alimentary canal.**
Ans. The salivary glands, liver and pancreas send their juices into the alimentary canal and aid in digestion.
12. **What is the name of the space behind the mouth?**
Ans. The space behind the mouth is called oral cavity or mouth cavity.
13. **Which biological components in the oral cavity are used for the taste of food?**
Ans. Oral cavity contains taste buds on the surface of tongue for the taste of food.
14. **What changes takes place during the mechanical digestion?**
Ans. During the mechanical digestion of food, the teeth cut and grind food into smaller pieces.
15. **What happens during chemical digestion in oral cavity?**
Ans. In oral cavity, partial chemical digestion of carbohydrates is done by three pairs of salivary glands. These glands are attached with oral cavity and secrete saliva.
16. **State the role of salivary glands in digestion.**
Ans.
- Salivary glands produce saliva which is the mixture of water and mucus.
- Salivary glands secrete digestive enzyme salivary amylase which breakdown the starch into maltose.

17. Write down the composition of saliva.

Ans. Saliva: Saliva is a mixture of water, mucus and salivary amylase.

18. What is "bolus" and how is it moved into the pharynx?

Ans. Bolus: The food mass in the oral cavity is called bolus.

- It is swallowed by pushing it into the pharynx.

19. Write down the steps of swallowing.

Ans.
- After the bolus formation, the tongue pushes bolus to back of mouth.
- The palate moves upward to close the opening of nasal cavity.
- The tongue moves the bolus into the pharynx.
- The top of the trachea is pushed up against the epiglottis.
- The glottis closes as the epiglottis covers it.
- The swallowed food passes over the closed trachea and enters the esophagus.

20. What is pharynx?

Ans. Pharynx: Pharynx is a short tube like part after oral cavity. It connects oral cavity to esophagus and also connects nose to windpipe (trachea).

21. What is the important function of pharynx?

Ans. An important function of pharynx is to prevent the entry of food particles into the lungs. It is done with the help of epiglottis.

22. Define epiglottis and glottis.

Ans. Epiglottis: Epiglottis is a flap of elastic cartilage tissue located in the pharynx. It prevents the food particles from entering into the wind pipe (trachea).
Glottis: The glottis is the opening of the trachea.
During swallowing, this opening is closed off.

23. Describe the function of epiglottis during swallowing?

Ans. When swallowed food passes through pharynx, the top of trachea (windpipe) is pushed up against epiglottis. In this way, the opening of trachea (glottis) closes and the swallowed food passes over it.

24. State the length of the oesophagus.

Ans. Oesophagus is a long tube (about 25 cm or 9.84 inches long).

25. What is " peristalsis" and how does it facilitate the movement of food to stomach?

Ans. Peristalsis: Peristalsis is the series of successive waves of muscular contraction in the muscular walls of oesophagus.

- When food enters oesophagus, successive, waves of contraction are generated in its muscular walls. These waves move food along the oesphagus to the stomach.

26. Where is the stomach present in human body?

Ans. Stomach is J-shaped organ located in the upper left side of the abdominal cavity below the diaphragm.

27. What is the purpose of cardiac sphincter?

Ans. Cardiac sphincter (lower oesophageal sphincter) prevents food from flowing back from stomach into the oesophagus.

28. How does the stomach contribute the mechanical digestion of food?

Ans. The walls of the stomach are made of thick smooth muscles. When food arrives in stomach, these muscles contract rigorously. Their contraction help in churning (breaking down) of food into smaller pieces. Heat is also produced which helps to melt the lipids.

29. List the three main components of gastric juice.

Ans. Gastric juice contains hydrochloric acid, pepsinogen and mucus.

30. What is the function of mucus?

Ans. The mucus forms a protective layer on the inner walls of stomach. Here it neutralizes the HCl.

31. What is chyme?

Ans. Chyme: Due to the action in stomach, the food becomes a soup-like mixture called chyme.

32. What is the role of pyloric sphincter?

Ans. Pyloric sphincter controls the flow of chyme. Each time the pyloric sphincter opens about 5 to 15 ml of chyme moves into the small intestine.

33. What do you know about small intestine?

Ans. Small Intestine: Small Intestine is highly coiled tube and is nearly 7m (about 23 ft) long. It has three parts:
Duodenum, Jejunum, Ileum.

34. Which two major accessory organs discharge their secretions into the duodenum?

Ans. In duodenum, secreations of liver and pancreas act on food and aid in digestion.

35. State the role of bile in small intestine.

Ans. Bile contains salt which break large fats into small droplets. In this way a milky fluid is formed in which fat droplets are kept separate.

36. Which enzymes are present in pancreatic juice?

Ans. Pancreatic juice contains many enzymes e.g trypsin, pancreatic amylase and lipase.

37. Write down the functions of enzymes present in the pancreatic juice.

Ans. Trypsin: It digest proteins.
Pancreatic Amylase: It digest carbohydrates.
Lipase: It digest lipids.

38. What are the end product of digestion that move into the circulatory system?

Ans. After the complete digestion of food, the end products i.e amino acids, simple sugars, glycerol and fatty acids etc move from alimentary canal into the circulatory system.

39. Define villi and tell how it increases the efficiency of absorption?

Ans. Villi: Villi are millions of tiny figner-like projections found on the highly folded inner walls of the small intestine.
The folds and villi provide a large surface area for the absorption of food.

40. By what two biological processes are food molecules absorbed through the wall of villus?

Ans. Food molecules are absorbed through the process of diffusion and active transport.

41. What are lacteals and what is their role in digestion?

Ans. Lacteals: Lacteals are the lymph vessels present in the villi of small intestine.
Role: They absorb glycerol and fatty acid and transport them.

42. How does amino acids and simple sugars enter the blood stream?

Ans. Amino acids and simple sugars enter the blood stream by entering into the blood capillaries present in the villi of small intestine.

43. What is the function of hepatic portal vein?

Ans. Hepatic portal vein carries the amino acids and sugars to liver.

44. How undigested material and water moves to large intestine?

Ans. The undigested material and water move to large intestine by peristalsis.

45. Name the parts of large intestine.

Ans. Large intestine has three parts: **i.** Caecum **ii.** Colon **iii.** Rectum

46. What is Faeces? Write their components.

Ans. Faeces: Feaces are the undigested solidified material formed in large intestine.
Components: Faeces contain the undigested material, large number of bacteria, broken cells of alimentary canal, bile pigments and water.

47. Where liver is located in human body?

Ans. Liver: Liver is a large organ located to the right of the stomach.

48. Write down any two function of liver.

Ans. Functions of liver: (i) Liver stores fat-soluble vitamins.
(ii) Liver convert ammonia into less toxic urea for excreation through urine.

1.3 Disorders of the digestive system

49. What is diarrhoea? Write down its causes.

Ans. Diarrhoea: Diarrhoea is characterized by frequent, loose or watery stools. Diarrhoea can lead to dehydration, especially in children and the elderly.
Causes: Infection (bacterial, viral and parasitic), food allergies, stress, certain medications (e.g. antibiotics) are the causes of diarrhoea.

50. What are the symptoms of diarrhoea?

Ans. Symptoms: Signs and symptoms of diarrhoea includes frequent, loose or watery stools, abdominal cramps or pain, bloating and dehydration. (thirst, dry mouth, dark urine).

51. What is constipation? Mention any two causes of constipation.

Ans. Constipation: Constipation is a condition in which faeces are not eliminated from the body at regular intervals.
Causes: Lack of fibre in diet and lack of physical exercise are the causes.

52. How can constipation be prevented?

Ans. Prevention: Constipation can be prevented by eating a high-fibre diet and by drinking plenty of fluids.

53. What is meant by peptic ulcer?

Ans. Peptic Ulcer: Peptic ulcers are sores that develop in the walls of alimentary canal.

54. How many types of ulcer are present?

Ans. Gastric ulcer, duodenal ulcer or oesophageal ulcer.

55. How ulcers can be treated?

Ans. Treatment: Antibiotics to clear H.Pylori infection, medicines called antacids and proton pump inhibitors.

Exercise Questions (Solved)

A. Select the correct answers for the following questions.

1. The three portions of the small intestine, in the correct order, are:
(a) Duodenum, jejunum, ileum (b) Ileum, duodenum, jejunum
(c) Colon, caecum, rectum (d) Caecum, colon, rectum

2. The wavelike movement of muscles that pushes food through the digestive system is called:
(a) Chemical digestion (b) Mechanical digestion
(c) Peristalsis (d) Absorption

3. The part of the digestive system where no chemical digestion takes place is:
(a) Oral cavity (b) Oesophagus (c) Stomach (d) Duodenum

4. Which group of enzymes breaks up starches?
(a) Proteases (b)Lipases (c) Amylases (d) Pepsin

5. The pancreas produces digestive enzymes and releases them into:
(a) Colon (b) Gall bladder (c) Liver (d) Duodenum

6. In stomach, pepsinogen is converted into pepsin by the action of:
(a) Bile salts (d) Hormones (c) HCI (d) Bicarbonate

7. In which part are the carbohydrates, lipids and proteins digested?
(a) Oral cavity (b) Stomach (c) Small intestine (d) Large intestine

8. The enzyme trypsin is found in:
(a) Pancreatic juice (b) Bile (c) Gastric juice (d) Saliva

9. The common bile duct carries bile from gall bladder to:
(a) Stomach (b) Duodenum (c) Colon (d) Pancreas

10. Why the small intestine has many folds and contains villi and microvilli?
(a) To slow down the passage of food. (b) To promote food absorption.
(c) To prevent the backflow of chyme. (d) To produce enzymes.

Answers

1. (a)	2. (c)	3. (b)	4. (c)	5. (d)
6. (c)	7. (c)	8. (a)	9. (b)	10. (b)

B. Write short answers.

1. State the role of salivary glands in digestion.

Ans. • Salivary glands produce saliva which is the mixture of water and mucus.

• Salivary glands secrete digestive enzyme salivary amylase which breakdown the starch into maltose.

2. What do the terms swallowing and peristalsis mean?

Ans. Swallowing: Swallowing is a process by which food is moved from the oral cavity into the oesophagus.

Peristalsis: Peristalsis is a series of successive waves of muscular contraction.

3. What are the functions of HCl in gastric juice?

Ans. Functions of HCl:

(i) HCl converts pepsinogen into an active enzyme pepsin.

(ii) HCl kills pathogenic bacteria present in food.

4. State the role of pancreatic juice contribute in food.

Ans. Role of pancreatic juice:

(i) Pancreatic juice contains enzymes trypsin, pancreatic amylase and lipase that digest proteins, carbohydrates and fats/lipids respectively.

(ii) Pancreatic juice contains sodium bicarbonate that neutralize the acidity of chyme.

5. Write a brief note on the structure of villi.

Ans. Villi: Villi are millions of tiny figner-like projections found on the highly folded inner walls of the small intestine.

The folds and villi provide a large surface area for the absorption of food.

6. What are the causes and symptoms of ulcers?

Ans. Symptoms: Burning stomach pain, rush of saliva after regurgitation, loss of appetite, weight loss and blood vomiting are the symptoms of ulcer.

Causes: Infection due to Helicobacter pylori bacteria, long term use of non steroidal anti-inflammatory drugs (NSAIDs), excessive alcohol consumption, smoking, stress (trhough not a direct cause, it can make symptoms worse) are the causes of ulcers.

C. Write answers in detail.

1. Describe the absorption of food in small intestine.

Ans. For answer See Question. No. 8

2. Explain the role of oral cavity in the digestive system.

Ans. For answer See Question. No. 3

3. Explain the structure and functions of stomach.

Ans. For answer See Question. No. 6

4. Justify the importance of liver and pancreas in digestion.

Ans. Role of liver: For answer See Question. No. 10

Role of Pancreas:

• **Secretion of pancreas:** The secretion of pancreas i.e. pancreatic juice enters duodenum through pancreatic duct, which joins the common bile duct before entering duodenum.

• **Enzymes of pancreatic juice:** Pancreatic juice contains many enzymes e.g.

(i) Trypsin (ii) Pancreatic amylase (iii) Lipase

These enzymes digest proteins, carbohydrates and lipids respectively. Pancreatic juice also contains sodium bicarbonate that neutralizes the acidity of chyme. The glands present in the walls of small intestine also secrete enzymes for the complete digestion of all types of food.

D. Inquisitive Questions:

1. Why does someone with liver disease have difficulties in digesting fats?

Ans. A person with liver disease has trouble in digesting fats because the liver is responsible for producing bile. Bile helps in the digestion of fats. In liver disease, bile production is reduced, so fats are not digested properly.

2. Why is it important to maintain a healthy balance of gut bacteria?

Ans. Maintaining a healthy balance of gut bacteria is important because a healthy balance of gut bacteria helps in proper digestion of food and prevent the growth of harmful microorganisms in the intestine.

3. How can a malfunction in the cardiac sphincter lead to acid reflux?

Ans. The cardiac sphincter is a ring of muscles at the junction of the oesophagus and the stomach. Its role is to prevent food and stomach acid from flowing back into the oesophagus. If it malfunctions or fails to close properly, the highly acidic gastric juice (HCl) moves upward into the oesophagus, causing burning sensation known as acid reflux.

4. Why is it necessary to store bile in the gallbladder before it is released?

Ans. The gallbladder acts as storage reservoir so that bile can be concentrated and released in large amount specifically when chyme enters in small intestine. This ensure there is enough bile available to immediately neutralize the acidic chyme from the stomach and begins the emulsification of fats effectively.

CHAPTER 2 Human Respiratory System

Students Learning Outcomes

After Studying this chapter, students will be able to:

- Describe the roles of the parts of the air passageway and lungs.
- Describe the mechanism of breathing in terms of movements of ribs and diaphragm.
- Differentiate between the composition of inspired and expired air.
- Discuss briefly diseases related to respiratory system like bronchitis, emphysema, pneumonia, asthma, and lung cancer.

Subjective Type Questions

Long Questions prepared in the light of new Examination Techniques (Knowledge, Understanding, Application, Analytical & Conceptual)

Q1. Distinguish between cellular respiration, gaseous exchange and breathing.

Ans. Cellular respiration:

Cellular respiration is a process in which cells oxidize food (glucose) and get energy.

- For this purpose, organisms need to carry oxygen to their cells and to remove carbon dioxide from cells.
- Cellular respiration is a chemical process.
- Cellular respiration takes place inside every cell.

Gaseous Exchange:

Gaseous exchange is the process in which oxygen present in the inhaled air (in lungs) moves into blood and carbon dioxide from the blood moves into the air to be exhaled.

- For gaseous exchange, animals do breathing.
- Gaseous exchange helps in respiration.

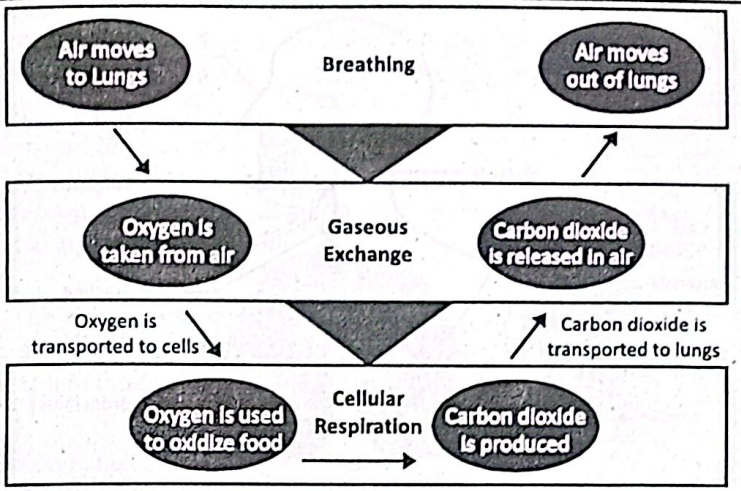
> **Q. What are product aerobic respiration.**
> **Ans.** In aerobic respiration, oxygen is utilized while carbon dioxide and water are produced

Breathing:

Breathing is the process in which animals move air into and out of their body.

It is done to get oxygen from air and to release carbon dioxide in it. Breathing and respiration are not the same process.

- Breathing is a physical process while respiration is a chemical process.
- Breathing helps in gaseous exchange. Gaseous exchange in turn helps in respiration.



Relationship between respiration, gaseous exchange and breathing

2.1 Human Respiratory System

Q2. Write a short note on the major parts of the human air passageway.

Ans. Human respiratory system is responsible for breathing and gaseous exchange. The human respiratory system consists of two major parts.

(i) Air Passageway

(ii) Lungs

Air Passageway:

When air enters the body, it passes through connected tubes to reach the lungs. After gaseous exchange, air moves from the lungs to outside through the same connected tubes. These connected tubes are collectively called air passageway. It consists of the following parts.

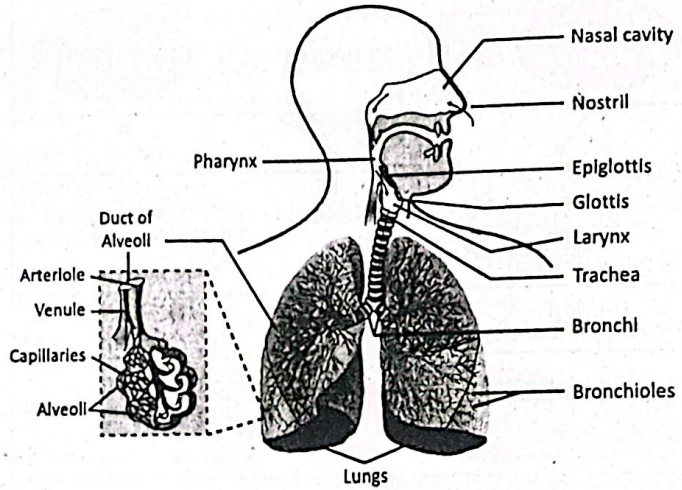
(i) Nostrils and Nasal cavity:

The nasal cavity is made up of two narrow cavities between nostrils and pharynx. Air enters the nasal cavity through nostrils.

Role of Fine hairs: Fine hairs in nasal cavity filter the incoming air by trapping large dust particles.

Role of Mucus: Mucus on the walls of nasal cavity traps small dust particles. Mucus also warms the air and keeps its temperature nearly equal to the temperature of body.

> **Q. Which is common passage for food and air?**
> **Ans.** Pharynx is a common passage for food to oesophagus and for air to larynx.
> **Q. How sound is produced?**
> **Ans.** The vibrations of vocal cords and the movements of lips, cheeks, tongue and jaws produce specific sounds which result in speech.



The air passageway and the lungs

(ii) Pharynx: Nasal cavity opens into pharynx.

Glottis: At the floor of pharynx there is an opening called glottis. It opens in larynx.

Epiglottis: The glottis is guarded by a flap called epiglottis.

Role of epiglottis: It prevents food and liquid from entering the windpipe and lungs.

(iii) Larynx:

Larynx is a box present between pharynx and trachea. Larynx is also called the voice box.

Sound production: Two fibrous bands called vocal cords are attached to the inner walls of larynx. The vibration of vocal cords produce sound.

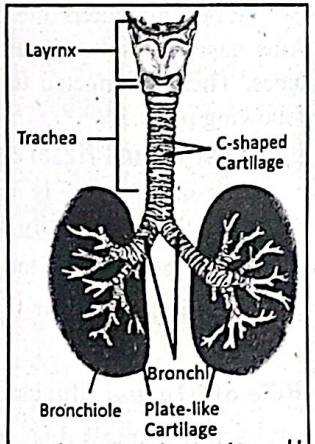
(iv) Trachea and Bronchi:

Trachea (windpipe) is a 12 cm (4.72 inches) long tube attached with larynx. It ends in two branches called bronchi. Each bronchus enters into the lung of its side.

The inner walls of trachea and bronchi are lined with mucus and cilia.

Role of mucus and cilia: Mucus traps fine dust particles and bacteria. Cilia moves the dust particles and mucus upwards to the pharynx.

(v) Bronchioles and Alveoli: Inside lungs, both bronchi continue to divide into very small tubes called bronchioles. Each bronchiole ends at an alveolar duct. This duct opens into a cluster of pouches. These thin-walled pouches are called alveoli.



Cartilage in Trachea and Bronchi

When air reaches alveoli, oxygen moves from the air into blood and carbon dioxide passes out of blood into the air in the alveoli.

Q3. Describe the functions and locations of the bronchus, trachea and alveoli.

Ans. Bronchus Location: The trachea is divided in two branches called bronchi (singular: bronchus) each bronchus enters into the lung of its side.

Functions:

- The bronchi carry air from the trachea.
- The inner walls of bronchi lived with cilia and mucus.
- Mucus traps fine dust particles and mucus upward to the pharynx.
- Bronchi also helps in regulating air flow.

Trachea:

Location: The trachea also called windpipe is a long tube that attached with larynx and passes down through next into the chest cavity.

Q. How many pairs of ribs make up the chest wall?
Ans. The chest wall is made up of 12 pairs of ribs and the rib muscles called inter-coastal muscles.

Functions:

- Trachea conduct air to and from the lungs.
- In the walls of trachea C-shaped cartilages are present. Which prevent it from collapsing and keep the airway open.
- The inner walls of trachea have cilia and mucus that trap dust. Particles and move them upward.

Alveoli:

Location: Alveoli are the thin-walled pouches present at the end of bronchioles inside the lungs.

Functions: Alveoli are the main sites of gaseous exchange. When air reaches alveoli, oxygen moves from the air into blood and carbon dioxide passes out of blood into the air in the alveoli.

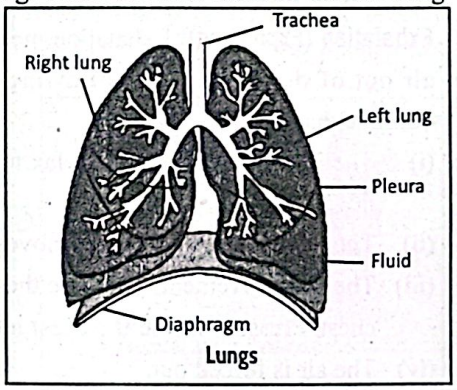
Q4. Describe the structure of lungs.

Ans. Lungs:

There is a pair of lungs in the thoracic cavity. Lungs are spongy and elastic organs. The left lung is slightly smaller than the right lung. There are two lobes in the left lung while right lung has three lobes.

Diaphragm: Diaphragm is the thick muscular structure below the lungs.

Membranes of lungs: Lungs are enclosed in a double membrane called pleura. Its inner layer is attached to the surface of the lungs while the outer layer lines the inner surface of the chest wall and the diaphragm. It contains a pleural fluid for reducing friction between lungs and the chest wall.

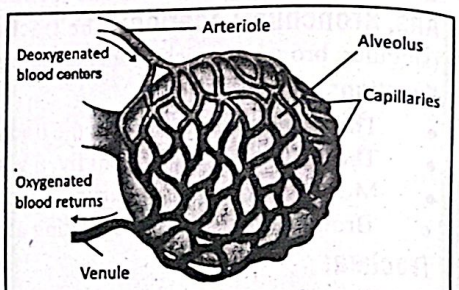


Lungs

Q5. How blood circulate through lungs?

Ans. Blood circulation in lungs:

Pulmonary artery carries deoxygenated blood from heart to lungs. Inside each lung, the pulmonary artery divides into smaller arterioles. The arterioles divide further and make capillaries around the alveoli. After surrounding the alveoli, the capillaries join to form venules. The venules join to form pulmonary vein which carries oxygenated blood back to heart.



Blood circulation in lungs (around an alveolus)

2.2 The Mechanism of Breathing

Q6. Explain the process of inhalation and exhalation step by step.

Ans. Breathing: Breathing is a physical process in which air is taken into the lungs and expelled out the lungs.

Phases of breathing: There are two phases of breathing.

(i) Inhalation (ii) Exhalation

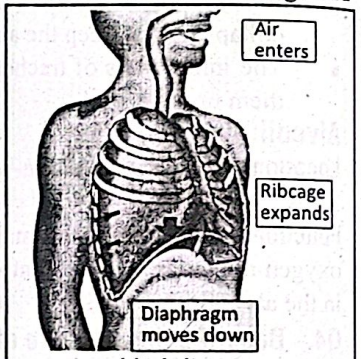
Inhalation(Inspiration): Inhalation means intake of air to the lungs. The following events occur during inhalation.

(i) The intercoastal muscles (muscles located between the ribs) contract to expand the ribcage.

(ii) At the same time, diaphragm also contracts and moves down.

(iii) These two contractions increase the volume of the chest. Pressure inside the chest cavity is reduced.

(iv) The air is moved into lungs.



(a) Inhalation

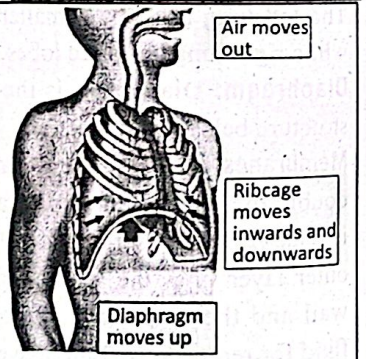
Exhalation (Expiration): Exhalation means moving the air out of the lungs. The following events occur during exhalation:

(i) The inter coastal muscles relax to move ribcage inwards:

(ii) The diaphragm relaxes and moves up.

(iii) The two movements decrease the volume of the chest. Pressure inside the chest increases.

(iv) The air is forced out.



(b) Exhalation

Q7. Describe the breathing rate at rest and during exercise.

Ans. Breathing Rate at rest: Humans breathe 16 -20 times per minute in normal conditions i.e., at rest.

Breathing rate during exercise: During exercise or hard job, muscles carry out cellular respiration at greater rate. So, more carbon dioxide is produced. The respiratory centre in brain detects greater concentration of carbon dioxide in blood. It sends messages to the muscles of ribs and diaphragm at greater speed. The speed of contraction and relaxation of these muscles increases. So, the breathing rate increases up to 30-40 times per minute.

Q. How much water is lost in breathing per day?
Ans. We lose half a litre of water a day through breathing. This is the water vapour we see when we breathe onto glass.

Q8. What are the differences in composition between inhaled and exhaled air?

Ans. Composition of the Inhaled and the Exhaled Air

Feature	Inspired Air	Expired Air
Oxygen %age	21	16
Carbon dioxide %age	0.04	4
Nitrogen %age	79	79
Water vapours	Variable	Saturated
Temperature	Variable	Almost equal to body temperature
Dust particles	Variable	Almost none

2.3 Respiratory Disorders

Q9. What is bronchitis? Write down its types, causes symptoms and treatments.

Ans. Bronchitis: Bronchitis means inflammation (swelling) in bronchi or bronchioles. In bronchitis, the inner space of bronchioles decreases.

Types of bronchitis:

(i) Acute bronchitis (short term) (ii) Chronic bronchitis (long term)

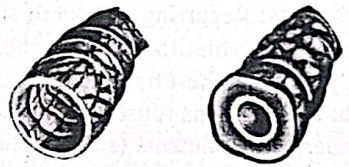
Acute bronchitis: The acute bronchitis usually lasts about two weeks and patient recover with no permanent damage to the bronchi or bronchioles.

Chronic bronchitis: In chronic bronchitis, mucus producing cells in the walls of bronchi increase in number. Thus, there is thick mucus in bronchi. It obstructs the inhaled and exhaled air. It usually lasts for at least three months to two years.

Causes of bronchitis: Infections by viruses or bacteria, chemical irritants (e.g. tobacco smoke) are the causes of bronchitis.

Symptoms: Coughing, wheezing, fever, chills and shortness of breath are the symptoms of bronchitis.

Treatment: Medications (cough suppressants) to ease breathing, antibiotics, antiviral medicines and avoiding irritants like smoke and pollution.



Normal and inflamed bronchi

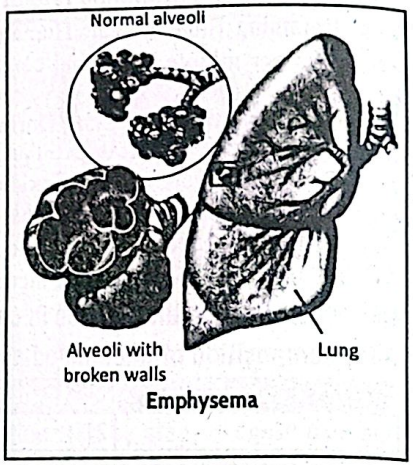
Q10. Write a note on emphysema.

Ans. Emphysema: In emphysema, the inner walls of alveoli become weak and then rupture. Thus, one larger air space is created instead of many small ones. So, the space for gaseous exchange decreases and the patient cannot inhale properly.

Causes of emphysema: Long-term exposure to irritants in air e.g., tobacco smoke, chemical fumes and other air pollutants.

Symptoms: Shortness of breath, chronic cough, (with or without mucus) wheezing and chest tightness.

Treatment: Medicines to relieve cough and breathing problems. Emphysema cannot be cured completely.



Emphysema

Q11. Discuss how the pneumonia is a respiratory disorder?

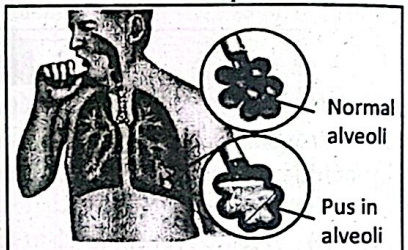
Ans. Pneumonia:

Pneumonia is an inflammation in the lungs, due to infection in alveoli. In pneumonia, the alveoli are filled with pus.

Causes: Infections by bacteria, viruses or fungi are the common causes of pneumonia.

Symptoms: The pneumonia patient suffers from high fever, chills, shortness of breath, and cough with sputum.

Treatment: Bacterial pneumonia is treated by using antibiotics. The viral and fungal pneumonia are treated by using antiviral and antifungal drugs. Bacterial vaccines are also available to prevent bacterial pneumonia.



Pneumonia

Q12. Describe the changes that occurs in the bronchial tubes during asthma attack.

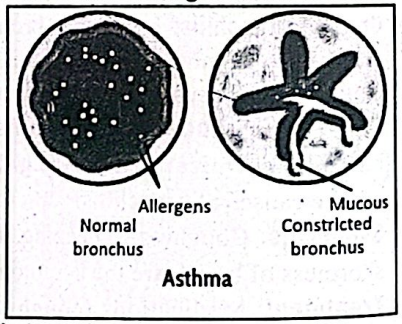
Ans. Asthma:

It is an inflammation of bronchi in which bronchi and bronchioles swell and are constricted.

Symptoms: Recurring attacks of shortness of breath, wheezing (whistling sound when breathing out), coughing and chest tightness.

Causes: Allergens (dust mites, pollen, mold, and pet dander), air pollutants (smoke, chemical fumes, and strong fragrances), weather changes, especially cold air, genetic factors (family history of asthma or allergies).

Treatment: Medicines (bronchodilators) to dilate bronchioles during asthma attack.

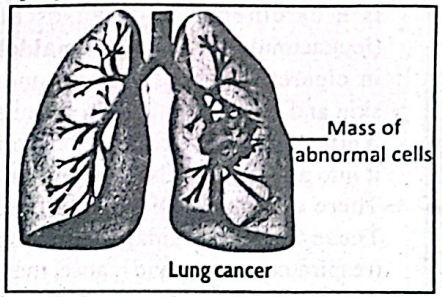


Asthma

Q13. What is lung cancer? Describe its causes symptoms and treatment.

Ans. Lung Cancer: Cancer means uncontrolled increase in the number of cells in any part of the body. When the masses of non-functional cells are formed in lungs, it is called lung cancer. It is the most common cancer in the whole world.

Causes: Carcinogens (such as those in tobacco smoke), ionizing radiation, viral infection. Passive smoking i.e., the inhalation of smoke from another's smoking is also a cause of lung cancer. The smoke from the upper burning portion of cigarette is more dangerous than smoke exhaled by the smoker.



Lung cancer

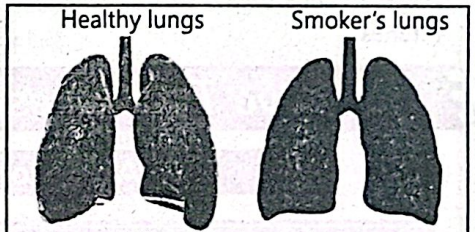
Symptoms: The most common symptoms are shortness of breath, coughing (including coughing up blood), and weight loss.

Treatment: The patient of lung cancer is given one or more treatments, including surgery, chemotherapy, or radiation therapy.

Q14. Describe effects of smoking.

Ans. Effects of Smoking:

Smokers have a much higher risk of developing life-threatening diseases. The most important risk of smoking is the abnormalities and cancers in lungs, kidneys, oral cavity, larynx, breast, bladder, oesophagus, pancreas and stomach.



Effect of smoking on lungs

Tobacco smoke contains over 4,000 different chemicals e.g, nicotine and carbon monoxide. Out of these, there are more than 69 known carcinogens (cause cancer in humans). For example tar and benzene.

- **Nicotine** is the major component of cigarettes. It damages many tissues including brain. It also hardens the walls of arteries and results in heart problem.
- **Carbon monoxide** is produced when tobacco is burnt during smoking. It is a poisonous gas. It combines with RBCs and prevents oxygen transport.

Q. What do you know about lung cancer?
Ans. Lung cancer is the most frequently diagnosed cancer globally, accounting for about 12.4% of all new cancer cases. In the world, it causes more than 1.5 million deaths annually. In Pakistan, lung cancer accounts for about 5.1 % of all new cancer cases annually. There are about 22,000 new lung cancer cases each year.
Source: World Health Organization
Q. What is probability of heart diseases and lung cancer in non smokers?
Ans. Non-smokers who inhale the smoke of others have 30% more chances of heart diseases and lung cancer.

- **Tar** is present in cigarettes in the form of solid particles. When it is inhaled along with smoke, it is deposited in lungs. It reduces the surface area for gaseous exchange.

- **Benzene** is a major component of cigarettes. It is a carcinogen and causes blood cancer (leukaemia). Similarly, **formaldehyde** present in cigarettes causes cancers and respiratory, skin and gastrointestinal problems.
- **Ammonia** frees nicotine from tobacco turning it into a gas. It is poisonous for the body.
- There are many other **irritants** in cigarettes. These irritants damage the air passageways (respiratory tract) and cause many respiratory diseases, including cancer.

Smoking also increases blood cholesterol levels, blood pressure. It weakens blood vessels. Smoking causes the staining of teeth and bad breath. Tooth loss is 2 to 3 times higher in smokers than in non-smokers.

Smoking increases the risk of tuberculosis by two to four times, and of pneumonia by four times.

Q. What is ratio of adult smoker in Pakistan?

Ans. In Pakistan, 12% of adults do smoking. 7.6% of all deaths in Pakistan are caused by tobacco use.

Q. What is vaping? Write its effects.

Ans. Vaping refers to inhaling vapor produced by an e-cigarette. These devices heat a liquid, which may contain nicotine, flavours, and other chemicals.

Many young people are attracted to vaping. They believe it a safer alternative to cigarettes, though this is not true.

Vaping can cause lung inflammation and lung injury. Nicotine and other chemicals in vape increase heart rate and blood pressure, contributing to heart disease.

Q. When the World No Tobacco Day is celebrated?

Ans. The World No Tobacco Day is celebrated on the 31st of May every year.

Objective Type Questions

Additional MCQ's

Multiple Choice Questions prepared in the light of new Examination Techniques (Knowledge, Understanding, Application, Analytical & Conceptual)

1. Organisms get energy by doing:
(a) Transpiration (b) Breathing
(c) Gaseous exchange (d) Cellular respiration

2. Which of the following is a by product of aerobic respiration?
(a) Oxygen (b) Glucose
(c) Carbon dioxide and water (d) Nitrogen

3. The process of taking in oxygen and removing carbon dioxide from cells is known as:
(a) Breathing (b) Oxidation (c) Gaseous Exchange (d) Digestion

4. Through which process animals move air into and out of the body?
(a) Oxidation (b) Breathing (c) Reduction (d) Transpiration

5. Respiration is a process:
(a) Chemical (b) Physical (c) Mechanical (d) Biological

2.1 Human respiratory System

6. The human respiratory system consists of which two major parts?
(a) Nasal cavity and trachea (b) Heart and lungs
(c) Air passageway and lungs (d) Ribs and diaphragm

7. Where is carbon dioxide produced?
(a) In the air passageway (b) During cellular respiration
(c) Outside the lungs (d) In the mechanical breathing

8. Role of fine hairs in nostrils is:
(a) Filter the air (b) Mucus Production
(c) Protection (d) Warms the air

9. The function of mucus in the nasal cavity:
(a) Traps dust particles (b) Filter the air
(c) Warms the air (d) Protection

10. Nasal cavity opens into:
(a) Larynx (b) Bronchi (c) Trachea (d) Pharynx

11. At the floor of pharynx there is an opening called:
(a) Trachea (b) Glottis (c) Epiglottis (d) Vocal cords

12. The box present between pharynx and trachea is:
(a)Bronchi (b) Alveoli (c) Nasal cavity (d) Larynx

13. Pharynx is a common passage for:
(a) Taste and smell (b) Food and air
(c) Breathing and respiration (d) Food and water

14. The vibration of vocal cords produce:
(a) Heat (b) Cold (c) Saliva (d) Sound

15. The length of trachea is:
(a) 10cm (b) 12cm (c) 14cm (d) 16cm

16. Each bronchus enters into the:
(a) Heart (b) Alveoli (c) Pharynx (d) Lung

17. The inner walls of trachea and bronchi are lined with:
(a) Mucus (b) Cilia (c) Both a and b (d) Flagella

18. The cartilaginous rings in the wall of trachea are:
(a) U-shaped (b) V-shaped (c) N-shaped (d) C-shaped

19. What do the bronchi divide into once they are inside the lungs?
(a) Trachea (b) Alveolar ducts (c) Bronchioles (d) Pharynx

20. Each bronchiole ends at a specific opening called the:
(a) Alveolar duct (b) Lungs cavity (c) Diaphragm (d) Bronchus

21. What are the thin walled pouches at the end of the alveolar ducts called:
(a) Capillaries (b) Alveoli (c) Lobes (d) Branches

22. Which structures surround the alveoli to facilitate gas exchange?
(a) Rib muscles (b) Cartilage ring (c) Blood capillaries (d) Pleural fluid

23. How many pairs of ribs are present in the chest cavity?
(a) 8 (b) 12 (c) 16 (d) 20

24. Rib muscles are called:
(a) C-shaped cartilages (b) Inter-coastal muscles
(c) Spongy muscles (d) Elastic muscles

25. Where is the pair of lungs located in the human body?
(a) Abdominal Cavity (b) Pelvic cavity
(c) Thoracic cavity (d) Cranial cavity

26. What is the name of the thick muscular structure located below the lungs?
(a) Pleura (b) Diaphragm (c) Alveolus (d) Trachea

27. Lungs are:
(a) Hard and rigid (b) Spongy and elastic
(c) Liquid and smooth (d) Hollow and thin

28. How many lobes are present in the right lung?
(a) One (b) Two (c) Three (d) Four

29. How many lobes are present in the left lung?
(a) One (b) Two (c) Three (d) Four

30. What is the purpose of pleural fluid found between the lung membranes?
(a) To carry oxygen (b) To reduce friction
(c) To filter dust (d) To warm the air

31. Capillaries around the alveoli join together to form:
(a) Arteriales (b) Venules (c) Bronchioles (d) Pleura

32. The Venules carry oxygented blood back to the:
(a) Lungs (b) Kidneys (c) Stomach (d) Heart

2.2 The mechanism of breathing

33. The Physical movements for taking air to lungs and then removing air from lungs are called as:
(a) Respiration (b) Photosynthesis (c) Transpiration (d) Breathing

34. During inhalation the inter-Coastal muscles and diaphragm:
(a) Move upward (b) Move inward (c) Contract (d) Relax

35. During inhalation the volume of chest cavity:
(a) Decreases (b) Increases (c) Remains same (d) No change

36. During exhalation:
(a) Inter-coastal muscles relax (b) Diaphragm relax
(c) Volume of chest cavity decreases (d) All of these

37. Human breathing rate per minute at rest is:
(a) 11-15 (b) 16-20 (c) 21-25 (d) 26-30

38. During exercise the breathing rate increase up to:
(a) 10-15 times (b) 20-25 times (c) 30-40 times (d) 35-45 times

39. The amount of oxygen in inspired air is:
(a) 16% (b) 20% (c) 19% (d) 21%

40. Percentage of oxygen in expired air is:
(a) 16% (b) 20% (c) 25% (d) 34%

41. Amount of carbon dioxide in expired air is:
(a) 21% (b) 4% (c) 16% (d) 0.04%

42. The percentage of nitrogen in both inspired and expired air is:
(a) 21-4 (b) 79-79 (c) 21-0.04 (d) 0.04-4

2.3 Respiratory Disorders

43. The inflammation in bronchi and bronchioles refers to:
(a) Pneumonia (b) Emphysema (c) Bronchitis (d) Asthma

44. Acute bronchitis lasts upto:
(a) One week (b) Two weeks (c) Three weeks (d) Four days

45. Mucus-producing cells increase in which type of bronchitis:
(a) Acute (b) Chronic (c) Both (d) None of these

46. Chronic bronchitis lasts for:
(a) Days (b) Weeks (c) Months (d) Years

47. Emphysema effects the:
(a) Bronchi (b) Alveoli (c) Lungs (d) Air passageway

48. Pneumonia is an infection of:
(a) Kidneys (b) Heart (c) Lungs (d) Blood

49. If both lungs are infected the disease is called:
(a) Typhoid (b) Double pneumonia
(c) Gout (d) Arthritis

50. Pneumonia may be caused by:
(a) Bacteria (b) Viruses (c) Fungi (d) All of these

51. Inflammation of bronchi in which bronchi and bronchioles swell and are constricted is:
(a) Lung cancer (b) Bronchitis (c) Emphysema (d) Asthma

52. Allergens are:
(a) Dust mites (b) Pollens
(c) Pet dander and mold (d) All of these

53. Allergens, Pollutants, weather changes and genetic factors are the causes of:
(a) Lung Cancer (b) Asthma (c) Bronchitis (d) Emphysema

54. The uncontrolled increase in the number of cells in any part of the body is called:
(a) Asthma (b) Malaria (c) Pneumonia (d) Cancer

55. Carcinogens are especially present in:
(a) Perfumes (b) Dust (c) Pet dander (d) Tobacco smoke

56. The inhalation of smoke from another's smoking is called:
(a) Active smoking (b) Passive smoking (c) Cancer (d) None of these

57. Tobacco smoke contains chemicals:
(a) 1000 (b) 2000 (c) 3000 (d) 4000

58. **Out of 4000 how many tobacco smoke chemicals are carcinogens?**
(a) More than 50 (b) More than 60 (c) More than 40 (d) More than 69

59. **Major component of cigarette is:**
(a) carbon dioxide (b) Carbon monoxide
(c) Benzene (d) Nicotine

60. **Tar is present in cigarettes in the form of:**
(a) Solid (b) liquid (c) Gas (d) Plasma

61. **When the world NO Tobacco Day is celebrated?**
(a) 15th June (b) 27th March (c) 31st May (d) 25th February

62. **How many time the risk of tooth loss increases in smokers than in non-smokers?**
(a) 2-3 times (b) 2-4 times (c) 3-4 times (d) 1-3 times

63. **Smoking increase the risk of tuberculosis by:**
(a) Three times (b) Four times (c) Five times (d) Two times

Answers

1.	(d)	2.	(c)	3.	(c)	4.	(b)	5.	(a)	6.	(c)	7.	(b)
8.	(a)	9.	(c)	10.	(d)	11.	(b)	12.	(d)	13.	(b)	14.	(d)
15.	(b)	16.	(d)	17.	(c)	18.	(d)	19.	(c)	20.	(a)	21.	(b)
22.	(c)	23.	(b)	24.	(b)	25.	(c)	26.	(b)	27.	(b)	28.	(c)
29.	(b)	30.	(b)	31.	(b)	32.	(d)	33.	(d)	34.	(c)	35.	(b)
36.	(d)	37.	(b)	38.	(c)	39.	(d)	40.	(a)	41.	(b)	42.	(b)
43.	(c)	44.	(b)	45.	(b)	46.	(d)	47.	(b)	48.	(c)	49.	(b)
50.	(d)	51.	(d)	52.	(d)	53.	(b)	54.	(d)	55.	(d)	56.	(b)
57.	(d)	58.	(d)	59.	(d)	60.	(a)	61.	(c)	62.	(a)	63.	(d)

Additional Short Questions

Short Answer Questions prepared in the light of new Examination Techniques (Knowledge, Understanding, Application, Analytical & Conceptual)

1. **What do you know about the process cellular respiration?**

Ans. **Cellular respiration:** Cellular respiration is the process in which cells oxidize food (glucose) and get energy.

- For this purpose, organisms need to carry oxygen to their cells and to remove carbon dioxide from cells.

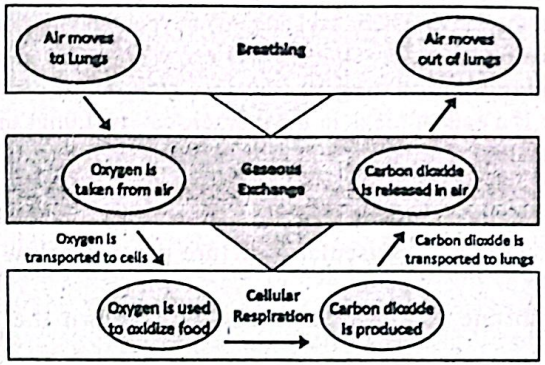
2. **What is breathing**

Ans. **Breathing:** Breathing is a mechanical process in which animals move air into and out of their body.

3. **What is meant by gaseous exchange?**

Ans. Gaseous exchange is the process in which oxygen present in the inhaled air (in lungs) moves into blood and carbon dioxide from the blood moves into the air to be exhaled.

4. **Draw a sketch to show the relationship between respiration, gaseous exchange and breathing.**



2.1 Human Respiratory System

5. **What are the major parts of human respiratory system?**

Ans. The human respiratory system consists of two major parts i.e., air passageway and lungs.

6. **What is the role of nasal cavity in the respiratory system?**

Ans. The nasal cavity filters incoming air using fine hairs and mucus. It regulates the air's temperature nearly equal to that of the body.

7. **Differentiate between glottis and epiglottis.**

Ans. **Glottis:** At the floor of pharynx there is an opening called glottis. It opens in larynx.
Epiglottis: The glottis is guarded by flap called epiglottis.

8. **What is voice box?**

Ans. Larynx is also called the voice box. Two fibrous bands called vocal cords are attached to the inner walls of larynx. The vibrations of vocal cords produce sounds.

9. **Write short not on trachea.**

Ans. **Trachea:** Trachea also called windpipe is a 12cm (4.72 inches) long tube attached with larynx. The inner walls of trachea are lined with mucus and cilia. In the walls of trachea, C-shaped cartilages are present.

10. **How structure of trachea is different from bronchi?**

Ans. The trachea has C-shaped cartilages and remains a single tube while bronchi have irregular cartilage plates and are branching air passages inside the lungs.

11. **Write down the functions of mucus and cilia in the inner walls of trachea and bronchi.**

Ans. **Mucus:** Mucus traps fine dust particles and bacteria.
Cilia: Cilia moves the dust particles and bacteria upwards to the pharynx.

12. **How C-shaped cartilages play its role in trachea?**

Ans. The C-shaped cartilages present in the walls of trachea prevent trachea and bronchi

from collapsing even when there is no air in then.

13. Write a short note on alveoli.

Ans. Alveoli: Alveoli are tiny, thin-walled, sac like structures present at the ends of bronchioles in the lungs where exchange of oxygen and carbon dioxide takes place between air and blood.

14. What do you know about lungs?

Ans. Lungs: There is a pair of lungs in the thoracic cavity. Lungs are Spongy and elastic organs. The left lung is slightly smaller and has two lobes, while right lung is larger and has three lobes.

15. Define diaphragm.

Ans. Diaphragm: The thick muscular structure present below the lungs is called diaphragm.

16. What is membrane of lungs called also write down the function of pleural fluid?

Ans. Lungs are enclosed in a double membrane called pleural membrane.

Role of pleural fluid: Pleural fluid reduce friction between lungs and the chest wall.

17. How blood circulation takes place in lungs?

Ans. Blood circulation in lungs: Pulmonary artery carries deoxygenated blood from heart to lungs. Inside each lung, the pulmonary artery divides into smaller arterioles. The arterioles further divide and make capillaries around the alveoli. After surrounding the alveoli, the capillaries join to form venules. The venules join to form pulmonary vein which carries oxygenated blood back to heart.

2.2 The Mechanism of Breathing

18. How many phases of breathing are?

Ans. There are two phases of breathing:

(i) Inhalation **(ii)** Exhalation

19. What does inhalation mean?

Ans. Inhalation means intake of air to the lungs.

20. Explain the mechanism of inhalation.

Ans. During inhalation:

- The inter-coastal muscles contract to expand the ribcage.
- At the same time, diaphragm also contracts and move down.
- The contractions increase the volume of the chest.
- Pressure inside the chest decreases.
- Air is moved into lungs.

21. What changes occurs in the thoracic cavity during exhalation?

Ans. During exhalation:

- The inter-coastal muscles relax to move ribcage inwards.
- At the same time diaphragm also relaxes and moves up.

- These movement decrease the volume of the chest.
- Pressure inside the chest increases.
- Air is forced out.

22. Why the breathing rate increases during exercise?

Ans. During exercise or hard job, muscles carry out cellular respiration at greater rate. So, more carbon dioxide is produced. The respiratory centre in brain detects greater concentration of carbon dioxide in blood. It sends messages to the muscles of ribs and diaphragm at greater speed. The speed of contraction and relaxation of these muscles increases. So, breathing rate increases up to 30–40 times per minute.

23. What is the percentage of oxygen in inhaled and exhaled air?

Ans. The percentage of oxygen in inhaled air is 21 and in exhaled air is 16.

24. What is the percentage of carbon dioxide in inhaled and exhaled air?

Ans. The amount of carbon dioxide inhaled air is 0.04% and that exhaled air is 4%.

25. What is the percentage of nitrogen in inhaled and exhaled air?

Ans. The amount of nitrogen in inhaled air is 79% and that of exhaled air is also 79%.

2.3 Respiratory Disorders

26. What is meant by bronchitis? Write down its types.

Ans. Bronchitis: Bronchitis means inflammation (swelling) in bronchi and bronchioles. In bronchitis, the inner space of bronchioles decreases.

Types of bronchitis:

(i) Acute bronchitis: It lasts for two weeks.

(ii) Chronic bronchitis: It lasts for years.

27. What is chronic bronchitis?

Ans. In chronic bronchitis, mucus producing cells in the walls of bronchi increases in number. Thus there is thick mucus in bronchi. It obstructs the inhaled and exhaled air.

28. List the symptoms of bronchitis.

Ans. Symptoms of bronchitis: Coughing, wheezing, fever, chills and shortness of breath are the symptoms of bronchitis.

29. Write causes and treatment of bronchitis.

Ans. Causes: Causes include infections by viruses or bacteria, chemical irritants (smoke).

Treatment: Medications (cough suppressant) to ease breathing, antibiotics, (if it is due to bacterial infection) antiviral medicines (if it is due to viral infection) and avoiding irritants like smoke and pollution.

30. What happens in emphysema?

Ans. In emphysema, the inner walls of alveoli become weak and then rupture. Thus, one larger air space is created instead of many small ones. So, the space for gaseous exchange decreases and the patient cannot inhale properly.

31. Mention the symptoms and treatments of emphysema.

Ans. Symptoms: Symptoms of emphysema includes shortness of breath, chronic cough, (with or without mucus) wheezing and chest tightness.

Treatments: Treatments of emphysema are medicines to relieve cough and breathing problems. Emphysema cannot be cured completely.

32. Write a short note on pneumonia.

Ans. Pneumonia: Pneumonia is an inflammation in the lungs, due to infection in alveoli. In pneumonia, the alveoli are filled with pus.

Causes: Infections by bacteria, viruses and fungi.

Symptoms: The pneumonia patient suffers from high fever chills, shortness of breath and cough with sputum.

Treatment: Pneumonia is treated with antibiotics, antiviral and antifungal drugs and also with vaccines.

33. What is asthma? Write down its causes.

Ans. Asthma: Asthma is the inflammation of bronchi in which bronchi and bronchioles swell and constricted.

Causes: Causes include allergens, air pollutants, weather changes etc.

34. Write down symptoms of Asthma.

Ans. Symptoms of Asthma: Recurring attacks of shortness of breath, wheezing, coughing and chest tightness are the symptoms.

35. Define allergens.

Ans. Allergens: Allergens are allergy causing substances. It triggers the immune system such as pollen, dust, animal dander, mold etc.

36. Why passive smoking is dangerous?

Ans. The inhalation of smoke from another's smoking is called passive smoking. Passive smoking is dangerous because the smoke from the upper burning portion of cigarette is more dangerous than smoke exhaled by the smoker

37. What are the symptoms of lung cancer?

Ans. The most common symptoms of lung cancer are shortness of breath, coughing and weight loss.

38. What are the possible treatments for the lung cancer patients?

Ans. The patient of lung cancer is given one or more treatments including surgery, chemotherapy or radiation therapy.

39. State any two harmful effects of smoking on human health.

Ans. Effects of smoking: The most important risk of smoking is the abnormalities and cancer in lungs, kidneys, oral cavity, larynx, breast, bladder, esophagus, pancreas and stomach.

40. What is nicotine? Mention any two harmful effects of nicotine on the body.

Ans. Nicotine: Nicotine is a major component of cigarettes. It damages many tissues including brain. It also hardens the walls of arteries and results in heart problem.

41. What is tar? How does it affect the lungs and gaseous exchange?

Ans. Tar: Tar is present in cigarettes in the form of solid particles. When it is inhaled with smoke, it is deposited in lungs. It reduces the surface area for gaseous exchange.

42. What are carcinogens? Name any two carcinogens present in the cigarettes.

Ans. Carcinogens: Carcinogens are the substances that cause cancer in living organism.

Nicotine, tar and Benzene are the carcinogens present in cigarette.

43. Write down the harmful effects of formaldehyde and ammonia.

Ans. Formaldehyde: Formaldehyde present in cigarettes causes cancers and respiratory, skin and gastrointestinal problems.

Ammonia: Ammonia frees nicotine from tobacco turning it into a gas. It is poisonous for the body.

44. What are the harmful effects of smoking apart from lung cancer?

Ans.
- Smoking increases blood cholesterol levels.
- Smoking increases blood pressure.
- It weakens blood vessels.
- Smoking causes the staining of teeth.

Exercise Questions (Solved)

A. Select the correct answers for the following questions.

1. Breathing means;
(a) Breakdown of C-H bonds to produce energy
(b) Movements that take air in and out of body
(c) Getting oxygen from the air and removing carbon dioxide
(d) Transport of oxygen through blood to different parts of the body

2. Which path does air take immediately after passing through the larynx?
(a) Pharynx (b) Bronchi (c) Trachea (d) Alveoli

3. Why are alveoli surrounded by capillaries?
(a) To absorb water (b) To exchange gases
(c) To produce mucus (d) To trap dust particles

4. Which feature of alveoli helps in rapid gas exchange?
(a) Thick walls (b) Large diameter (c) Moist surface (d) Strong muscles

5. Which action increases lung volume during breathing?
(a) Relaxing the diaphragm (b) Contracting intercostal muscles
(c) Closing the trachea (d) Stiffening alveolar walls

6. Inhaled air contains 21% oxygen. What is its percentage in exhaled air?
(a) 0% (b) 16% (c) 21% (d) 42%

7. Which factor controls the breathing rate?
(a) Carbon dioxide in blood (b) Oxygen in blood
(c) Carbon dioxide in muscles (d) Oxygen in muscles

8. The walls of alveoli are broken in:
(a) Pneumonia (b) Bronchitis (c) Emphysema (d) Asthma

9. Smoking leads to lung cancer by:
(a) Increasing oxygen uptake
(b) Promoting uncontrolled cell division
(c) Slowing down healing (d) Enlarging the trachea

10. Which chemical in cigarette smoke directly leads to addiction?
(a) Carbon monoxide (b)Tar (c) Nicotine (d) Formaldehyde

Answers

1. (b)	2. (c)	3. (b)	4. (c)	5. (b)
6. (b)	7. (a)	8. (c)	9. (b)	10. (c)

B. Write short answers.

1. Differentiate between gaseous exchange and breathing.

Ans. **Gaseous Exchange:** Gaseous exchange is the process in which oxygen present in the inhaled air (in lungs) moves into blood and carbon dioxide from the blood moves into the air to be exhaled.

- For gaseous exchange, animals do breathing.

Breathing: Breathing is a mechanical process in which animals move air into and out of their bodies.

- Breathing helps in gaseous exchange.

2. Differentiate between breathing and cellular respiration.

Ans. **Breathing:** Breathing is a mechanical process in which animals move air into and out of their body.

Cellular respiration: Cellular respiration is a chemical process where cells oxidize food (glucose) to release energy.

3. What is the function of cartilages present in the walls of trachea and bronchi?

Ans. The cartilages present in the walls of trachea and bronchi prevent trachea and bronchi from collapsing even when there is no air in them.

4. What is the average breathing rate in human at rest and during exercise?

Ans. Humans breathe 16–20 times per minute in normal conditions at rest. The breathing rate increases up to 30–40 times per minute during exercise.

5. How does the structure of alveoli maximize gas exchange?

Ans. Alveoli maximize the gas exchange through a large surface area provided by millions of tiny sacs and a dense network of capillaries.

6. List the symptoms, causes, and treatments of bronchitis.

Ans. **Symptoms of bronchitis:** Coughing, wheezing, fever, chills and shortness of breath are the symptoms of bronchitis.

Causes: Causes include infections by viruses or bacteria, chemical irritants (smoke).

Treatment: Medications to ease breathing, antibiotics, antiviral medicines and avoiding irritants like smoke and pollution.

7. Mention the symptoms and treatments of emphysema.

Ans. **Symptoms:** Symptoms of emphysema includes shortness of breath, chronic cough, wheezing and chest tightness.

Treatments: Treatments of emphysema are medicines to relieve cough and breathing problems. Emphysema cannot be cured completely.

8. What are carcinogens? Name any two carcinogens present in cigarettes.

Ans. **Carcinogens:** Carcinogens are the substances that cause cancer in living organism. Nicotine, tar and Benzene are the carcinogens present in cigarette.

9. Complete the following table:

Ans.

Feature	Inspired Air	Expired Air
Oxygen	21%	16%
Carbon dioxide	0.04%	4%
Nitrogen	79%	79%

C. Write answers in detail.

1. Explain the process of inhalation and exhalation step by step.

Ans. For answer See Question. No. 6

2. Write a short note on the major parts of the human air passageway.

Ans. For answer See Question. No. 2

3. Describe the functions and locations of the bronchus, trachea, and alveoli.

Ans. For answer See Question. No. 3

4. What are the possible causes of lung cancer? Explain the harmful effects of smoking apart from lung cancer.

Ans. For answer See Question. No.13 (causes) Question No.14(other effects of smoking)

D. Inquisitive Questions

1. What can happen to breathing if diaphragm stops working properly?

Ans. The main function of diaphragm is inhalation. It if not works properly the chest cavity will not be able to expand or contract. In this way less oxygen reaches to the blood.

2. Why is it dangerous when smoke particles settle inside lungs?

Ans. Smoke particles in the lungs damage alveoli and airway, reduce oxygen absorption and can cause serious diseases like Emphysema.

3. Why does the trachea C-shaped cartilage rings while bronchioles do not have them?

Ans. **Trachea:** Trachea has C-shaped cartilage rings which helps it to open at all times preventing in from collapsing when there is no air in them.

Bronchioles: Bronchioles do not have C-shaped cartilages rings because they are very much smaller, soft and flexible. Their walls can be kept open by smooth muscles so rigid cartilage is not needed.

4. During asthma attacks, patients feel harder to exhale than to inhale. Why is it so?

Ans. Asthma is the inflammation of bronchi in which bronchi and bronchioles swell and are constricted.

During inhalation the chest expand.

Pulling the air in so inhalation is easier, while exhalation is harder because the chest cavity relaxes and the pressure increases, which causes the already narrowed and inflamed airways to collapse or compress further making it very difficult for air to leave the lungs.

CHAPTER 3 Human Blood Circulatory System

Students Learning Outcomes

After Studying this chapter, students will be able to:

- Describe how the blood is circulated inside the human body.
- Explain how blood is used to transport materials throughout the human body.
- Identify the different types of organs connected to the blood system and their roles.
- Identify the different components that make up the blood.
- Name the cell types found in blood and their roles.
- Explain the structure of the heart with a diagram.
- Explain common heart diseases (coronary heart disease, myocardial infarction, angina).
- Explain the harmful effects of smoking related to heart diseases.

Subjective Type Questions

Long Questions prepared in the light of new Examination Techniques (Knowledge, Understanding, Application, Analytical & Conceptual)

3.1 Blood and Its Components

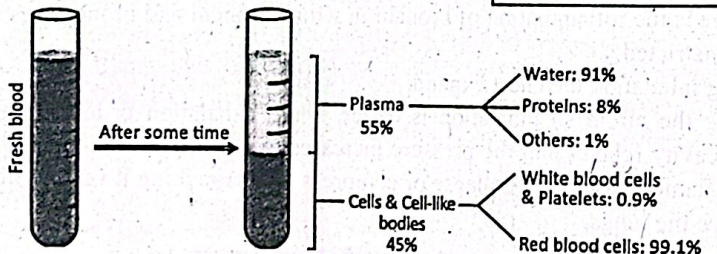
Q.1: What is blood? Write down its functions and composition.

Ans. Blood: Blood is a fluid connective tissue that circulates throughout the body. Its main function is transport of substances and protection of body.

Blood is a type of connective tissue. Its main function is to transport materials through the body. It carries important materials to where they are needed. It transports oxygen from the lungs to all body cells and carries carbon dioxide back to the lungs for removal. Blood also delivers nutrients from the digestive system to the cells, hormones from glands to target organs, and waste products from the cells to kidneys for excretion.

About 55% of blood is composed of a fluid portion called plasma while 45% of blood is made up of cells or cell-like bodies. The adult human has about 5 litres blood in the body.

Q. What is serum?
Ans. If fibrinogen is removed from blood plasma, the rest is called serum.



Percentage composition of blood

Q.2: Write a note on Blood Plasma.

Ans. Blood Plasma: It is the liquid portion of blood. Plasma is composed 90-92% of water, 7 – 9% of proteins and 1% of other substances.

(i) Proteins: Antibodies are important plasma proteins. Antibodies defend the body against pathogens. Fibrinogen and albumin are plasma proteins.

Functions of fibrinogen and and albumin:

- **Fibrinogen:** It is also a plasma protein it is responsible for blood clotting.
- **Albumin:** It is plasma protein which maintains the osmotic pressure of blood.

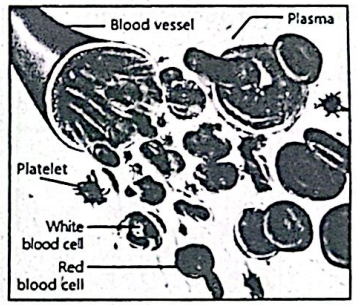
(ii) Salts: The important plasma salts are made of sodium, chloride and bicarbonate ions. In addition there are little amounts of calcium, magnesium, copper, potassium and zinc.

(iii) Nutrients, wastes and hormones: Plasma contains nutrients like glucose, lipids and amino acids etc. They enter blood from the digestive system. The wastes produced by cells are also present in plasma. Hormones secreted by endocrine glands are also carried by plasma.

(iv) Respiratory gases: Small amounts of carbon dioxide (about 5–7%) and oxygen (about 1.5%) are dissolved in plasma.

Q.3: Describe the structure, formation and functions of Red blood cells (Erythrocytes) in the human body.

Ans. Physical appearance and Composition: Red blood cells (RBCs) are disc-shaped cells with a depression at the centre. They contain a red portion haemoglobin. It transports oxygen and little amount of carbon dioxide. There are about 4 to 5.5 million RBCs per mm^3 of blood.



Blood composition

Formation and development: Before and immediately after birth, RBCs are formed in liver and spleen. In adults, they are formed in the red bone marrow of short bones (sternum, ribs and vertebrae).

Functions: Their primary function is to transport oxygen and a small amount of carbon dioxide throughout the body. It helps in maintaining proper gas exchange in the body.

Life span: The average life span of a RBC is about 120 days.

Removal of RBCs: When RBCs complete their age, they are removed by spleen, bone marrow and liver.

Q. How many red blood cells are present in body?
Ans. There are more than 30 trillion RBCs throughout the body. About 2 million RBCs die and are replaced every second.

Q.4: What are White Blood Cells (Leukocytes)? Discuss their role in body's immune defence mechanism and write down its types.

Ans. White Blood Cells: WBCs are colourless and have irregular shapes. They are formed in the red bone marrow. Some WBCs mature in lymph nodes, tonsils, thymus or spleen. WBCs are larger in size and less in number than RBCs. Each mm^3 of blood normally contains about 7,000 WBCs.

Function: WBCs defend the body against diseases.

Types of White Blood Cells: There are several types of WBCs:

(i) Granulocytes: These WBCs have granules in cytoplasm. They include neutrophils, eosinophils and basophils.

Neutrophils: They destroy bacteria and clean up dead cells at infection sites.

Eosinophils: The fight with parasites and cause allergic reactions.

Basophils: They release histamine to cause inflammation and produce allergic reactions.

(ii) Agranulocytes: They have clear cytoplasm. There are two types of arganulocytes i.e. monocytes and lymphocytes.

Monocytes: Monocytes make macrophages which engulf the germs and dead cells.

Lamphocytes: Lamphocytes make antibodies against pathogens.

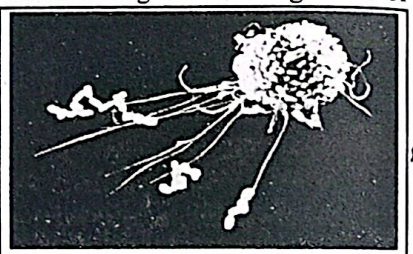
Q. What do you know about pus?
Ans. Macrophages die in the process of killing the germs. The dead cells accumulate and make the white substance called pus, seen at infection sites.

Q.5: What are platelets? Write down their functions.

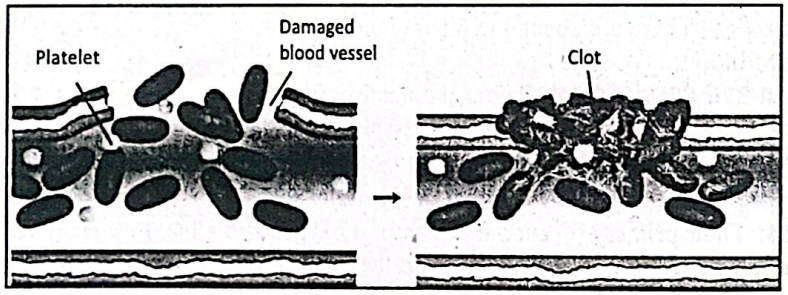
Ans. Platelets: Platelets are not whole cells. They are small fragments of large cells of bone marrow. Platelets lack a nucleus.

Functions:

- Platelets helps in blood clotting at the site of injury.
- Platelets convert fibrinogen into fibrin.
- Fibrin forms a network that traps RBCs to form a clot.
- It prevents excessive bleeding until the damaged vessel is repaired.



A macrophage engulfing the bacteria



Formation of clot by platelets

Q.6: Explain how blood transports materials throughout the human body?

Ans. Blood acts as a comprehensive transport system using both its liquid component (plasma) and specialized cells to move essential materials.

Oxygen transport: Red blood cells contain haemoglobin which transports oxygen.

Carbon dioxide: Blood carries carbon dioxide produced in body cells and transports it back to lungs.

Nutrients transport: Glucose, lipids, amino acids and vitamins are transported by plasma from intestine to all body tissues.

Waste Removal: Metabolic wastes are carried by blood to excretory organs for elimination.

Hormone transport: Blood carries hormones from endocrine glands to target organs to regulate body functions.

3.2 Human Heart

Q.7: Explain the structure of the heart with a diagram.

Ans. Heart: The heart is a muscular organ that pumps blood through a network of blood vessels. The heart lies within the chest cavity, beneath the breast bone (sternum) between the two lungs.

Structure of Heart: Red blood cells contain haemoglobin which transports oxygen.

Pericardium: In human heart, a tough, sac-like membrane is called pericardium.

Function of pericardium: Pericardium secretes a fluid around heart. This fluid reduces friction between the pericardium and heart.

Septum: Human heart has two sides. The wall between the left and right sides is called septum.

Chambers of the heart: The upper and lower sides of the heart is divided into two chambers. The upper chambers are called atria and lower chambers are called ventricles. The atria have thinner walls as compared to ventricles.

Valves of the heart: Special flaps called valves are present between the chambers of both sides. The valves open in only one direction.

Q. Which is the largest chamber in the heart?
Ans. The left ventricle is the largest and strongest chamber in the heart.

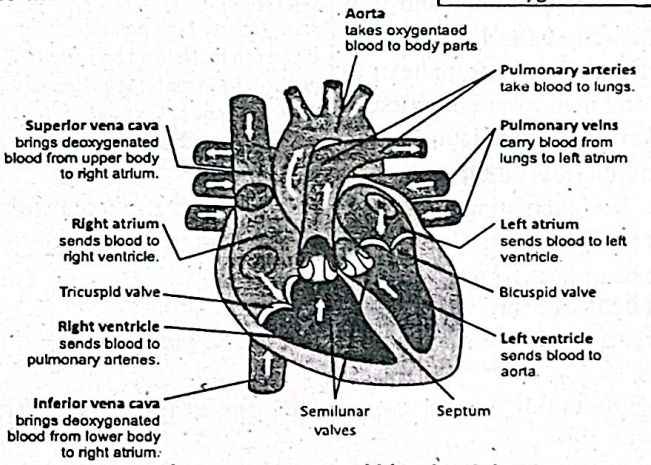
Tricuspid valve: The valve between right atrium and right ventricle is called tricuspid valve (made of 3 flaps).

Bicuspid valve: The valve between left atrium and left ventricle is called bicuspid valve (made of 2 flaps).

Semilunar valve: A valve present between each ventricles and large vessels is called semilunar valve.

Function of valves: The valves prevent blood from flowing back into the ventricles.

Q. What is the color of oxygenated and deoxygenated blood?
Ans. Oxygenated blood is bright red and deoxygenated blood is dark red.



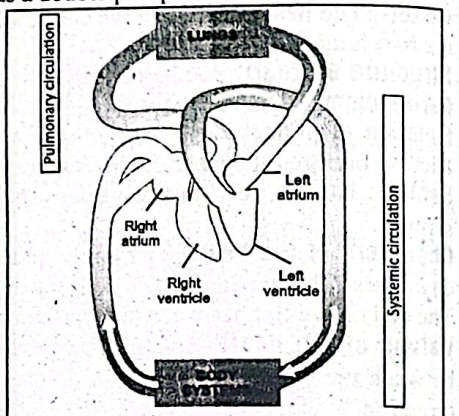
Human heart; structure and blood circulation

Q.8: Describe the pathway of blood through the human heart and explain its importance.

Ans. Heart: Heart is a muscular organ that pumps blood through a network of blood vessels. The heart lies within the chest cavity.

Circulation of bood as a double pump: The right side of the heart collects blood from body and sends it to the lungs while the left side collects blood from the lungs and sends it to the body. It means that human heart works as a double pump.

The deoxygenated Pathway (to the lungs): Two veins i.e., superior and inferior vena cava bring deoxygenated blood (with high concentration of CO_2 and low concentration of O_2) from parts of the body (other than lungs). These veins open in the right atrium. The right atrium contracts and sends this blood into the right ventricle. The right ventricle contracts and pumps this blood into pulmonary arteries. The pulmonary arteries take this blood to lungs. In lungs CO_2 diffuses out of the blood and O_2 diffuses into the blood.



Pulmonary and systemic circulations

The oxygenated Pathway (to the body): From lungs pulmonary veins carry the oxygenated blood (low concentration of CO_2 and high concentration of O_2) back. These veins open in the left atrium of heart. This blood is pumped into left ventricle. When left ventricle contracts it pumps the blood into a large blood vessel called aorta. From aorta, this blood is transported to all parts of the body.

Pulmonary and systemic circulation: The flow of blood from heart to lungs and then from lungs to heart is called pulmonary circulation. The flow of blood from heart to the body tissues and then from body tissues to heart is called systemic circulation.

Q. How blood flows during systemic and pulmonary circulation?
Ans. Due to high pressure in systemic circulation, blood can reach to all body parts. On the other hand, due to low pressure in pulmonary circulation, blood flows in lungs in slow speed. It gives sufficient time for gaseous exchange in lungs.

Q.9: Write a note on heart beat.

Ans. Heartbeat: The alternating contraction (systole) and relaxation (diastole) of heart chambers makes one heartbeat. The average human heart beats 70 times per minute. This is also called the heart beat.

Phases of heart beat: A heart beat has two phases:

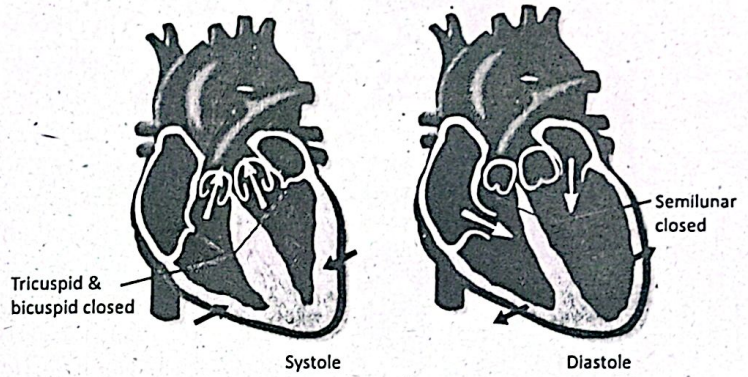
Systole: Systole occurs when both ventricles contract to pump the blood into pulmonary arteries and aorta.

- During systole "lubb" sound is produced due to the closing of tricuspid and bicuspid valves.

Diastole: Diastole occurs immediately after systole when both atria relax so that blood

enters the atria. Contraction of the atria fills the ventricles.

- During diastole "dubb" sound is produced due to the closing of semilunar valves.



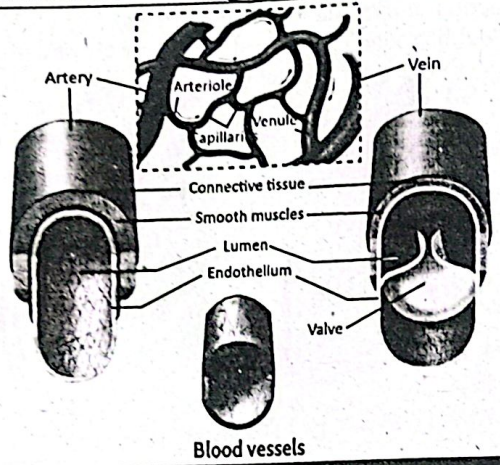
One Heartbeat

3.3 Blood Vessels

Q.10: Compare the structure and function of artery, a vein and a capillary.

Ans.

Feature	Artery	Vein	Capillary
Direction of blood flow	Carry blood away from the heart.	Carry blood towards the heart.	Connect arterioles with venules.
Type of blood	Carry oxygenated blood	Carry deoxygenated blood	Blood exchanges gases and nutrients.
Wall thickness	Thick, strong and elastic	Thin walls as compared to arteries	Extremely thin walls.
Layers of wall	Three layers Endothelium smooth muscles connective tissue	Three layers but middle layer is thinner	Single layer of endothelium only
Lumen	Narrow lumen	Broad lumen	Very narrow lumen
Valves	Absent	Present	Absent
Blood Pressure	Blood flows under high pressure.	Blood flows under low pressure	Blood flows slowly.
Function	Transport blood from heart to body organs.	Return blood from body to heart.	Allow exchange of oxygen, nutrients and wastes between blood and tissues.



Blood vessels

3.4 Arterial and Venous System

Q.11: Differentiate between arterial and venous system.
OR Explain arterial and venous system and compare their roles in blood circulation.

Ans. Arterial system:

Arteries of Pulmonary circulation: A large artery called pulmonary trunk carries deoxygenated blood from right ventricle. It branches into two smaller pulmonary arteries, each artery supplying blood to each lung.

> **Q. What is the main function of aorta?**
> **Ans.** Aorta makes right and left coronary arteries which supply oxygenated blood to the heart muscles. From heart muscle deoxygenated blood returns to left atrium through coronary veins.

- **Arteries of Systemic circulation:** Oxygenated blood is pumped from left ventricle into aorta. It forms arteries which supply blood to head, shoulders and arms. Aorta passes through the thorax and becomes dorsal aorta. It makes many arteries that supply blood to all parts of the lower region. For example, hepatic aartery supplies blood to the liver and renal arteries supply blood to kidneys. Aorta divides and makes two femoral arteries which supply blood to legs.

Venous System:

- **Veins of Pulmonary circulation:** Two pulmonary veins carry oxygenated blood from lungs to the left atrium of heart.

> **Q. Describe the appearance of veins.**
> **Ans.** Veins are blue-looking, but the blood inside is actually dark red.

- **Veins of Systemic circulation:** Two major veins i.e., superior vena cava and the inferior vena cava carry deoxygenated blood from body to right atrium. The superior vena cava is made by joining of veins from head, shoulders and arms. The inferior vena cava is made of many veins from parts of the lower region. For example, two femoral veins from legs empty into inferior vena cava. Renal veins carry blood from the kidneys. The hepatic portal vein carries blood from alimentary canal to the liver. From liver, a hepatic vein carries blood to the inferior vena cava.

3.5 Cardiovascular Disorders

Q.12: What are cardiovascular disorders? Describe the causes, symptoms and prevention of coronary heart disease (CHD)?

Ans. Cardiovascular disorders:

The diseases that involve the heart or blood vessels are collectively called cardiovascular disorders or cardiovascular diseases (CVDs).

Coronary Heart Disease (CHD): It is the narrowing or blockage of the coronary arteries, which supply blood to the heart muscle. This condition is primarily caused by atherosclerosis i.e., accumulation of fatty deposits (plaques) inside arteries.

> **Q. Differentiate between arteriosclerosis and atherosclerosis.**
> **Ans.** Arteriosclerosis is the general hardening and thickening of arterial walls.
> Atherosclerosis is a specific type of arteriosclerosis, caused by the build-up of fats, cholesterol, and other substances (plaque) inside the arteries.

Causes: High levels of low-density lipoproteins (e.g., cholesterol) in blood, high blood pressure, smoking, diabetes, sedentary lifestyle.

Causes: High levels of low-density lipoproteins (e.g., cholesterol) in blood, high blood pressure, smoking, diabetes, sedentary lifestyle.

Symptoms: Asymptomatic in early stages; may lead to chest pain or discomfort as the condition progresses.

Risk Factors: Family history, obesity, high blood pressure, high cholesterol levels, and lifestyle factors.

Prevention: Healthy diet, regular exercise, smoking cessation and management of blood pressure and cholesterol levels.

Complications: If left untreated, CHD can lead to more severe conditions, including myocardial infraction and heart failure.

Q.13: Enlist the causes, symptoms, complications and prevention of myocardial infarction.

Ans. Myocardial Infarction: "Myocardium" means heart muscle. "Infarction" means tissue death. The death of heart muscles is called myocardial infarction. It is commonly known as a "heart attack". It occurs when blood flow to a part of the heart muscle is blocked for prolonged a period leading to death of the heart muscle.

> **Q. According to WHO. What percentage of deaths are caused by cardiovascular diseases?**
> **Ans.** According to the World Health organization (WHO), cardiovascular disorders are responsible for about 32% of all global deaths.
> In Pakistan, CVDs contribute to nearly 29% of all fatalities

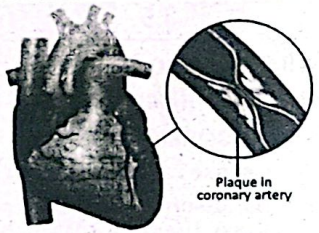
Causes: A blockage in one or more coronary arteries often caused by a blood clot that forms over atherosclerotic plaques.

Symptoms: Chest pain, tightness, and pressure; shortness of breath; sweating; pain radiating to the arm, neck or jaw.

Treatment: Emergency treatment (medicines to dissolve clots), angioplasty to open blocked arteries, and stenting to keep arteries open.

Complications: Heart failure, arrhythamias (irregular heartbeats), and sudden cardic arrest.

Prevention: Maintaining weight with a healthy diet; avoiding smoking; excercise regularly; control blood pressure, cholesterol and diabetes.



Artherosclerosis and resulting Myocardial infraction

Q.14: Write a note on Angina Pectoris as a cardiovascular disorder.

Ans. Angina Pectoris:

Angina Pectoris (commonly called Angina) is chest pain or discomfort caused by reduced blood flow to the heart muscle, typically due to coronary artery disease. Angina is a symptom of CHD and often indicates that the heart is not getting enough oxygen.

Symptoms:

Chest pain or discomfort, chest pressure, squeezing or heaviness. Pain can radiate to the shoulders, neck or arms.

Treatment: Lifestyle changes, medications, procedures like angioplasty or stent placement.

Complications: If untreated, can progress to myocardial infarction and increase the risk of heart failure.

Q. What is silent heart attack?
Ans. Sometime heart attack occurs without symptoms. It is called silent heart attack. It is more common in the elderly and in patients with diabetes

Q.15: Explain the harmful effects of smoking related to heart diseases.

Ans. Harmful Effects of Smoking Related to Heart Diseases:

Smoking is the major risk factor for the development of heart diseases. Here's an overview of how smoking adversely impacts heart health:

(i) Increased Risk of Atherosclerosis: Smoking accelerates atherosclerosis by damaging the endothelium of arteries.

(ii) Increased Risk of Blood clot Formation: Smoking increases the chances for blood to clot by promoting platelet aggregation. The clots that can block coronary arteries and lead to myocardial infarction.

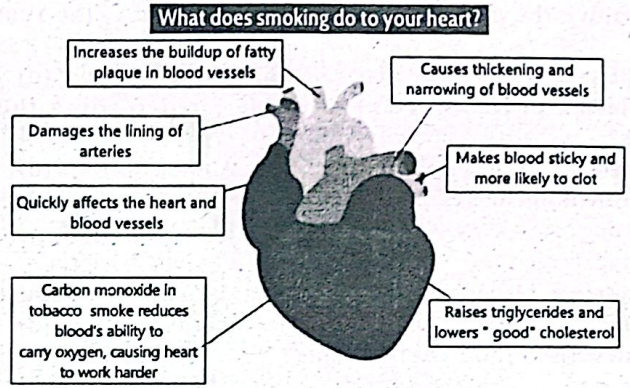
(iii) Elevated Blood Pressure: Smoking contributes to elevated blood pressure by causing vasoconstriction.

(iv) Heart Rate and Rhythm Abnormalities: Arrhythmias are irregular heartbeats that can be dangerous. Smoking affects heart rhythm by increasing heart rate.

(v) Reduced Oxygen Delivery:

Carbon monoxide from cigarette smoke binds to haemoglobin in RBCs more effectively than oxygen, reducing the blood's oxygen-carrying capacity.

Q. What do you know about world Heart day?
Ans. World Heart Day is held on 29 September every year. Its objective is to give awareness to common people about the risks of cardiovascular disorders.



Public awareness poster on "Effects of Smoking on Heart"

(vi) Impact on Overall Cardiovascular Health: Smoking contributes to the narrowing of arteries in the legs, which can further strain the heart.

Objective Type Questions

Additional MCQ's

Multiple Choice Questions prepared in the light of new Examination Techniques
(Knowledge, Understanding, Application, Analytical & Conceptual)

3.1 Blood and its Components

1. **The human transport system is composed of which two key parts?**
   (a) nervous system and circulatory system (b) Blood circulatory
   (c) Lymphatic system (d) Both b and c
2. **Which of the following is not one of the three main components of the blood circulatory system?**
   (a) Heart (b) Blood vessels (c) Lungs (d) Blood
3. **Blood is considered as a type of:**
   (a) Epithelial tissue (b) connective tissue (c) Muscular tissue (d) Nervous tissue
4. **What is the primary overall function of blood?**
   (a) To produce energy (b) To transport material
   (c) To digest food (d) To filter toxins
5. **How much blood does an average adult human have in their body?**
   (a) About 2 litres (b) About 10 litres (c) About 5 litres (d) About 8 litres
6. **The fluid portion of blood called:**
   (a) Cytoplasm (b) Serum (c) Plasma (d) Lymph
7. **How much portion of blood is composed of plasma?**
   (a) 45% (b) 91% (c) 55% (d) 8%

8. **If you remove the protein fibrinogen from plasma, the remaining fluid is called:**
(a) Pure plasma (b) Haemoglobin (c) Serum (d) Lymph
9. **Which plasma proteins are responsible for defending the body against pathogens?**
(a) Albumin (b) Fibrinogen (c) Antibodies (d) Platelets
10. **Plasma protein fibrinogen play its role in:**
(a) Maintaing osmotic pressure (b) Blood clotting
(c) Carrying oxygen (d) Fighting bacteria
11. **Which protein is responsible for maintaing the osmotic pressure of blood?**
(a) Albumin (b) Antibody (c) Fibrinogen (d) Globulin
12. **Which nutrients are present in plasma?**
(a) Lipids (b) Amino acids (c) Glucose (d) All of these
13. **Disc-shaped cells are:**
(a) Red blood cells (b) White blood cells
(c) Platelets (d) Plasma
14. **Which protein helps RBCs to transport oxygen?**
(a) Albumin (b) Fibrinogen (c) Haemoglobin (d) Globulin
15. **Normal range of RBCs per mm^3 of blood:**
(a) 7,000 (b) 2 million (c) 4 to 5.5 million (d) 7 million
16. **In adults, RBCs are primarily formed in:**
(a) Liver and spleen (b) Red bone marrow
(c) Lymph nodes (d) Thymus
17. **What is the average life span of a Red Blood cell?**
(a) 7 days (b) 120 days (c) 1 year (d) Two years
18. **The characteristic property of white blood cells is:**
(a) Contain haemoglobin (b) disc-shaped
(c) colourless (d) smaller than RBCs
19. **Approximately how many WBCs are typically found in each mm^3 of blood?**
(a) 4 million (b) 3 million (c) 7,000 (d) 70,000
20. **What is the primary function of white blood cells?**
(a) To transpoprt oxygen (b) To defend body against diseases
(c) To help blood clotting (d) To remove carbon dioxide
21. **Primary function of Basophils:**
(a) Engulfing dead cells (b) Producing antibodies
(c) Releasing histamine (d) Carrying oxygen
22. **What is the specific role of Lymphocytes?**
(a) Making antibodies (b) Releasing histamine
(c) Forming a fibrin (d) Cleaning up dead cells
23. **Average life span of a platelet is:**
(a) 120 days (b) 1 to 2 days (c) 7 to 12 days (d) 24 hours
24. **During the clotting process, which plasma protein is converted into fibrin?**
(a) Histamine (b) Haemoglobin (c) Fibrinogen (d) Antibody

25. **In a $1mm^3$ sample of blood, there are approximately how many platelets?**
(a) 100,000 (b) 250,000 (c) 500,000 (d) 1,000,000

3.2 Human Heart

26. **The tough, sac-like membrane that surrounds and protect heart is known as the:**
(a) Pleura (b) Pericardium (c) Septum (d) Epicardium
27. **The muscular wall that seperates the left and right sides of the heart is called:**
(a) Valve (b) Pericardium (c) Septum (d) Venacava
28. **The bicuspid valve is located between which two chambers?**
(a) Right atrium and right ventricle (b) Left atrium and left ventricle
(c) Right ventricle and pulmonary artery (d) Left ventricle and aorta
29. **Primary function of semilunar valves is:**
(a) To allow blood to flow (b) To prevent blood from back flow
(c) To seperate oxygenated and deoxygenated blood
(d) To pump blood to lungs
30. **How many flaps make up the tricuspid valve?**
(a) 1 (b) 2 (c) 3 (d) 4
31. **Which blood vessels bring deoxygenated blood from the body to the right atrium?**
(a) Pulmonary veins (b) Pulmonary arteries
(c) Superior and inferior vena cava (d) Aorta
32. **The pulmonary veins are unique because they carry:**
(a) Deoxygenated blood to lungs (b) Oxygenated blood back to left atrium
(c) Deoxygenated blood to the right atrium
(d) Oxygenated blood to the rest of the body
33. **Deoxygenated blood is:**
(a) Bright red (b) Dark red (c) Pale red (d) Pale yellow
34. **When the left ventricle contracts, it pumps blood directly into the:**
(a) Pulmonary vein (b) Right ventricle (c) Aorta (d) Vena cava
35. **The flow of blood from heart to the lungs and then back to the heart is called:**
(a) Systemic circulation (b) Pulmonary circulation
(c) Coronary circulation (d) Double circulation
36. **The flow of blood from heart to body tissues and then from body tissues to heart is called:**
(a) Pulmonary circulation (b) Coronary circulation
(c) Systemic circulation (d) Diastole
37. **The alternating contraction and relaxation of heart chambers is called:**
(a) Heart failure (b) Heart beat (c) Systole (d) Diastole
38. **The "dubb" sound of the heart beat is produced by the closing of the:**
(a) Tricuspid valves (b) Bicuspid valves
(c) Semilunar valves (d) Closed valves
39. **What is the average heart rate of a healthy adult human?**
(a) 60 times per minute (b) 70 times per minute

(c) 80 times per minute (d) 100 times per minue

40. "Lubb" sound is produced during:
(a) Diastole (b) Systole
(c) Systemic circulation (d) Pulmonary circulation

3.3 Blood Vessels

41. The middle layer of an arterial wall is primarily composed of:
(a) Endothelium (b) Connective tissue
(c) Smooth muscles and elastic tissues (d) Skeletal muscle

42. The hollow internal cavity of a blood vessel through which blood flows is called:
(a) Septum (b) Lumen (c) Valve (d) Pericardium

43. Small blood vessels are:
(a) Arteries (b) Veins (c) Capillaries (d) Aorta

44. The walls of the capillaries are composed of only a single layer of cells called:
(a) smooth muscles (b) connective tissue (c) Endothelium (d) Epithelium

45. Capillaries unite to form small veins called:
(a) Endothelium (b) Epithelium (c) Vena cava (d) Venules

46. Most veins carry deoxygenated blood towards the heart. Which of the following is exception?
(a) Renal veins (b) Hepatic veins (c) Pulmonary veins (d) Vena cava

47. Oxygenated blood is pumped from the left ventricle into the:
(a) Superior vena cava (b) Aorta
(c) Pulmonary artery (d) Hepatic vein

48. Which artery supplies blood to the head, shoulders and arms?
(a) Renal artery (b) Femoral artery (c) Aorta (d) Hepatic artery

49. Which artery supplies blood to the kidneys?
(a) Hepatic artery (b) Renal artery (c) Femoral artery (d) Cornary artery

50. The hepatic artery supplies blood to the:
(a) Liver (b) Kidneys (c) Legs (d) Heart

51. Which arteries supply blood to the legs?
(a) Renal arteries (b) Hepatic arteries (c) Pulmonary arteries (d) Femoral arteries

52. Renal veins carry blood away from the:
(a) Liver (b) Lungs (c) Kidneys (d) Heart

53. Which vein carries blood from the liver to the inferior vena cava?
(a) Hepatic vein (b) Renal vein
(c) Hepatic portal vein (d) Femoral vein

54. Veins are:
(a) Red-looking (b) Green-looking
(c) Blue-looking (d) Bright blue-looking

3.5 Cardiovascular Disorders

55. Diseases involving the heart or blood vessels are called:
(a) Respiratory disorders (b) Cardiovascular disorders
(c) Digestive disorders (d) Renal disorders

56. Coronary Heart Disease (CHD) is the narrowing or blockage of:
(a) Renal arteries (b) Coronary arteries
(c) Pulmonary arteries (d) Hepatic portal vein

57. What is the primary cause of Coronary Heart disease?
(a) Exercise (b) Atherosclerosis
(c) Low blood pressure (d) Drinking water

58. The death of heart muscles is called:
(a) Angenia Pectoris (b) Emphysema
(c) Myocardial infraction (d) Coronary heart disease

59. Which of the following is an emergency treatment used to physically open blocked coronary arteries?
(a) Dialysis (b) Vaccination (c) Angioplasty (d) Antibiotic therapy

60. The chest pain or discomfort caused by reduced blood flow to the heart muscle is called.
(a) Myocardial Infarction (b) Coronary Heart Disease
(c) Angina Pectoris (d) Asthma

Answers

1. (d)	2. (c)	3. (b)	4. (b)	5. (c)	6. (c)	7. (c)
8. (c)	9. (c)	10. (b)	11. (a)	12. (d)	13. (a)	14. (c)
15. (c)	16. (b)	17. (b)	18. (c)	19. (c)	20. (b)	21. (c)
22. (a)	23. (c)	24. (c)	25. (b)	26. (b)	27. (c)	28. (b)
29. (b)	30. (c)	31. (c)	32. (b)	33. (b)	34. (c)	35. (b)
36. (c)	37. (b)	38. (c)	39. (b)	40. (b)	41. (c)	42. (b)
43. (c)	44. (c)	45. (d)	46. (c)	47. (b)	48. (c)	49. (b)
50. (a)	51. (d)	52. (c)	53. (a)	54. (c)	55. (b)	56. (b)
57. (b)	58. (c)	59. (c)	60. (c)			

Additional Short Questions

Short Answer Questions prepared in the light of new Examination Techniques (Knowledge, Understanding, Application, Analytical & Conceptual)

3.1 Blood and its components

1. The human transport system is consist of which two parts?
Ans. The human transport system consists of two key parts:
(i) Blood circulatory system **(ii)** Lymphatic system

2. What is blood? Name its main components.
Ans. Blood: Blood is a type of connective tissue. Its main function is to transport materials throughout the body.
Main components: Its main components are plasma, red blood cells (RBCs), white blood cells (WBCs) and platelets.

3. State two functions of blood in the human body.
Ans. Functions of blood:
(i) Blood transports oxygen from lungs to all body cells and carries carbon dioxide

back to lungs for removal.

(ii) Blood delivers nutrients, hormones and waste products.

4. What do you know about plasma?

Ans. Blood plasma: Plasma is the liquid portion of blood. Plasma is composed of 90-92% of water, 7-9% of proteins and 1% of other substances.

5. Write down the role of proteins in blood plasma.

Ans. Antibodies are important plasma proteins.

- Antibodies defend the body against pathogens.
- Fibrinogen (a plasma protein) responsible for blood clotting.
- Albumin (a plasma protein) maintains the osmotic pressure of blood

6. Which salts are present in blood plasma?

Ans. The important plasma salts are made of sodium, chloride and bicarbonate ions.

7. State the role of respiratory gases in plasma.

Ans. Small amount of carbon dioxide and oxygen are dissolved in plasma. About 1.5% of oxygen and about 5-7% of carbon dioxide is carried as dissolved in plasma.

8. What is the function of red blood cells?

Ans.

- Red blood cells transport oxygen from lungs to body tissues.
- Red blood cells carries small amount of carbon dioxide back to lungs.

9. Write two functions of white blood cells.

Ans. White blood cells (Leucocytes):

- White blood cells defend the body against diseases.

fragments of large cells of bone marrow. Platelets lack a nucleus. Their life span is 7-12 days.

15. What happens if the number of platelets in blood decreases?

Ans. If number of platelets decreases blood clotting becomes slow, leading to excessive bleeding even from minor wounds.

3.2 Human Heart

16. What is human heart and describe its location in the body?

Ans. Heart: The heart is a muscular organ that pumps blood through a network of blood vessels.

Location: The heart lies within the chest cavity, behind the breast bone(sternum), between the two lungs.

17. Name four chambers of human heart and state one function of each.

Ans. The four chambers of human heart are:

(i) Right atrium: Receives deoxygenated blood from the body.

(ii) Left atrium: Receives oxygenated blood from the lungs.

(iii) Right ventricle: Pumps deoxygenated blood to the lungs.

(iv) Left ventricle: Pumps oxygenated blood to the whole body.

18. Why are valves present in the heart? Name two heart valves.

Ans. Valves prevent blood from flowing back into the ventricles.

Two he[illegible]

Additional Short Questions

[illegible] Answer questions prepared in the light of new examination pattern
[illegible] Understanding, Application, Analytical & Conceptual]

3.1 Blood and its components

[illegible] system is consist of which two parts?
[illegible] system consists of two key parts:
[illegible] system (ii) Lymphatic system
[illegible] main components
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[illegible] components are plasma, red blood cells (RBCs), white
[illegible] human body.
[illegible] body cells and carries carbon dioxide

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3.3 Cardiovascular Disorders

55. Diseases involving the heart or blood vessels are called:
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(c) Digestive disorders (d) Renal disorders

[illegible] (b)

1. The human tra
Ans. The human transpo
(i) Blood circulat
2. What is blood? Name i
Ans. Blood: Blood is a type o
material that goes about the body
Main components: It's main con
blood cells (WBCs) and platelets
3. State two functions of blood in the
Ans. Functions of blood:
(i) Blood transports oxygen from lungs to a

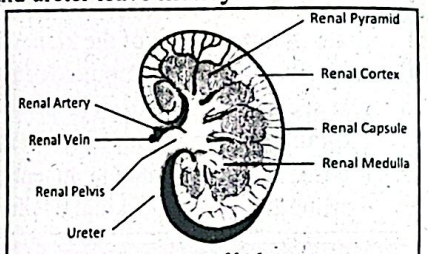
Kidneys remove extra water, salts and nitrogenous wastes from blood and make urine. From each kidney, a tube called ureter carries urine to the urinary bladder. The urinary bladder temporarily stores urine. The urethra is the tube that carries urine from the urinary bladder to the outside.

Kidneys are the major organs of urinary system. Renal arteries supply them blood with metabolic wastes (e.g. urea, extra water and salts). Kidneys filter these wastes from blood and then excrete then in the form of urine.

Structure of kidney:

External Structure: Kidney is surrounded by a tough tissue called renal capsule. On the concave side of the kidney, there is a depression called hilus. It is the point from where renal artery enters in kidney and renal vein and ureter leave kidney.

Internal Structure: Internally, a kidney is divided into two regions. The outer region is called renal cortex while the inner one is called renal medulla. There are many cone shaped areas in renal medulla, called renal pyramids. The base of each pyramid faces the renal cortex while its tip is in a cavity called renal pelvis. It extends to outside of kidneys and forms a ureter.

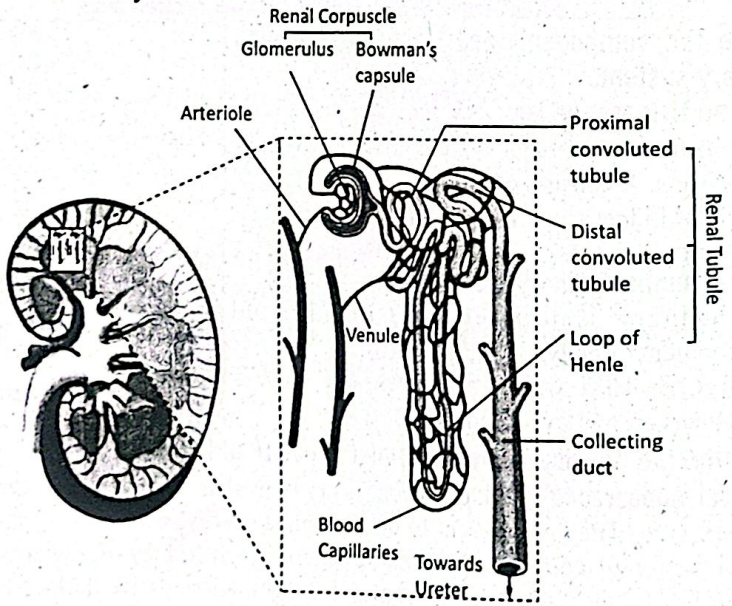


Structure of kideny

Q.3: Describe a structure of a nephron and draw a labelled diagram.

Ans. Nephron:

The functional unit of kidney are called nephron. There are more than one million nephrons in each kidney.



The Structure of Nephron

Parts of nephron: A nephron consists of two parts:

(i) Renal corpuscle (ii) Renal tubule

(i) **Renal corpuscle:** It is the first part of nephron and is composed of glomerulus and the Bowman's capsule.

Glomerulus: It is a network of capillaries.

Bowman's capsule: It is a cup-shaped structure around the glomerulus.

(ii) **Renal tubule:** It is a long tube attached with the Bowman's capsule. It has three parts:

(a) Proximal convoluted tubule

(b) Loop of Henle

(c) Distal convoluted tubule.

The distal convoluted tubule of many nephrons open in a single collecting duct. Many collecting ducts join together and open into the renal pelvis.

4.2 Functioning of the kidney

Q.4: Describe the process of pressure filtration and re-absorption in kidneys.

Ans. Pressure filtration:

Blood enters kidney through a renal artery. The artery divides into many arterioles. Each arteriole divides into the capillaries of glomerulus.

When blood reaches glomerulus, its pressure is very high. So, many small molecules (water, salts, glucose and urea etc.) move out of glomerulus. These materials enter Bowman's capsule. This step is called pressure filtration. The filtered material in Bowman's capsule is called glomerular filtrate. It is about 20% of the blood plasma that enters the glomerulus.

Reabsorption: The glomerular filtrate moves to the next part of nephron i.e., renal tubule. Many useful materials are reabsorbed from glomerular filtrate into the blood capillaries surrounding the renal tubule.

- Large amount of water, nearly 100% of glucose and amino acids, and most of the salts are reabsorbed from proximal convoluted tube.
- Some water is reabsorbed from descending limb of the loop of Henle. Large amounts of salts are reabsorbed from ascending limb of the loop of Henle.
- Some water is also reabsorbed from distal convoluted tubule and collecting duct.

Q. Which particles are not filtered through the glomerular capillaries?
Ans. Blood cells and proteins are not filtered through the glomerular capillaries because they are relatively larger in size.

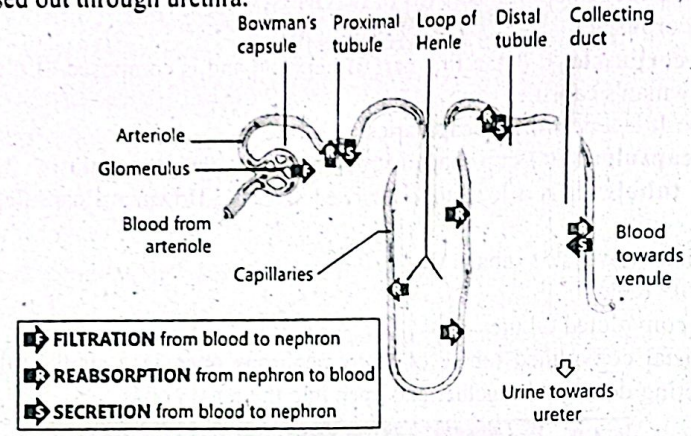
Q.5: What is tubular secretion? How it helps in removing wastes from the blood?

Ans. Tubular Secretion:

When useful materials are reabsorbed into blood, some of the remaining wastes present in blood are secreted from blood capillaries to renal tubule. It is an active transport process and is called tubular secretion.

After reabsorption and tubular secretion, the filtrate in the renal tubules is known as urine. Urine from all nephrons moves to the renal pelvis. From renal pelvis, urine moves to the urinary bladder via ureters. Here it is stored. When the urinary bladder is filled,

urine is passed out through urethra.



Functioning of kidney

Q.6: How kidneys play its role in osmoregulation?

Ans. Osmoregulation:

Osmoregulation means the control of the amount of water according to body's needs.

Role of kidneys in osmoregulation: Kidneys are the main organs which work for osmoregulation. They control the amount of water in blood. So, the amount of water in other body fluids is also controlled.

Diluted urine: If there is excess water in blood, more water is filtered from the glomerulus's to Bowman's capsule. There is less reabsorption of water from renal tubule to capillaries. In this way abundant dilute urine is produced and the amount of water in blood is brought to normal.

Concentrated urine: If the amount of water in blood is less than normal, less water is filtered from the glomerulus to Bowman's capsule. There is more reabsorption of water from renal tubule to capillaries.

In this way, concentrated urine is produced and the water is retained in blood.

4.3 Disorders of Kidney

Q.7: Write a comprehensive note on kidney stones describing the causes, symptoms and treatments.

Ans. Kidney Stones:

Sometimes, the filtered minerals and salts (e.g., calcium oxalate, calcium and ammonium phosphate, and uric acid etc.) gather in kidneys and make hard, crystalline deposits. Such deposits cannot pass in urine and are called kidney stones. Some stones may leave kidneys and may be trapped in ureter or urinary bladder.

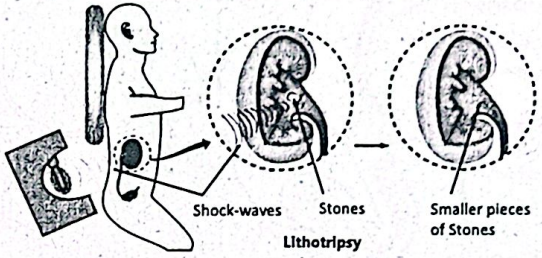
Symptoms: Severe pain in kidney or lower abdomen, burning in urethra, frequent urination, foul-smelling urine, blood and pus in urine, nausea, vomiting, bloating.

Causes: Presence of more calcium oxalate, calcium and ammonium phosphates in diet

(green vegetables, fats, dairy products), extra amounts of vitamins C and D in diet, reduced water intake, excess uric acid in blood, urinary tract infections, and alcohol consumption.

Treatment: If kidney stones are small in size, the patient is advised to drink plenty of water so that stones can pass through the urine.

Lithotripsy is another method for the removal of kidney stones. In lithótripsy, non-electric shock waves are fired on kidney from outside. The waves hit the stones and break them into smaller pieces, which pass out through urine.



Lithotripsy

If stones are large and cannot pass easily, the patient has to undergo surgery for the removal of stones.

Q.8: Write down the symptoms and causes of kidney failure.

Ans. Kidney Failure:

Kidney failure is also known as renal failure. "When one or both kidneys are not able to perform their function (removing waste materials from blood and then passing them out), the condition is called kidney failure."

Symptoms of kidney failure: Increase concentration of wastes in blood, rise in volume of body fluids, weight loss and blood in urine, swelling in legs, feet and face-are the symptoms of kidney failure.

Causes of kidney failure: Long-term diabetes mellitus and hypertenstion, dehydration, severe kidney infections, overuse of certain medicines (e.g nonsteroidal anti inflammatory drugs-NSAIDs), large kidney stones, physical damage to kidneys heart or liver failure are the causes of kidney failure.

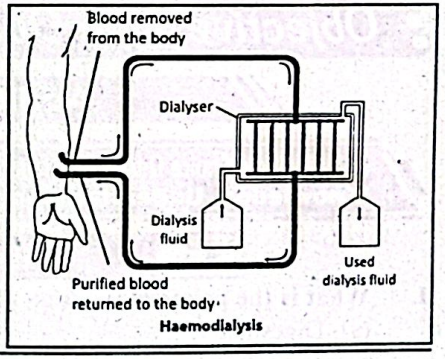
Q.9: Define dialysis and describe the processes of peritoneal dialysis and haemodialysis.

Ans. Dialysis:

Dialysis is a method in which wastes are extracted from blood by using a dialysis fluid. There are two methods of dialysis:

1. Haemodialysis 2. Peritoneal dialysis

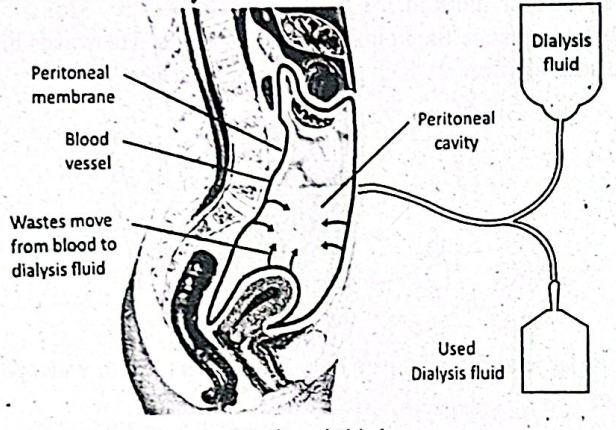
1. Haemodialysis: In haemodialysis, the patient's blood is pumped through a machine called dialyzer. The dialyzer contains long tubes. Blood flows inside the tubes while dialysis fluid flows outside. Extra water and wastes move from



Haemodialysis

blood and enter the dialysis fluid. The purified blood is then returned back to the body.

2. Peritoneal Dialysis: In this method, dialysis fluid is pumped into the peritoneal cavity (the space around gut in abdomen). The walls of peritoneal cavity are lined with peritoneal membrane. The wastes pass from the blood present in blood vessels of peritoneal membrane into the dialysis fluid. After some time, the dialysis fluid is drained.



Peritoneal Dialysis

Q. Which organization controlled organ transplantation in Punjab?
Ans. In Punjab, organ transplantation is controlled by Punjab Human Organ Transplant Authority It ensures that people can have suitable transplantation with safety and quality.

Q.10: How kidney transplant is done?

Ans. Kidney transplantation:

Kidney transplantation is done for advanced treatment of kidney failure.

Procedure: In this treatment, a healthy kidney from some donor is transplanted in patient's body, along with damaged kidney. The donor of kidney may be a decreased person or a living one. Living-donor may or may not be a relative of the patient. In all cases, the donor's kidney is matched with the patient's immune system. When a matching kidney is transplanted, it works normally in patient's body for ten to fifteen years.

Objective Type Questions

Additional MCQ's

Multiple Choice Questions prepared in the light of new Examination Techniques (Knowledge, Understanding, Application, Analytical & Conceptual)

4.1 Human Urinary System

1. **What is the primary function of the urinary system?**
(a) Digestion (b) Regulation of internal environment

(c) Pumping blood (d) Oxygen transport

2. **Which organs are responsible for removing extra water and nitrogenous wastes?**
(a) Lungs (b) Kidneys (c) Liver (d) Heart

3. **The tube that carries urine from the kidney to the bladder is:**
(a) Urethra (b) Renal artery (c) Ureter (d) Hilus

4. **Where is urine temporarily stored before being exereted?**
(a) kidneys (b) Ureter (c) Urinary bladder (d) Renal capsule

5. **Typical shape of a human kidney is:**
(a) Sphere-shaped (b) Bean-shaped (c) Cube-shaped (d) Cone-shaped

6. **Where are the kidneys located in human body?**
(a) Thoracic cavity (b) Pelvic cavity
(c) Abdominal cavity (d) Cranial cavity

7. **Approximate length of the human kidney is:**
(a) 5cm (b) 10cm (c) 4cm (d) 15cm

8. **Which vessels supplies the kidneys with blood?**
(a) Renal veins (b) Pulmonary arteries
(c) Renal arteries (d) Hepatic portal vein

9. **The tough tissue surrounding the kidney is known as:**
(a) Renal capsule (b) cortex (c) Hilus (d) Diaphragm

10. **The outer region of the kidney is:**
(a) Renal medulla (b) Renal cortex (c) Renal pyramid (d) Nephrons

11. **The functional units of kidneys are:**
(a) Medulla (b) ureter (c) Renal pelvis (d) Nephrons

12. **How many nephrons are present in each kidney?**
(a) More than thousand (b) More than one million
(c) More than two million (d) More than three million

13. **A nephron consist of:**
(a) Renal corpuscle (b) Renal tubule (c) Both a and b (d) Collecting duct

14. **Renal corpuscle is composed of:**
(a) Glomerulus (b) Bowman's capsule
(c) Loop of henle (d) Both a and b

4.2 Functioning of Kidney

15. **Which particles are not filtered through the glomerular capillaries?**
(a) Proteins (b) Blood cells (c) Lipids (d) A and B both

16. **Each arteriole divides into the:**
(a) Arteries (b) tubules (c) Capillaries (d) Veins

17. **Which blood vessel is responsible for bringing blood into the kidney for filtration?**
(a) Renal vein (b) Renal artery (c) Hepatic artery (d) Pulmonary vein

18. **During the reabsorption process, where do the useful materials move to after leaving the renal tubule?**
(a) Glomerular capillaries (b) Bowman's capsule
(c) The bladder (d) Blood capillaries

19. **The primary substance reabsorbed in the descending limb of the loop of Henle:**
(a) Proteins (b) Urea (c) Some water (d) Salts

20. **In which part of loop of Henle are large amount of salts reabsorbed?**
(a) Descending limb (b) Ascending limb
(c) Glomerulus (d) Renal pelvis

21. **Tubular secretion is an:**
(a) Passive transport process (b) Active transport process
(c) Osmosis process (d) None of these

22. **After reabsorption and tubular secretion, the filtrate in the renal tubule is known as:**
(a) Blood (b) Urine (c) Feaces (d) Glomerular fillrate

23. **Osmoregulation refers to the control of:**
(a) Glucose (b) Salts (c) Water (d) Urea

24. **Main organ which work for osmoregulation:**
(a) Liver (b) Kidney (c) Heart (d) Stomach

25. **If you drink a lot of water, your kidneys will produce:**
(a) Concentrated urine (b) Diluted urine
(c) No urine (d) Salty urine

26. **Concentrated urine means there is:**
(a) More water and less waste (b) Less water and more waste
(c) No waste at all (d) Only pure water

27. **Why does the kidney produce concentrated urine?**
(a) to get rid of extra water (b) To save water for the body
(c) To make the bladder full faster (d) To clean the renal artery

4.3 Disorders of Kidney

28. **What are kidney stones made of?**
(a) Sugar and proteins (b) Deposits of minerals and salts
(c) Only excess water (d) Blood cells

29. **Which of the following salts is a common cause of kidney stones?**
(a) sodium chloride (b) Calcium oxalate
(c) Potassium (d) Magnesium sulfate

30. **Which symptom is associated with kidney stones?**
(a) Severe pain in lower abdomen (b) Difficulty in breathing
(c) Memory loss (d) High hair growth

31. **What is the major dietry cause of kidney stones?**
(a) Eating too much fruit (b) Eating green vegetables and dairy products
(c) Drinking too much water (d) Lack of salt in food

32. **Extra amount of which vitamins can contribute to stone formation.**
(a) Vitamin A and B (b) Vitamin C and D
(c) Vitamin K and A (d) Vitamin E and B

33. **In which technique non-electric shock waves are fired on kidney from outside.**
(a) Surgery (b) Laser (c) Lithotripsy (d) Dialysis

34. **When one or both kidneys are not able to perform their function, the condition is called:**
(a) Kidney stone (b) Lithotripsy (c) Dialysis (d) Kidney failure

35. **All are the causes of kidney failure except:**
(a) Blood in urine (b) Swelling in lags (c) Weight loss (d) Headache

36. **A treatment in which wastes are extracted from blood is known as:**
(a) Kidney transplant (b) dialysis
(c) Lithotripsy (d) None of these

37. **What is the name of the machine used to clean blood during Haemodialysis?**
(a) Lithotripter (b) Peritoneal cavity (c) Dialyzer (d) Nephroscope

38. **In Punjab, which authority controls organ transplantation to ensure safety and quality?**
(a) Punjab Medical Board
(b) Punjab Human organ Transplant Authority
(c) Kidney stones Relief centre (d) Dialysis Control Bureau

39. **Which of the following method is done for advanced treatment of kidney failure?**
(a) Haemodialysis (b) Peritoneal Dialysis
(c) Lithotripsy (d) Kidney Transplantation

40. **For how many years a transplanted kidney works normally?**
(a) Five to ten years (b) Ten to fifteen years
(c) Three to four years (d) Five to eight years

Answers

1. (b)	2. (b)	3. (c)	4. (c)	5. (b)	6. (c)
7. (b)	8. (c)	9. (a)	10. (b)	11. (d)	12. (b)
13. (c)	14. (d)	15. (d)	16. (c)	17. (b)	18. (d)
19. (c)	20. (b)	21. (b)	22. (b)	23. (c)	24. (b)
25. (b)	26. (b)	27. (b)	28. (b)	29. (b)	30. (a)
31. (b)	32. (b)	33. (c)	34. (d)	35. (d)	36. (d)
37. (c)	38. (b)	39. (d)	40. (b)		

Additional Short Questions

Short Answer Questions prepared in the light of new Examination Techniques
(Knowledge, Understanding, Application, Analytical & Conceptual)

4.1 Human urinary system

1. **Write down the role of human urinary system.**

Ans. The human urinary system regulates the internal environment of body. It ensures that waste products and excess substances are removed from body.

2. **Enlist the main parts of human urinary system.**

Ans. The human urinary system consists of a pair of kidneys, a pair of ureters, a urinary bladder and a urethra.

3. Differentiate between ureter and urethra.

Ans. Ureter: Ureter carries urine from the kidneys to the urinary bladder.

Urethra: Urethra is the tube that carries urine from the urinary bladder to the outside.

4. State two functions of the kidneys.

Ans. (i) Kidneys filter metabolic wastes from blood and remove extra water and salts.

(ii) They maintain the body's internal fluid balance.

5. Why is the left kidney slightly higher than the right kidney?

Ans. The left kidney is slightly higher because the right kidney is pushed down a little by the large size of liver.

6. Describe the shape and size of a human kidney.

Ans. Kidneys are bean-shaped organs having a concave and convex side.
Each kidney is about 10cm long, 5cm wide and 4cm thick.

7. What is the hilus? Write its importance.

Ans. Hilus: On the concave side of kidney, there is a depression called hilus.
It is the point from where renal artery enters in kidney and renal vein and ureter leave kidney.

8. Differentiate between renal cortex and renal medulla:

Ans. Renal cortex: Renal cortex is the outer region of the kidney.
Renal medulla: Renal medulla is the inner region of the kidney containing renal pyramids.

9. Why nephron is called the functional unit of kidney?

Ans. The functional units of kidneys are called nephrons. They filter blood and form urine, so the kidney's function depends on nephron.

10. Name the major parts of the nephron.

Ans. A nephron consists of two major parts:

(i) Renal corpuscle **(ii)** Renal tubule

11. Differentiate between renal corpuscle and renal tubule.

Ans. Renal corpuscle: It is the first port of the nephron where filtration of blood takes place.

- It consists of Bowman's capsule and glomerulus.

Renal tubule: It is the second part of the nephron where reabsorption and secreation occur.

- It consists of proximal convoluted tubule, Loop of henle and distal convoluted tubule.

12. What is glomerulus and Bowman's capsule?

Ans. The glomerulus is a network of capillaries while the Bowman's capsule is a cup-shaped structure around the glomerulus.

4.2 Functioning of the kidney

13. What do you know about glomerular filtrate?

Ans. Glomerular filtrate: It is the fluid that is filtered from the blood into the Bowman's capsule. It contains water, salts, glucose and urea etc.

14. How reabsorption takes place in kidney?

Ans.
- Large amount of water, nearly 100% of glucose and amino acids and most of the salts are reabsorbed from proximal convoluted tube.
- Some water is reabsorbed from ascending limb of loop of Henle.
- Large amount of salts are reabsorbed from ascending limb of the loop of Henle.
- Same water is also reabsorbed from distal convoluted tubule and collecting duct.

15. What do you know about the process of tubular secreation?

Ans. Tubular secretion: When useful materials are reabsorbed into blood, some of the remaining wastes present in blood are secreted from blood capillaries to renal tubule. It is an active transport process and is called tubular secreation.

16. Define Osmoregulation.

Ans. Osmoregulation: Osmoregulation is the control of water and salts balance in the body.

- It is mainly performed by the kidney's.

17. How excess water in the blood is controlled?

Ans. If there is excess water in blood, more water is filtered from the glomerulus to Bowman's capsule. There is less reabsorption of water from renal tubule to capillaries. In this way, abundant dilute urine is produced and the amount of water in blood is brought to normal.

18. How less amount of water in blood is brought to normal?

Ans. If the amount of water in blood is less than normal, less water is filtered from the glomerulus to Bowman's capsule. There is more reabsorption of water from renal tubule to capillaries. In this may, concentrated urine is produced and the water is preserved in blood.

4.3 Disorders of Kidney

19. How kidney stones are formed?

Ans. Sometimes, the filtered minerals and salts e.g. calcium oxalate, calcium and ammonium phosphate and uric acid etc.) gather on kidneys and make hard, crystalline deposits. Such deposits cannot pass in urine and are called kidney stones.

20. Write down some symptoms of kidney stones.

Ans. Severe pain in kidney or lower abdomen, burning in urethra, frequent urination, foul-smelling urine, blood and pus in urine are the symptoms of kidney stones.

21. Write down any two symptoms and causes of kidney failure.

Ans. Symptoms: Increases concentration of wastes in blood rise in volume of body fluid and blood in urine are the symptoms.

Causes: Long-term diabetes mellitus and severe kidney infections are the major causes of kidney failure.

22. Define dialysis write down the names of its two methods.

Ans. Dialysis: Dialysis is a treatment in which wastes are extracted from blood by using a dialysis fluid.

Methods of dialysis:

(i) Haemodialysis **(ii)** Peritoneal Dialysis

23. How kidney transplantation takes place?

Ans. Kidney transplantation is done for advanced treatment of kidney failure. In this

treatment, a healthy kidney from some donor is transplanted in patients body, along with damaged kidney. The donor's kidney should be matched with the patient's immune system. When a matching kidney is transplanted, it works normally in patient's body for then to fifteen years.

Exercise Questions (Solved)

A. Select the correct answers for the following questions.

1. **The process of regulating the amount of water in body fluid is called;**
   (a) Filtration (b) Reabsorption
   (c) Tubular secretion (d) Osmoregulation
2. **What happens in the proximal convoluted tubule of nephron?**
   (a) Blood is filtered by glomerulus
   (b) Reabsorption of water and nutrients occurs
   (c) Urine is stored
   (d) Water is secreted into the bloodstream
3. **Which structure is responsible for filtering blood to produce urine?**
   (a) Nephron (b) Renal Pelvis (c) Ureter (d) Renal capsule
4. **Which structure in nephron is responsible for filtering blood?**
   (a) Loop of Henle (b) Glomerulus
   (c) Proximal convoluted tubule (d) Distal convoluted tubule
5. **In which part of nephron, the reabsorption of nutrients occurs?**
   (a) Glomerulus (b) Proximal convoluted tubule
   (c) Loop of Henle (d) Distal convoluted tubule
6. **Which process in nephron involves the active transport of materials from blood into nephron?**
   (a) Filtration (b) Reabsorption (c) Secretion (d) Excretion
7. **Which is NOT present in the filtrate entering the Bowman's capsule of nephron?**
   (a) Water (b) Calcium ions (c) Blood cells (d) Urea
8. **In which procedure a machine is used to filter blood outside the body?**
   (a) Peritoneal dialysis (b) Haemodialysis (c) Lithotripsy (d) Renal surgery
9. **What is the primary purpose of haemodialysis?**
   (a) To rehydrate the body (b) To replace lost nutrients
   (c) To filter waste products from blood (d) To regulate blood pressure
10. **In peritoneal dialysis, what acts as the filtering membrane?**
    (a) Dialysis machine (b) Renal cortex
    (c) Peritoneal membrane (d) Renal tubules

Answers

1. (d)	2. (b)	3. (a)	4. (b)	5. (b)
6. (c)	7. (c)	8. (b)	9. (c)	10. (c)

B. Write short answers.

1. **Enlist the main parts of the human urinary system.**

Ans. The human urinary system consists of a pair of kidneys, a pair of ureters, a urinary bladder and a urethra.

2. **Briefly describe how kidneys control the composition of blood.**

Ans. Kidneys control the composition of blood by the following processes:
(i) Pressure filtration **(ii)** Reabsorption **(iii)** Tubular Secretion
Kidneys control blood composition by first filtering water, salts and wastes from blood in the glomerulus. Then the tubules reabsorb useful substances like glucose, amino acids, water and needed salts back into the blood. Finally, they remove extra wastes and ions through secreation and form urine.

3. **Name the major parts of a nephron.**

Ans. A nephron consists of two major parts:
(i) Renal corpuscle **(ii)** Renal tubule

4. **What materials in diet can cause kidney stones?**

Ans. Presence of more calcium oxalate, calcium and ammonium phosphate in diet (green vegetables, fats, dairy products) and extra amount of vitamin C and D in diet can cause kidney stones.

5. **What do you mean by lithotripsy?**

Ans. Lithotripsy: Lithotripsy is the method for removal of kidney stones. In lithotripsy, non-electric shock waves are fired on kidney from outside. The waves hit the stone and break them into smaller pieces, which pass out through urine.

6. **Define kidney failure. Name the treatments for kidney failure.**

Ans. Kidney failure: When one or both kidneys are not able to perform their function (removing waste materials from blood and then passing them out), the condition is called kidney failure.

Treatments for kidney failure:
Treatments for kidney failure are:
(i) Dialysis which may be Haemodialysis and Peritoneal dialysis.
(ii) Kidney Transplant.

7. **Differentiate between:**
   i. Excretion and osmoregulation
   ii. Renal cortex and renal medulla
   iii. Renal corpuscle and renal tubule
   iv. Pressure filtration and tubular secretion
   v. Haemodialysis and peritoneal dialysis

i. Excretion and osmoregulation.

Ans. Excretion: Excreation is the removal of metabolic wastes such as urea, CO_2 and extra salts from the body.
- Its main organs are kidneys, lungs and skin.

Osmoregulation: Osmoregulation is the control of water and salts balance in the body.
- It is mainly performed by the kidneys.

ii. Renal cortex and renal medulla.

Ans. Renal cortex: Renal cortex is the outer region of the kidney.

Renal medulla: Renal medulla is the inner region of the kidney containing renal pyramids.

iii. Renal corpuscle and renal tubule.

Ans. Renal corpuscle: It is the first part of the nephron where filtration of blood takes place.

- It consists of Bowman's capsule and glomerulus.

Renal tubule: It is the second part of the nephron where reabsorption and secretion occur.

- It consists of proximal convoluted tubule, Loop of henle and distal convoluted tubule.

iv. Pressure filtration and tubular secretion.

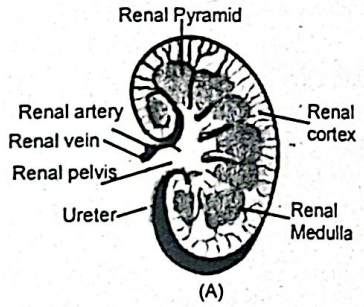
Ans. Pressure filtration: Pressure filtration occurs in glomerulus. Blood is filtered under pressure into Bowman's capsule forming glomerular filtrate. It mainly removes wastes, excess water and salts from blood.

Tubular secretion: It occurs in renal tubule. Extra ions are actively secreted from blood into tubules.

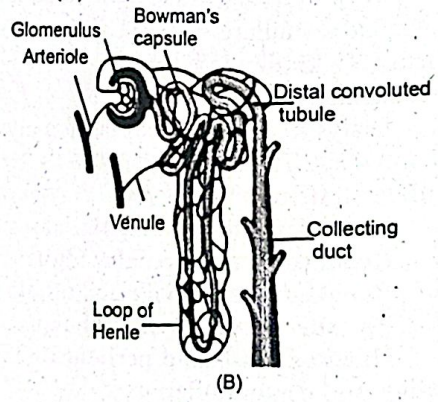
v. Haemodialysis and peritoneal dialysis.

Ans. - **Haemodialysis:** In haemodialysis, the patients blood is pumped through a machine called dialyzer.
- Usually done 3-4 times a week.
- **Peritoneal dialysis:** In peritoneal dialysis, blood is filtered inside the body through the peritoneal membrane
- Can be done continuously at home.

8. Label the parts of the diagrams (A) and (B):



(A)



(B)

D. Write answers in detail.

1. Write a note on the structure of kidney.

Ans. For answer see Q's 2

2. Describe the structure of a nephron and draw a labelled diagram.

Ans. For answer see Q's 3

3. Describe the process of pressure filtration and re-absorption in kidneys.

Ans. For answer see Q's 4

4. What is tubular secretion? How it helps in the removing wastes from blood?

Ans. For answer see Q's 5

5. Write a comprehensive note on kidney stones describing the causes, symptoms and treatments.

Ans. For answer see Q's 7

6. Write down the symptoms and causes of kidney failure.

Ans. For answer see Q's 8

7. Define dialysis and describe the processes of peritoneal dialysis and haemodialysis.

Ans. For answer see Q's 9

D. Write answers in detail.

1. "Along with excretion, kidneys also play role in osmoregulation." Comment on this statement.

Ans. This statement is correct because kidneys not only remove wastes like urea and excess salts (excretion) but also maintain water and salt balance (osmoregulation) in the body.

Osmoregulation is the maintenance of the balance of water and salts in body fluids. Kidneys produce dilute urine when water is excess and concentrated urine when water is low, keeping the blood composition and internal environment stable.

2. How does the nephron ensure that essential nutrients are not lost in urine?

Ans. The nephron uses a process called selective reabsorption. As the filtrate travels through proximal convoluted tubule, nearly all glucose, amino acids and essential salts are actively transported back into the surrounding peritubular capillaries thus nephron ensures that essential nutrients stay in blood while wastes are excreted.

3. Why is long loop of Henle important in the balance of water and salts in body?

Ans. The long loop of henle creates a concentration gradient in the kidney medulla, which allow the nephron to reabsorb more water and salts. This helps to produce concentrated urine when the body needs to conserve water, maintaining the water and salt balance in the body.

4. How can chronic diseases like diabetes lead to kidney failure?

Ans. Chronic diseases like diabetes can damage the blood vessels in the kidneys, reducing their ability to filter blood properly. Over time, this can lead to accumulation of wastes, loss of kidney function and eventually kidney failure.

CHAPTER 5 Coordination

Students Learning Outcomes

After Studying this chapter, students will be able to:

- Describe the nervous system and its role.
- Discuss the central nervous system and peripheral nervous system.
- Outline the types of neurons with diagrams.
- Define a stimulus with examples.
- State that nerve impulses are electrical signals that travel across neuron.
- Define and sketch synapses.
- Introduce neurotransmitters.
- Explain through sketching a diagram the involvement of the nervous system when a person accidentally touches something painfully hot and withdraws their hands as a reflex.
- Explain the endocrine system.
- Identify the major endocrine glands and hormones with their functions.

Subjective Type Questions

Long Questions prepared in the light of new Examination Techniques
(Knowledge, Understanding, Application, Analytical & Conceptual)

Q.1: Define Coordination. Briefly explain the components of coordinated action.

Ans. Coordination: Coordination means integration among different parts of the body and their response to stimuli in order to keep harmony with the environment.

Coordinated action: A coordinated action has five components:

(i) Stimulus **(ii)** Receptor **(iii)** Coordinator **(iv)** Effector **(v)** Response

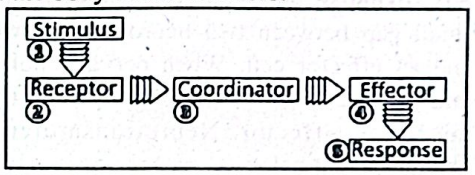
- **Stimulus:** Any change in external or internal enviornment, which can initiate a response in the body is called a stimulus.
  Examples: Touch, light, sound, heat, cold, pressure, infection etc are the stimuli.
- **Receptor:** The organ, tissue or cell which receives stimuli is called the receptor. Receptors send the messages of stimulus to coordinators.
  Example: Ears are the receptors for the stimulus of sound.

> **Q.** Define Synapse.
> **Ans.** The junction between two neurons and between a neuron and another cell is called synapse.

- **Coordinator:** A coordinator receives information from receptors and sends messages to particular organs for proper action.
  Example: In nervous coordination, brain and spinal cord are coordinators. In chemical coordination, endocrine glands are the coordinators.
- **Effectors:** These are the parts of the body which receive coordinator's message and perform specific actions.

Example: In nervous coordination, muscles and glands are the effectors. While in chemical coordination, different tissues of the body act as effectors.

- **Response:** A response is the action performed by effectors, on receiving the message from coordinator.
  Example: Pulling our hand away from something very hot is a response.



5.1 Neurons - The units of Nervous System

Q.2: Describe the structure of a neuron and support your answer with a labeled diagram.

Ans. Neurons: Neurons or nerve cells are the cells that transmit messages in the body in the form of nerve impulses.

Nerve impulse: It is a wave of electrochemical changes that travels across the membranes of neurons.

> **Q.** In central nervous system which parts of neuron form gray and white matter?
> **Ans.** In the Central Nervous System (CNS), myelinated axons form the white matter, and the non-myelinated axons, dendrites and cell bodies form the grey matter

Structure of Neuron:

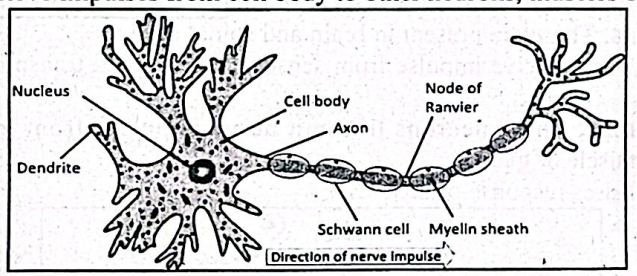
Major structural Components: A neuron consists of three major parts:

(i) Cell body **(ii)** Dendrites **(iii)** Axon

Cell body: The cell body contains the nucleus, other organelles and most of cytoplasm.

Dendrites: Small branches which project from the cell body are called dendrites. They Transmit nerve impulse towards cell body.

Axon: Axon is a long branch from cell body. Its terminal end is further branched. Axon transmits nerve impulses from cell body to other neurons, muscles or glands:



A Model Neuron (Motor)

Cells of neurons: Neurons are supported by specialized cells called neuroglia.

Example: Schwann cells are a type of neuroglia.

Myelin Sheaths: Schwan cells produce insulating covering called myelin sheaths over the membrane of axons.

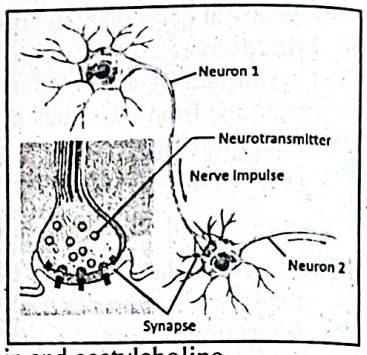
Myelinated and non-myelinated axons: Axons which are covered by myelin sheath are called myelinated. The axons which are not covered with myelin sheath are called non-myelinated.

Nodes of Ranvier: The myelin sheath is interrupted at intervals by small gaps called nodes of Ranvier.

Q.3: Explain briefly Synapse and Neurotransmitters.

Ans. Synapse and Neurotransmitters: A synapse is a small gap between two neurons or between a neuron and an effector cell. When nerve impulse reaches the end of a neuron, it cannot jump directly to the next neuron or effector. Neurotransmitters are special chemicals that help to carry messages across a synapse.

When a nerve impulse reaches the end of a neuron, it releases neurotransmitters. They travel across the synapse and attach to the next neuron or effector cell. It helps the nerve impulse continue its journey. Examples of neurotransmitters include dopamine serotonin and acetylcholine



Q.4: What are the differences and similarities among the three types of neurons.

Ans. Similarities among all types of Neurons:

(i) All types of neurons have same basic structure i.e. dendrites, cell body and axons.
(ii) They are all designed to transmit electrical signals called nerve impulses.
(iii) They all comminucate through synapses and neurotransmitters to pass messages to next cells.
(iv) All neurons are supported by specialized cells, called neuroglia.

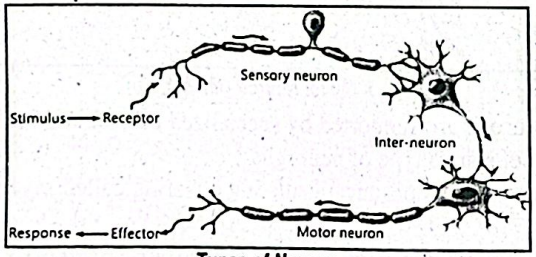
Differences among the types of Neurons:

(i) **Sensory Neurons:** They transmit nerve impulses from receptors to the CNS (central nervous system).
Function: Detect stimuli.

Q. Define Ganglia.
Ans. In certain parts of body, the cell bodies of neurons form groups enveloped by membranes. The groups of cell bodies are called ganglia (Singular: ganglion).

(ii) **Inter-neurons:** These are present in brain and spinal cord.
Function: They receive impulse from sensory neurons and transmit them to motor neurons.

(iii) **Motor neurons:** These neurons transmit nerve impulses from inter-neurons to effectors (muscle or glands).
Function: Causes response or action.



Types of Neuron

Q.5: What are nerves? How different types of nerves are helpful in coordination and communication.

Ans. Nerve: A nerve is a collection of axons that are enveloped by a covering or connective tissue.

Nerves arises from brain and spinal cord make the Peripheral Nervous System (PNS).

Types of Nerves:

(i) **Sensory nerves:** Sensory nerves contain the axons of sensory neurons only.
(ii) **Motor nerves:** Motor nerves contain the axons of motor neurons only.
(iii) **Mixed nerves:** Mixed nerves contain the axons of sensory and motor neurons.

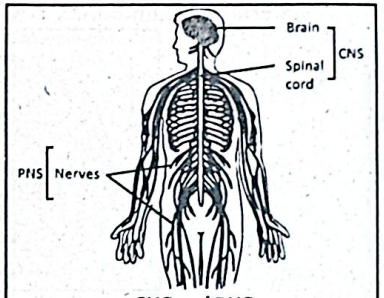
5.2 Divisions of the Nervous System

Q.6: Briefly describe the division of nervous system.

Ans. Divisions of the Nervous System:

There are two major components of nervous system i.e., central nervous system (CNS) and peripheral nervous system (PNS). The CNS comprises of brain and spinal cord. The PNS consists of nerves that arise from brain and spinal cord and spread in different parts of body.

All these components are made of neurons and supporting (neuroglial) cells.



CNS and PNS

Q.7: Write the major functions of the forebrain, midbrain and hindbrain.

Ans. Brain: Brain is present inside cranium (Part of skull).

Meninges: Inside cranium, brain is covered by three layes of membranes, collectively called meninges. Meninges protect the brain from harmful substances.

Ventricles: Brain contains fluid-filled cavities called ventricles. The ventricles of brain are continuous with the central canal of spinal cord. Fluid within ventricles and central canal is called cerebrospinal fluid (CSF).

Q. What is the weight of average adult human brain?
Ans. The average adult human brain weighs 1.4 kg, or about 2% of total body weight. It contains about 100 billion neurons.

Major parts of brain: The brain can be divided into three major parts:

(i) Forebrain (ii) Midbrain (iii) Hindbrain

(i) **Forebrain:** It is the largest area of brain.
Cerebrum: Controls thinking, speaking, problem solving, intelligence, feelings, learning and voluntary actions.
Thalamus: Involved in pain perception and consciousness.
Hypothalamus: Regulates body temperature hunger, thirst, sleep and emotional stress.

(ii) **Midbrain:** Midbrain connects the forebrain and hindbrain. Midbrain enables the body to make adjustments to movements. It is also responsible for sleep/wake, alertness and temperature regulation.

(iii) **Hindbrain:** Hindbrain consists of medulla oblongata, cerebellum and pons.
Cerebellum: Coordinates balance and muscle movement.
Medulla oblongata: Controls autonomic functions such as heartbeat, heartrate, breathing and blood pressure. It also controls reflexes such as vomiting, coughing sneezing.
Pons: Pons regulates alertness, sleep and wakefulness.

Q.8: Write a descriptive note on forebrain also explain its major parts.

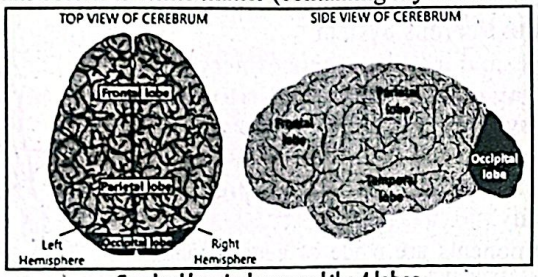
Ans. Forebrain: It is the largest area of brain. Following are the major parts of this

region:

(i) Cerebrum 2. Thalamus 3. Hypthalamus

1. **Cerebrum:** Cerebrum is the largest part of forebrain. A deep groove (longitudinal tissue) divide the cerebrum into right and left cerebral hemispheres.

The upper layer of both hemispheres is highly folded and is called cerebral cortex. It is made of grey matter (containing cell bodies and non-myelinated axons). The material beneath cortex is white matter (containing myelinated axons).



Cerebral hemispheres and the 4 lobes

Each hemisphere is further divided into four lobes.

(i) **Frontal lobe** contains regions for problem solving, judgment, speaking and movements.

(ii) **Parietal lobe** has regions for language and touch.

(iii) **Temporal lobe** contains regions which deal with memory, learning, fellings and hearing.

Q. How messages are received in brain?
Ans. Each hemisphere receives information from the opposite side of the body and sends message to that side. For example, the sensation of a touch on the right hand is received by the left hemisphere.

(iv) **Occipital lobe** has regions for vision and color perception.

Thalamus: Thalamus is a structure wrapped by the cerebrum.

Function: It conveys information coming from receptors to the cerebrum. Thalamus is also involved in pain perception and consciousness.

Hypothalamus: It lies above midbrain and just below thalamus. In human, it is about the size of an almond.

Function: It regulates body temperature, hunger, thirst, sleep and emotional states. It also controls the secretions of the major endocrine gland i.e. pituitary gland.

Q.9: Explain the structure and functions of the midbrain and hindbrain.

Ans. Midbrain: The midbrain is located between forebrain and hindbrain, So, it is a bridge between these two parts.

Function:

(i) Midbrain conveys information between forebrain and hindbrain.

(ii) It enables the body to make adjustments to movements.

(iii) It is responsible for sleep/wake, alertness and temperature regulation.

Hindbrain: Hindbrain consists of three parts. It controls all automatic body functions.

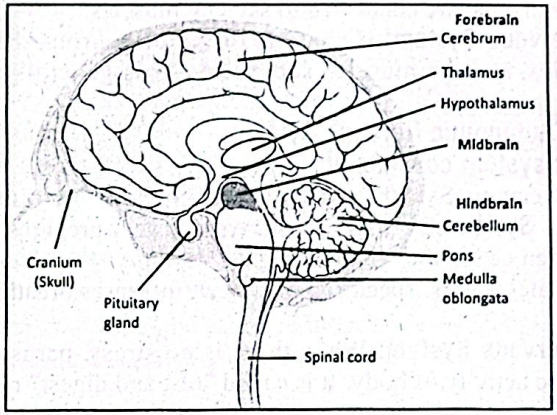
(i) **Medulla oblongata:** It is on the top of the spinal cord. It transmits impulses between spinal cord and the higher parts of brain. It controls autonomic functions such as heartbeat, heart rate, breathing and blood pressure it also controls reflexes such as vomiting, coughing and sneezing.

(ii) **Cerebellum:** It is behind medulla oblongata. It is the second largest part. Its surface is highly folded.

Functions: It coordinates balance and muscle movements.

(iii) **Pons:** It is present on the top of medulla.

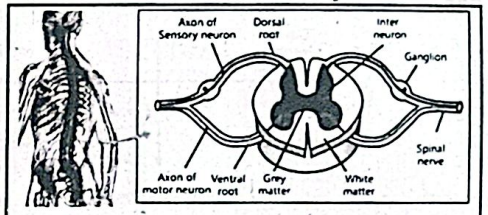
Functions: It makes connection between the spinal cord and cerebellum and between cerebrum and cerebellum. It also regulates alertness, sleep and wakefulness.



Structure of Brain

Q.10:Describe the structure of the spinal cord and draw its structural layout.

Ans. Spinal cord: Spinal cord is a tubular bundle of nerves that starts from brain and extends to lower back. It is located in vertebral column. It is also covered by meninges.



Spinal Cord and Spinal Nerves

Structure of spinal cord: The outer region of spinal cord is made of white matter. The central region is made of grey matter. It is butterfly shaped and surrounds the central canal. Thirty one pairs of spinal nerves arise from spinal cord. All the spinal nerves are mixed nerves because each contains axons of both sensory and motor neurons.

Dorsol root and ventral root: The dorsal root contains sensory axons and a ganglion where cell bodies are located. The ventral root contains axons of motor neurons.

Q. Define brain stem.
Ans. Medulla oblongata, pons, and midbrain connect the rest of brain to spinal cord. They are collectively called brainstem.

Functions of spinal cord:

(i) Spinal cord transmit impulses between brain and body parts.

(ii) It acts as a coordinating centre for some simple reflexes.

Q.11:Explain Peripheral Nervous system (PNS) including sensory and motor pathways.

Ans. Peripheral Nervous System (PNS): It is composed of nerves and their ganglia. Human has 12 pairs of cranial nerves and 31 pairs of spinal nerves.

Cranial and spinal nerves: Some cranial nerves are sensory, some are motor and some are

mixed. All spinal nerves are mixed.

Sensory and Motor Pathways:

Sensory Pathway: Conducting impulses from receptors to CNS.

Motor Pathway: Conducting impulses from CNS to effectors.

Systems of Motor Pathway: Motor Pathway has two systems.

(i) Somatic Nervous System (ii) Autonomic Nervous System

(i) **Somatic Nervous System:** It controls conscious and voluntary actions. It includes all the motor neurons that are connected to skeletal muscles.

(ii) **Autonomic Nervous System:** It consists of motor neurons that are connected to cardiac muscles, smooth muscles and glands. It is generally without conscious control.

Further division of Autonomic Nervous System:

Autonomic nervous system consists of:

- Sympathetic Nervous System
- Parasympathetic Nerous system

Sympathetic Nervous System: Sympathetic nervous system prepares body in emergency situations. This is often called the "fight or flight" response.

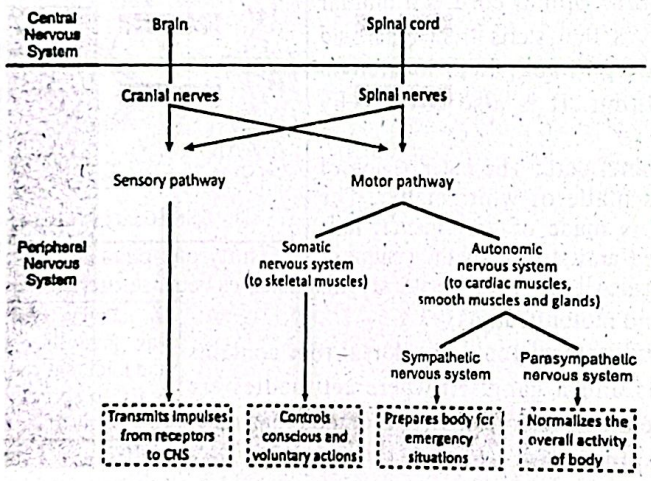
☆ This system dilates pupils, speeds up heartbeat, increases breathing rate and inhibits digestion.

Parasympathetic Nervous System: When there is no stress, parasympathetic nervous system normalizes the activity of body. It is called "rest and digest" response.

☆ It causes pupils to contract, promotes digestion and normalizes the rate of heartbeat.

Q.12:Draw the flow sheet diagram of Divisions of Nervous System.

Ans.



The Divisions of Nervous System

Q.13:What is meant by reflex action? Describe an example of reflex action and identify reflex arc in this example.

Ans. Reflex Action: A reflex action is a quick, involuntary response in which brain is not involves. Reflex actions are controlled by a reflex arc.

Example: We pull our hand away from a hot flame without thinking about it. It is a reflex

action and happens in a following way.

Detection: Skin receptors detect the stimulus of heat.

Transmission: A sensory neuron sends a nerve impulse to an inter-neuron of spinal cord.

Relay: The interneuron transmits the nerve impulses to motor neuron.

Execution: The motor neuron carries the nerve impulse to effector (muscle of arm).

Result: The effectors produces a response by contracting. So, our hand is pulled.

Reflex arc: Reflex arc is the pathway of neurons over which the nerve impulses travel during a reflex action. Using the above example the components identified are:

Receptor: Skin receptors that detect the stimulus heat.

Sensory neurons: Transmits the impulse to the interneuron of the spinal cord.

Interneuron: Found within the spinal cord, it transmits the impulse from sensory neuron to motor neuron.

Motor neuron: Carries the impulse from the spinal cord to the effectors.

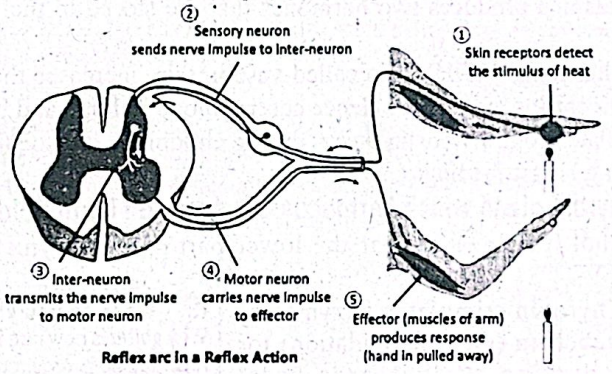
Effector: The muscle that produces the physical response.

Q. Differentiate between voluntary and industary actions.

Ans. When a receptor is stimulated, it sends information to the brain. The higher centres of brain (regions of cerebrum) analyse the information and send messages for appropriate actions. Such actions are under our conscious control and are called voluntary actions while some regions of brain control actions without any conscious control. Such actions are called involuntary actions

Q. What type of action is saliva secretion?

Ans. The secretion of saliva from salivary glands is an involuntary action. When we start chewing food in mouth, brain sends message to salivary glands to secrete saliva. It can also happen when we smell, see or even imagine food.



Reflex arc in a Reflex Action

5.3 Endocrine System

Q.14: Briefly explain the Endocrine System.

Ans. Endocrine System: It is the an other system responsible for coordination in animals. The endocrine system consists of special endocrine glands which produce and secrete hormones. Hormones are the chemicals, released from endocrine gland, which regulate different body functions like growth, reproduction, and glucose level in blood etc.

The endocrine glands do not have ducts to pour their hormones. That is why; they are also called ductless glands. Thev secrete hormones into blood which carries them to different parts of the body.

Q.15:State the hormones of pituitary gland and write their functions.

Ans. Pituitary Gland: It is small gland present in the brain. It is suspended from the hypothalamus by a short stalk. There are two lobes of pituitary gland i.e., anterior lobe and posterior lobe.

> **Q. What do you know about Naseer Soomro?**
> **Ans.** Naseer Soomro was once the tallest man in Pakistan. He was born normal size, but developed pituitary gland problem at the age of 10. His pituitary gland produced excess amounts of the Growth Hormone.

Hormones of Anterior Lobe of Pituitary:

(i) **Growth hormone (GH)** stimulates the growth of muscle, bone, and other tissues. If growth hormone is produced more than normal, it results in extra growth in body. This condition is called gigantism. On the other hand, if growth hormone is produced less than normal, it results in less growth in body. This condition is known as dwarfism.

(ii) **Adreno-cortico-tropic hormone (ACTH)** stimulates the adrenal cortex gland to produce its hormones.

(iii) **Thyroid-stimulating hormone (TSH)** stimulates the thyroid gland to produce its hormone (thyroxine) which controls metabolism.

(iv) **Luteinizing hormone (LH)** is needed for the release of egg cells from ovary (ovulation) in females. In males, it stimulates the testes to produce sex hormones. Anterior lobe also produces follicle stimulating hormone (FSH) that is involved in the reproductive system.

Hormones of Posterior Lobe of Pituitary:

The hypothalamus produces two hormones that are stored in the posterior lobe of pituitary gland.

(i) **Antidiuretic** hormone (ADH), also called vasopressin, increases the reabsorption of water from nephrons in kidneys. Hence control blood volume and blood pressure.

(ii) **Oxytocin** initiates contractions in uterus during childbirth. It also stimulates the flow of milk during breast feeding.

Q.16:Describe thyroid gland which harmones are secreted by thyroid gland?

Ans. Thyroid gland: It is located near the lower part of the larynx. It secretes two hormones:

(i) **Thyroxin:** Thyroxin stimulates enzymes of cellular metabolism (glucose oxidation) for energy production. It increases basal metabolic rate and produces heat.

> **Q. What do you know about goiter? Why goiter is now rare in Pakistan?**
> **Ans.** Iodine is required for the production of thyroxine. If a person lacks iodine in diet, thyroid gland cannot make hormone. In this condition, thyroid gland enlarges. This disorder is called goitre. Goitre is not rare in Pakistan because iodine is added to commercially available table salt.

If thyroxin is less produced: If thyroxin is produced less then the required amount, cellular metabolism slows down. It results in lethargy, weight gain and low heart rate and low body temperature.

If more thyroxin is produced: If more thyroxin is produced than required, cellular metabolism becomes faster. It results in weight loss; high blood pressure, high heart rate and high body temperature.

(ii) **Calcitonin:** Calcitonin stimulates the transfer of calcium ions from blood to bone

where the ealcium ions can be used to generate bone tissue. In this way calcitonin acts to decrease blood calcium levels.

Q.17:Write notes on adrenal glands.

Ans. Adrenal Glands: An adrenal gland is located above each kidney. Each adrenal gland has an inner core, the medulla and an outer layer the cortex.

Adrenal gland parts:

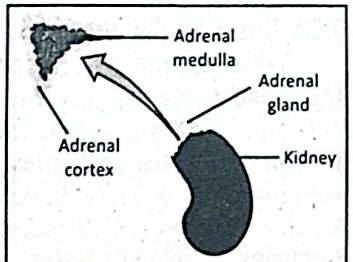
(i) Inner core (ii) Medulla (iii)Cortex

Hormones of adrenal Medulla: Adrenal medulla produces two hormones

(i) Epinephrine (ii) Nor-epinephrine

These hormones take part in emergency response of sympathetic nervous system.

When a person is in emergency, the medulla releases its hormones to prepare the body for "fight or flight" response. These hormones increase heart rate, blood pressure, blood glucose level and blood flow to the heart and lungs. They also stimulate enlargement of the bronchioles and dilation of the pupils.



Parts of adrenal gland

Hormones of adrenal cortex: Adrenal cortex secrete two hormones:

(i) **Cortisol:** It promotes the production of glucose from proteins.

(ii) **Aldosterone:** Aldosterone raises blood pressure and volume by stimulating salt and water retention by the kidneys.

> **Q. Write about the production and deficiency of parathormone?**
> **Ans.** When there is more parathormone, more calcium is transferred from bones to blood. So, the bones become weak. The deficiency of parathormone results in decereased blood calcium level. Itleads to tetany (muscle twitching, cramps and convulsions).

Q18. Write a note on Pancreas.

Ans. Dual nature of pancreas: Pancreas is unique because it functions as two types of glands:

Exocrine glands: It is a part of digestive system, where it plays the role of ducted (exocrine) gland and secretes digestive enzymes.

Islets of Langerhens hormones:

Pancreas also has special cells called islets of Langerhans. These cells function as an endocrine gland. They secerete two hormones:

(i) Insulin (ii) Glucagon

(i) **Insulin:** Insulin lowers the blood glucose level by stimulating body cells to store glucose or use it for energy.

(ii) **Glucagon:** Glucagon stimulates release of glucose from liver into the blood stream.

Q.19:What is Diabetes Mellitus? Describe its types and symptoms.

Ans. Diabetes Mellitus: In diabetes mellitus, the cells are unable to obtain glucose resulting in high blood glucose concentration.

Type-1 Diabetes: In type -1 diabetes mellitus, the pancreas does not produce required insulin. Such patients are treated with daily injections of insulin.

Type-2 Diabetes: In type-2 diabetes, insulin is produced but the target cells do not respond to it. This type of diabetes can be controlled through exercise and diet.

Symptoms: In diabetes, excess glucose inhibits water reabsorption by the kidneys, producing large amounts of urine. It results in dehydration and can cause kidney damage. Excess glucose may also lead to imbalance in water and salt concentration in body. The patients also experience loss of body weight, weakening of muscles and tiredness.

Q. For what purpose blood glucose concentration Test is performed?

Ans. Blood Glucose Concentration (BGC) Test: The amount of glucose in blood is measured by this test It is used to diagnose diabetes. Blood glucose may be measured on a fasting basis (collected after an 8 to 10 hour fast), randomly (anytime) and after a meal. The results of some BGC tests are given here.

Q.20: Describe the endocrine role of the gonads in human body. (OR) Which hormones are secreted by ovaries and testes?

Ans. Gonads: Gonads (ovaries in females and testes in males) are gamete - producing organs. They also produce sex hormones.

Hormones secreted by ovaries: In females, the overies secrete hormones called estrogen and progesterone. These hormones cause the release of egg from the ovary and regulate female secondary sex characteristics (e.g. development of breast).

Hormones secreted by testes: In males, the testes secrete a group of sex hormones called androgens (e.g. testosterone). It regulates male secondary sex characteristics (e.g. growth of hair on face and coarseness of voice etc).

Q.21:Write down the summary of Major Endocrine glands and discuss their functions in human body.

Ans.

Major Endocrine Glands and Their Functions

Gland	Hormone	Functions
Anterior lobe of pituitary	Growth hormone	Regulates development of muscles and bones
	Adrenocorticotropic hormone	Stimulates secretion of cortisol and aldosterone by the adrenal cortex
	Thyroid stimulating hormone	Stimulates the thyroid gland to produce its hormone
	Luteinizing	stimulates the ovary to release egg stimulates the testes to produce sex hormones
Posterior lobe of Pituitary	Antidiuretic hormone	increases the reabsorption of water from nephrons
	Oxytocin	Initiates contractions in uterus during childbirth Stimulates flow of milk from breasts
Thyroid	Thyroxine	Stimulates enzymes of cellular metabolism
	Calcitonin	Decreases blood calcium concentration
Parathyroid	Parathromone	increases blood calcium concentration
Adrenal medulla	Epinephrine Norepinephrine	Initiate body's response to stress and the "fight-or-flight" response to danger
Adrenal cortex	Cortisol	Promotes production of glucose from proteins
	Aldosterone	Promotes salt and water retention by the kidneys
Pancreas	Insulin	Lowers the blood glucose level by stimulating body cells to store glucose or use it
	Glucagon	Stimulates release of glucose from liver into blood
Ovaries	Oestrogen and Progesterone	Cause the release of egg from the ovary and regulate female secondary sex characteristics
Testes	Androgens (Testosterone)	Regulate male secondary sex characteristics

Objective Type Questions

Additional MCQ's

Multiple Choice Questions prepared in the light of new Examination Techniques (Knowledge, Understanding, Application, Analytical & Conceptual)

5.1 Neurons - The unit of nervous system

1. **What is the correct sequence of a coordinated action?**
   (a) Receptor → Stimuli → Coordinator → Response → Effector
   (b) Stimulus → Receptor → Coordinator → Effector → Response
   (c) Coordinator → Stimulus → Receptor → Effector → Response
   (d) Stimulus → Coordinator → Receptor → Response → Effector
2. **The example of stimuli is:**
   (a) Ear (b) Brain (c) Cold (d) Muscle
3. **In chemical coordination, which of the following acts as a coordinator?**
   (a) The Brain (b) Spinal Cord
   (c) Muscles (d) Endocrine Glands
4. **Which parts of the body typically act as effectors in nervous coordination?**
   (a) Eyes and ears (b) Brain and spinal cord
   (c) Muscles and glands (d) Sensory neurons
5. **A coordinated action ends at:**
   (a) Stimulus (b) Response
   (c) Effectors (d) Coordinated action
6. **The cells that transmit messages in the body are known as:**
   (a) Muscle cells (b) Red blood cells (c) White blood cells (d) Nerve cells
7. **A neuron consists of how many major parts?**
   (a) Two (b) Three (c) Four (d) Five
8. **Part of neuron which takes impulses towards cell body is called:**
   (a) Dendrites (b) Axons (c) Ganglia (d) Mylein sheath
9. **The myelin sheath is formed by:**
   (a) Dendrites (b) Axons
   (c) Nodes of Ranvier (d) Schwann cells
10. **In central Nervous system (CNS) myelinated axons form:**
    (a) Grey malter (b) White matter (c) Neuroglia (d) Dendrites

11. **Which of the following is the example of neurotransmitter?**
(a) Ganglia (b) Axon (c) Dendrite (d) Dopamine
12. **Which type of neurons transmit nerve impulses from receptors to the CNS?**
(a) Inter-neurons (b) Motor neurons (c) Sensory neurons (d) Mixed neurons
13. **Inter-neurons are present in:**
(a) Brain (b) Spinal cord (c) Heart (d) Both a and b
14. **The group of cell bodies are called:**
(a) Schwann cells (b) Dendrites (c) Myelin sheath (d) Ganglia
15. **Mixed nerves contain the axons of:**
(a) Sensory neurons (b) Motor neurons (c) Inter-neurons (d) Both a and b

5.2 Divisions of the Nervous System

16. **How many major components of nervous system are present in human body?**
(a) Two (b) Three (c) Four (d) Infinite
17. **All human activities are under the control of:**
(a) Heart (b) Backbone (c) Stomach (d) Brain
18. **Inside cranium, brain is covered by three layers of membranes, collectively called:**
(a) Dendrites (b) Meninges (c) Ventricles (d) Cerebrum
19. **The largest part of Human Brain is:**
(a) Forebrain (b) Midbrain (c) Hind brain (d) Medulla
20. **The weight of average adult human brain is:**
(a) 1kg (b) 1.2kg (c) 1.4kg (d) 1.6kg
21. **How many neurons are present in an adult human brain?**
(a) 10 billion (b) 100 billion (c) 1 trillion (d) 100 million
22. **The largest part of forebrain is:**
(a) Cerebrum (b) Thalamus
(c) Hypothalamus (d) Cerebral hemisphere
23. **Which lobe of brain deals with memory, learning, feelings and hearing?**
(a) Frontal lobe (b) Parietal lobe (c) Temporal lobe (d) Occipital lobe
24. **In humans hypothalamus is about the size of an:**
(a) Date (b) Almond (c) Grain seed (d) walnut
25. **Which part of brain is responsible for sleep/wake, alertness and temperature regulation?**
(a) Forebrain (b) Midbrain (c) Hindbrain (d) Thalamus
26. **This is not the part of the hindbrain:**
(a) Pons (b) Cerebellum
(c) Cerebrum (d) Medulla oblongata
27. **Which part of brain is present on the top of medulla:**
(a) Midbrain (b) Pons (c) Cerebrum (d) Thalamus
28. **A tubular bundle of nerves that starts from brain and extends to lower back:**
(a) Brain (b) Back bone (c) Spinal Cord (d) Endocrine gland
29. **The dorsal root of spinal cord contains:**
(a) Sensory axons (b) Ganglion (c) Motor neurons (d) Both a and b

30. **Ventral root contains axons of:**
(a) Inter neurons (b) Sensory neurons (c) Motor neurons (d) Mixed neurons
31. **How many pairs of cranial nerves are present in humans?**
(a) 10 (b) 12 (c) 31 (d) 22
32. **The number of spinal nerves in humans are:**
(a) 24 pairs (b) 12 pairs (c) 31 pairs (d) 16 pairs
33. **Somatic nervous system controls:**
(a) Voluntary actions (b) Involuntary actions
(c) Both a and b (d) None of these
34. **Which system is activated during emergency situations to prepare the body for action?**
(a) Parasympathic (b) Somatic (c) Sympathetic (d) Central
35. **Actions under our conscious control are analyzed by:**
(a) The spinal cord only (b) The higher centers of brain
(c) The sympathetic nervous system
(d) Motor neurons connected to smooth muscles
36. **A pathway of neurons over which the nerve impulses travel during a reflex action is called:**
(a) Endocrine system (b) Reflex action
(c) Reflex arc (d) Autonomic nervous system

5.3 Endocrine System

37. **Chemicals released from endocrine gland are:**
(a) Mutants (b) Nutrients (c) Hormones (d) Vitamins
38. **The small gland present in brain is:**
(a) Thyroid gland (b) Pituitary gland (c) Adrenal gland (d) Pancreas
39. **If growth hormone is produced more than normal the condition is called:**
(a) Dwarfism (b) Cancer (c) Tuberclosis (d) Gigantism
40. **Which hormone is responsible for the release of egg cells from ovary in females?**
(a) Adreno-cortico-trophic hormone (b) Thyroid stimulating hormone
(c) Luteinizing hormone (d) Growth hormone
41. **Antidiuretic hormone is also known as:**
(a) Luteinizing hormone (b) Thyroxin
(c) Oxytocin (d) Vasopressin
42. **Beneath the larynx in human neck, name of gland is:**
(a) Parathyroid (b) Thyroid (c) Adrenal (d) Pancreas
43. **Hormone increasing the level of calcium ions in blood is:**
(a) Adrenalin (b) Calcitonin (c) Parathormone (d) Oxytocin
44. **The hormone which decreases the level of calcium in blood:**
(a) Calcitonin (b) Thyroxin (c) Parathormone (d) Thyroid
45. **Gland located above each kidney is:**
(a) Parathyroid gland (b) Adrenal gland
(c) Thyoid gland (d) Pituitary gland

46. **Islets of Langerhans was discovered in:**
(a) 1769 (b) 1869 (c) 1896 (d) 1854

47. **Which hormone is also called emergency hormone?**
(a) Insulin (b) Oxytocin (c) Calcitonin (d) Adrenalin

48. **Insulin lowers:**
(a) Calcium level (b) Oxygen level (c) Blood glucose (d) Iodine level

49. **After 8–10 hours fast the normal blood glucose level is:**
(a) 70 to 99mg (b) 140 to 160mg (c) 100 to 125 mg (d) 140 to 200mg

50. **Testes and ovaries are called:**
(a) Glands (b) Gonads (c) Gametes (d) Embryo

51. **Male gonads are called:**
(a) Sperms (b) Eggs (c) Ovaries (d) Testes

52. **Ovaries secrete hormone:**
(a) Androgen (b) Testosterone (c) Estrogen (d) Oxytocin

53. **Which hormone develops the male secondary sex characters?**
(a) Testosterone (b) Estrogen (c) Progesterone (d) Insulin

Answers

1.	(b)	2.	(c)	3.	(d)	4.	(c)	5.	(b)	6.	(b)	7.	(b)
8.	(a)	9.	(d)	10.	(b)	11.	(d)	12.	(c)	13.	(d)	14.	(d)
15.	(d)	16.	(a)	17.	(d)	18.	(b)	19.	(a)	20.	(c)	21.	(b)
22.	(a)	23.	(c)	24.	(b)	25.	(b)	26.	(c)	27.	(b)	28.	(c)
29.	(d)	30.	(c)	31.	(b)	32.	(c)	33.	(a)	34.	(c)	35.	(b)
36.	(c)	37.	(c)	38.	(b)	39.	(d)	40.	(c)	41.	(d)	42.	(b)
43.	(c)	44.	(a)	45.	(b)	46.	(b)	47.	(d)	48.	(c)	49.	(a)
50.	(b)	51.	(d)	52.	(c)	53.	(a)						

Additional Short Questions

Short Answer Questions prepared in the light of new Examination Techniques (Knowledge, Understanding, Application, Analytical & Conceptual)

5.1 Neurons - The unit of nervous system

1. **Write down the names of the components of coordinated action with correct sequence.**

Ans. A coordinated action has five components.
1. Stimulus **2.** Receptor **3.** Coordinator **4.** Effector **5.** Response

2. **Differentiate between a receptor and an effector.**

Ans. **Receptor:** The organ, tissue or cell which receives stimuli is called the receptor.
For example: Ears are the receptors for the stimulus of sound.
Effector: These are the parts of the body which receives coordinator's message and perform specific actions.
For example: In nervous coordination muscles and glands are the effectors.

3. **Explain the role of a "coordinator" in both nervous and chemical coordination.**

Ans. A coordinator receives information from receptors and send messages to particular organs for proper actions.
- In nervous coordination brain and spinal cord are coordinators.
- In chemical coordination, endocrine glands are the coordinators.

4. **What is meant by response?**

Ans. **Response:** A response is the action performed by effectors, on receiving the message from coordinator.
For example: Pulling our hand away from something very hot.

5. **What is coordination? Where coordination occurs?**

Ans. **Coordination:** Coordination means integration among different parts of the body and their response to stimuli in order to keep harmony with the environment.
Coordination occurs in all multicellular organisms.

6. **Differentiate between Nerve cells and nerve impulse.**

Ans. **Nerve cells:** Neurons or nerve cells are the cells that transmit messages in the body in the form of nerve impulse.
Nerve impulse: Nerve impulse is a wave of electrochemical changes that travel across the membranes of neurons.

7. **What are the major parts of neuron?**

Ans. A neuron consists of three major parts i.e., cell body, dendrites and axons.

8. **What is the function of myelin sheath in neuron?**

Ans. Myelin sheath is an insulator so the membrane coated with this sheath does not conduct nerve impulse. In such a neuron impulses jump over the areas of myelin going from node to node.

9. **What are nodes of Ranvier?**

Ans. **Nodes of Ranvier:** The myelin sheath is interrupted at intervals by small gaps called nodes of Ranvier.

10. **What do you know about synapse and neurotransmitter?**

Ans. **Synapse:** A synapse is a small gap between two neurons or between a neuron and an effector cell.
Neurotransmitter: Neurotrasmitters are special chemicals that help to carry messages across a synapse.
Examples of neurotransmitters are dopamine and serotonin.

5.2 Divisions of the Nervous System

11. **How would you distinguish between central nervous system (CNS) and peripheral nervous system (PNS)?**

Ans. **Central Nervous System (CNS):** CNS comprises of brain and spinal cord.
Peripheral Nervous System (PNS): PNS consists of nerves that arise from brain and spinal cord and spread in different parts of body.

12. **How brain is protected?**

Ans. Brain is present inside cranium (part of skull). Inside cranium brain is covered by

three layer of membranes collectively called meninges. Meninges protect the brain from harmful substances.

13. Describe shortly about forebrain.

Ans. Forebrain is the largest part of brain. There are three major parts of forebrain.

(i) Cerebrum **(ii)** Thalamus **(iii)** Hypothalamus

Forebrain is responsible for thinking, memory and reasoning. It receives sensory information. It acts as coordinator.

14. Describe briefly the composition and location of cerebrospinal fluid (CSF).

Ans. The cerebrospinal fluid (CSF) is a fluid found within ventricles (fluid filled cavities) of the brain. These ventiricles are continuous with the central canal. CSF is the specific fluid that fills both these brain cavities and the central canal of the spinal cord.

15. Cerebral hemisphere is divided into how many lobes name them.

Ans. Each hemisphere is divided into four lobes.

(i) Frontal lobe **(ii)** Parietal lobe
(iii) Temporal lobe **(iv)** Occipital lobe

16. Write down the functions of frontal lobe and parietal lobe.

Ans. Frontal lobe: This lobe contains regions for problem solving, judgment, speaking and movements.

Parietal lobe: Parietal lobe has regions for language and touch.

17. Discuss the functions of temporal lobe.

Ans. The temporal lobe contains regions which deal with memory, learning, feelings and hearing.

18. Write a short note on midbrain.

Ans. Midbrain: It is located between forebrain and hindbrain.

Function:

☆ Midbrain enables the body to make adjustments to movements.
☆ It is responsible for sleep/wake, alertness and temperature regulation.

19. Differentiate medulla oblongata, cerebellum and pons on the basis of their functions.

Ans. Medulla oblongata:

☆ It transmits nerve impulses between spinal cord and higher parts of brain.
☆ It controls autonomic functions such as heartbeat, heart rate, breating and blood pressure.

Cerebellum:

☆ It coordinates balance and muscle movements.

Pons:

☆ It regulates alertness, sleep and wakefulness.

20. Discuss a few lines about spinal cord.

Ans. Spinal cord: It is a tubular bundle of nerves that starts from brain and extends to lower back. It is located in vertebral column. It is covered by meanings. It acts as coordinating centre for simple reflexes. It is butterfly shaped and surrounds the

central canal.

21. What do you know about the dorsal root and the ventral root of spinal cord?

Ans. Dorsal root: The dorsal root contains sensory axons and a ganglion where cell bodies are located.

Ventral root: Ventral root contains axons of motor neurons.

22. Which pathways are followed by cranial and spinal nerves?

Ans. The cranial and spinal nerves make two pathways.

(i) Sensory Pathway (Conducting impulses from receptors to CNS)
(ii) Motor Pathway (Conducting impulses from CNS to effectors)

23. How would you differentiate between sympathetic and parasympathetic nervous system.

Ans.

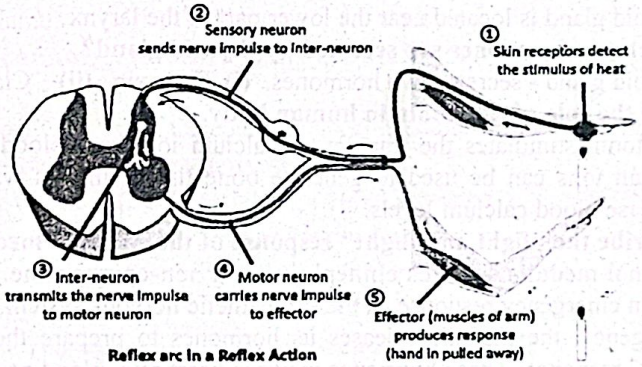
Sympathetic Nervous System	Parasympathetic Nervous System
Sympathetic Nervous system prepares body in emergency situations.	Parasympathetic nervous system normalizes the body activity.
It is often called "fight or flight."	It is often called "rest and digest".
This system dilates pupils, speeds up heartbeat, increase breathing rate and inhibits digestion.	It causes pupils to contract, promotes digestion and normalizes the rate of heartbeat.

24. Define reflex arc.

Ans. Reflex arc: A reflex arc is the pathway of neurons over which the nerve impulses travel during a reflex action.

25. Draw a pathway of reflex action.

Ans.



Reflex arc in a Reflex Action

5.3 Endocrine System

26. What are hormones?

Ans. Hormones: Hormones are the chemicals, released from endocrine gland, which regulate different body functions like growth, reproduction and glucose level in blood etc.

27. Why endocrine glands are called ductless glands?

Ans. The endocrine glands do not have ducts to pour their hormones. That is why; they

are called ductless glands.

28. Name the hormones secreted by anterior lobe of pituitary gland.

Ans. The anterior lobe of pituitary gland secretes:

(i) Growth Hormone (GH) **(ii)** Adreno-cortico-trophic hormone (ACTH)
(iii) Thyroid stimulating hormone (TSH)
(iv) Luteinizing Hormone (LH)

29. Write any two effects of Growth hormone on human body.

Ans. Gigantism: If growth hormone is produced more than normal, it results in extra growth in body. This condition is called gigantism.

Dwarfism: If growth hormone is less produced than normal it results in less growth in body. This condition is known as dwarfism.

30. What is the role of Luteinizing hormone in human body?

Ans. Luteinizing hormone (LH): It is needed for the release of egg cells from ovary (ovulation) in females. In males, it stimulates the testes to produce sex hormones.

31. Which two hormones are secreated by hypothalamus? Write down their functions.

Ans. The hypothalamus produces two hormones that are stored in posterior lobe of pituitary gland.

(i) Antidiuretic hormone (ADH): It is also called vasopressin, it increases the reabsorption of water from nephrons in kidneys.

(ii) Oxytocin: It initiates contractions in uterus during childbirth. It also stimulate the flow of milk during breast feeding.

32. Where thyroid gland is located?

Ans. Thyroid gland is located near the lower part of the larynx.

33. Which two hormones are secreted by thyroid gland?

Ans. Thyroid gland - secretes two hormones. **(i)** Thyroxin **(ii)** Clacitonin

34. State the role of calcitonin in human body.

Ans. Calcitonin stimulates the transfer of calcium ion from blood to bone, where the calcium ions can be used to generate bone tissue. In this way calcitonin acts to decrease blood calcium levels.

35. Describe the "fight and flight" response of the Adrenal medulla.

Ans. Adrenal medulla secretes epinephrine and non-epinephrine. The hormones take part in emergency response of the sympathetic nervous system. When a person is in emergency, the medulla releases its hormones to prepare the body for "fight or flight" response. These hormones increase heart rate, blood pressure, blood glucose level etc.

36. Write the function of insulin and glucagon.

Ans. Insulin: Insulin lowers the blood glucose level by stimulating body cells to store glucose or use it for energy.

Glucagon: Glucagon stimulates release of glucose from liver into the bloodstream.

37. Differentiate between type-1 and type-2 diabetes.

Ans. Type-1 diabetes:

☆ In this type, the pancreas does not produce required insulin.

☆ Such patients are treated with daily injections of insulin.

Type-2 diabetes:

☆ In this type, insulin is produced but the target cells do not respond to it.

☆ This type of diabetes can be controlled through exercise and diet.

38. What are gonads? Write down the names of male and female gonads.

Ans. Gonads: Gonads are gamete-producing organs. They also produce sex hormones. Testes are male gonads and ovaries are female gonads.

39. Name the hormones secreted by Ovaries and testes.

Ans. Hormones secreted by ovaries: Ovaries secrete hormones called estrogen and progesterone.

Hormones secreted by testes: Testes secret a group of sex hormones called androgens (e.g. testosterone).

Exercise Questions (Solved)

A. Select the correct answers for the following questions.

1. Schwann cells are the supporting cells for neurons. They make:
(a) Cell body (b) Axon (c) Myelin sheath (d) Dendrites

2. Which part of the brain controls balance while riding a bicycle?
(a) Cerebrum (b) Medulla (c) Cerebellum (d) Spinal cord

3. Which part of brain is responsible for sensations of temperature, hunger, thirst, and sleep?
(a) Hypothalamus (b) Thalamus (c) Pons (d) Cerebellum

4. If a patient cannot remember things, which part of their brain may be affected?
(a) Cerebrum (b) Cerebellum (c) Medulla (d) Spinal cord

5. During danger, which system activates quickly?
(a) Parasympathetic (b) Skeletal (c) Endocrine (d) Sympathetic

6. Why are reflex actions faster than normal actions?
(a) Brain processes them quickly (b) Brain is not involved
(c) Signals move slower (d) They need thinking

7. Which of these acts as exocrine as well as endocrine gland?
(a) Pituitary (b) Thyroid (c) Adrenal (d) Pancreas

8. The chemical messengers of the endocrine system are called;
(a) Neuro Transmitters (b) Hormones (c) Neurons (d) Enzymes

9. What could happen if hormone of parathyroid gland were missing?
(a) Low calcium levels (b) High blood sugar
(c) Weakmuscles (d) Poor digestion

10. Which endocrine gland prepares the body for "fight or flight" response?
(a) Thyroid (b) Pituitary (c) Adrenal (d) Pancreas

Answers

1. (c)	2. (c)	3. (a)	4. (a)	5. (d)
6. (b)	7. (d)	8. (b)	9. (a)	10. (c)

B. Write short answers.

1. Define stimulus with examples.

Ans. Stimulus: Any factor in external or internal environment, which can initiate a response in the body is called a stimulus.

For example: Touch, light, sound, infection etc. are the stimuli.

2. Differentiate between sensory, motor, and inter-neurons.

Ans. Ans. Sensory neurons: Sensory neurons transmit nerve impulses from receptors to the CNS.

Inter-neurons: Inter-neurons receive impulses from sensory neurons and transmit them to motor neurons.

Motor neurons: Motor neurons transmit nerve impulses from inter-neurons to effectors (muscles or glands).

3. Define reflex action and the reflex arc.

Ans. Ans. Reflex action: Reflex actions are the quick involuntary response in which brain is not involved.

Reflex arc: Reflex arc is the pathway of neurons over which the nerve impulses travel during a reflex action.

4. Differentiate between the following:

(a) Dendrite and axon **(b) Cerebrum and Cerebellum**

(c) Thalamus and Hypothalamus

Ans. (a) Dendrite and axon

Dendrites: Small branches which project from the cell body are called dendrites. They transmit nerve impulses towards cell body.

Axon: Axon is a long branch from cell body. Its terminal end is further branched. Axon transmits nerve impulses from cell body to other neurons, muscles and glands.

(b) Cerebrum and Cerebellum

Cerebrum: Cerebrum is the largest part of forebrain

☆ A deep groove divides the cerebrum into right and left cerebral hemispheres.

☆ Cerebrum involves in problem solving, speaking, learning, hearing, vision and color perception.

Cerebellum:

☆ It is the second largest part.

☆ Its surface is highly folded.

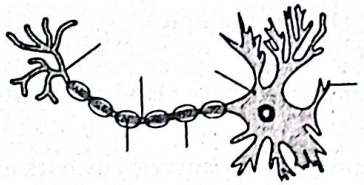
☆ It coordinates balance and muscle movements.

(c) Thalamus and Hypothalamus:

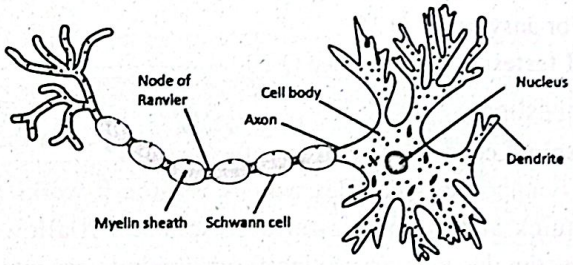
Ans. Thalamus: Thalamus is a structure wrapped by the cerebrum. It conveys information coming from receptors to the cerebrum. Thalamus is also involved in pain perception and consciousness.

Hypothalamus: Hypothalamus lies above midbrain and just below thalamus. It regulates body temperature, hunger, thirst, sleep and emotional states. It also controls the secretions of pituitary gland.

5. Identify the diagram and labels the different parts.



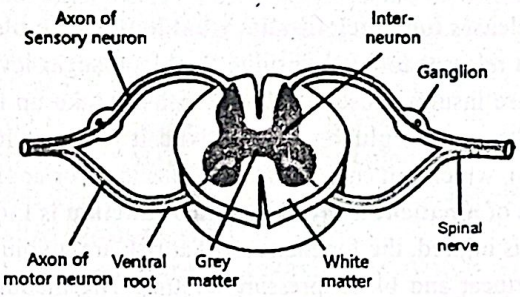
Ans.



Motor Neuron

6. Identify the following diagram, and locate the white matter, grey matter, three types of neuron, and ganglia.

Ans.



Spinal cord and spinal nerves

C. Write answers in detail.

1. Describe the structure of a neuron and support your answer with a labelled diagram.

Ans. For answer see Q's 02

2. What are the differences and similarities among the three types of neurons?

Ans. For answer see Q's 04

3. Write the major functions of the forebrain, midbrain, and hindbrain.

Ans. For answer see Q's 07

4. What is meant by reflex action? Describe an example of reflex action and identify the reflex arc in this example.

Ans. For answer see Q's 13

5. State the hormones of the pituitary gland and write their functions.

Ans. For answer see Q's 15

6. Write notes on adrenal glands, pancreas, ovaries and testes.

Ans. Adrenal glands: For answer see Q 17

Pancreas: For answer see Q 18

Ovaries and testes: For answer see Q 20

D. Inquisitive questions

1. Why is the spinal cord important in reflex actions?

Ans. Spinal cord is important in Reflex actions because it works as a primary control centre for quick and automatic reflex responses. It allows for an immediate response to a stimulus without waiting for the brain to process it. This significantly reduces time and protect the body for injury such as pulling your hand away from something hot.

2. Why is adrenaline called an "emergency hormone"?

Ans. Adrenalin (epinephrine) is released by the adrenal glands during emergency or high-stress, "fight or flight" situations. It prepares the body for an emergency by increasing heart rate, boosting blood flow to muscles and raising blood glucose levels to provide an instant burst of energy.

3. If pancreas releases too much insulin, what happens to blood sugar?

Ans. If the pancreas releases to much insulin, the blood sugar level drops too low. This happens because insulin causes the body's cells to take up more glucose from the blood. When too much glucose is removed it leads to low blood sugar level (hypoglycemia), which can cause weakness, dizziness or confusion.

4. If the medulla of a patient is injured, which function is most at risk?

Ans. If the medulla is injured, the functions most at risk are involuntary activities such as breathing, heartbeat and blood pressure control. The medulla controls these vital functions, so damage to it can seriously affect breathing, heart rate and blood pressure, It can be fatal.

CHAPTER 6 Reproductive System

Students Learning Outcomes

After Studying this chapter, students will be able to:

- Describe the role of hormones in both male and female sexual development.
- Describe the process of gametogenesis and fertilization.
- Identify, on diagrams of the parts of male reproductive system and describe their functions.
- Identify, on diagrams of the parts of female reproductive system and describe their functions.
- Explain AIDS as an example of sexually transmitted diseases.

Subjective Type Questions

Long Questions prepared in the light of new Examination Techniques (Knowledge, Understanding, Application, Analytical & Conceptual)

6.1 Formation of Gametes and Fertilization

Q.1: (a) Define sexual reproduction. Briefly explain Gonads.

Ans. All organisms have the ability to produce new individual or their kind. Sexual reproduction involves the joining (fusion) of male and female gametes.

Formation of Gametes and fertilization: Animals have special organs i.e., gonads where special cells called gametes are made. The gonads in male animals are called testes (Singular: testis) where male gametes i.e., sperms are produced. The gonads in females are called ovaries where female gametes i.e., egg cells or ova are produced.

(b) What is meant by gametogenesis? How they are formed?

Ans. The process of formation of gametes is called gametogenesis. It involves the cell division meiosis. Meiosis results in a reduction of the number of chromosomes in gametes to haploid (1 n) as compared to the diploid (2n) number in other body cells

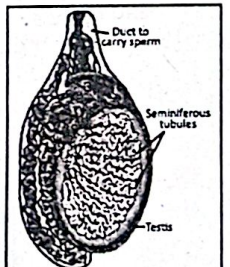
Q.2: Describe the process of spermatogenesis in detail.

Ans. Spermatogenesis: The process of formation of male gametes konwn as sperms is called spermatogenesis.

Site of production: Spermatogenesis takes place within the seminiferous tubules located inside the testes.

Hormonal Control: This process is regulated by two hormones.

- **Follicle Stimulating Hormone (FSH):** FSH is produced by the anterior pituitary gland and along with testosterone stimulate sperm production.
- **Testosterone:** Testosterone is produced by testes.



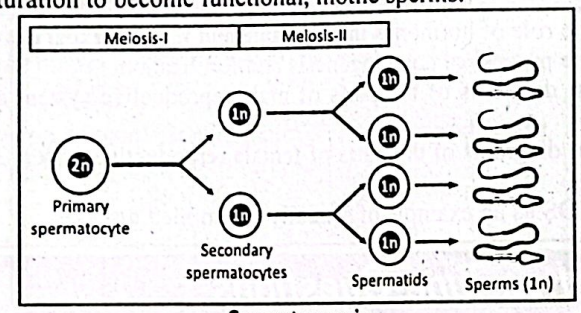
A testis

Stages of Spermatogenesis: The transformation form a diploid cell to mature sperms occurs in several distinct phases:

Primary Spermatocyte (2n): The process begins with diploid gamete mother cell.

Each secondary spermatocyte divides again during the second meiotic division. This result in the formation of four haploid (1n) cells called spermatids.

Maturation: In the final stage, the immature, non-motile spermatids undergo structural changes and maturation to become functional, motile sperms.



Spermatogenesis

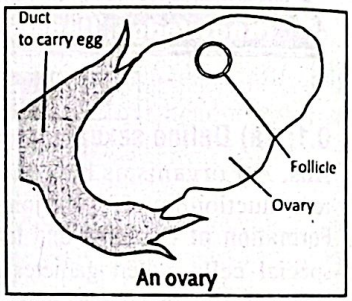
Q.3: Discuss the process of Oogenesis.

OR Write a note on formation of female gametes.

Ans. Oogenesis: The formation of female gametes (egg or ovum) is called oogenesis.

Occurance: It occurs in ovary in a small, fluid-filled sac called follicle.

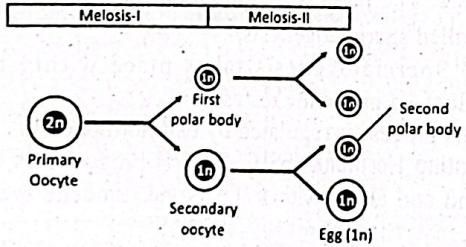
Hormone responsible: Follicle stimulating hormone released by the anterior of pituitary gland stimulates the formation of ovum in follicle.



An ovary

Stages of Oogenesis:

- In follicle, there is a diploid gamete mother cell called primary oocyte.
- It divides by meiosis.
- As a result of first meiotic division, two haploid cells are produced. The larger cell is called secondary oocyte while the smaller cell is called first polar body.
- In meiosis-II, secondary oocyte produces two haploid cells i.e. a second polar body and an egg.



Oogenesis

Q.4: Define fertilization. Write down the steps followed by fertilization.

Ans. Fertilization: Fertilization means the fusion of male and female gametes to form a new cell called zygote. In humans, fertilization occurs inside the body of female after the release of egg cell from ovary i.e., ovulation. Fertilization occurs in the following steps:

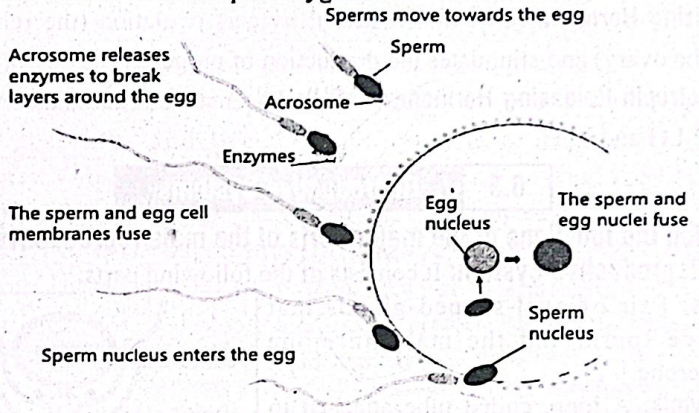
(i) Sperms move towards the egg due to the chemical signals released by the egg or surrounding cells.

(ii) The acrosome, a cap-like structure on the head of the sperm, releases enzymes which digest the egg's outer layers, allowing the sperm to reach the egg cell membrane.

(iii) The sperm and egg cell membranes fuse. This fusion triggers reactions in egg. So, the egg's outer layers become impermeable for more sperms.

(iv) After fusion of membranes, the sperm nucleus enters the egg.

(v) Both nuclei fuse to form a diploid zygote.



Steps of fertilization

6.2 Role of Hormones in sexual development

Q.5: Describe the role of hormones in male sexual development.

Ans. Hormones in Male Sexual Development:

Testosterone: It is primarily produced by the testes. It initiates and regulates the development of male secondary sexual characteristics during puberty, such as deepening of the voice, growth of facial and body hair, and increased muscle mass. It is also essential for spermatogenesis.

Follicle-Stimulating Hormone (FSH): In males, it is produced by the anterior pituitary gland. It stimulates the testes to produce sperm.

Luteinizing Hormone (LH): It is produced by the anterior pituitary gland. It stimulates the production of testosterone by the testes.

Gonadotropin-Releasing Hormone (GnRH): It is released by hypothalamus. It stimulates the pituitary to release LH and FSH.

Q.6: Describe the role of hormones in female sexual development.

Ans. Following hormones are involved in female sexual development.

Osterogens: It is primarily produced by the ovaries. It initiates and regulates the development of female secondary sexual characteristics during puberty, such as breast development, widening of the hips, and the onset of menstrual cycles. It also regulates the female reproductive cycle.

Progesterone: It is produced by the ovaries after ovulation. It prepares the uterus walls for implantation of fertilized egg. It maintains pregnancy by preventing contractions of the uterus.

Follicle-Stimulating Hormone (FSH): It is released from anterior pituitary gland. In females, it stimulates the growth of follicles, which contain the eggs. It also stimulates the production of oestrogen.

Luteinizing Hormone (LH): In females, it triggers ovulation (the release of an egg from the ovary) and stimulates the production of progesterone.

Gonadotropin-Releasing Hormone (GnRH): In females, it stimulates the pituitary to release LH and FSH.

6.3 Reproductive Systems

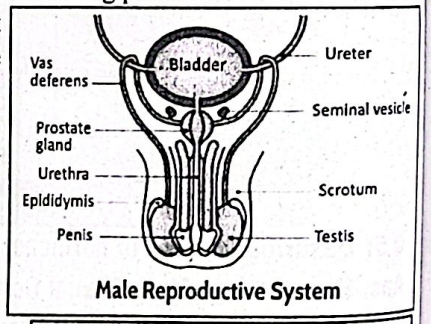
Q.7: Describe the functions of the major parts of the male reproductive system.

Ans. Male Reproductive System: It consists of the following parts:

Testes: Pair of oval-shaped glands that produce sperm and the male hormone testosterone.

Epididymis: A long, coiled tube attached to each testis where sperm are stored and matured.

Vas deferens: A muscular tube that transports mature sperm from the epididymis to the urethra.



Male Reproductive System

Seminal vesicles: Two small glands behind the bladder that produce a sugary fluid to nourish sperm.

Prostate gland: A walnut sized gland below the bladder that adds protective fluid to the semen.

> **Q.** How many sperms produced in one day?
> **Ans.** The average male produces around 1,500 sperm per second - that's over 100 million perday!

Urethra: A tube inside the penis that carries semen and urine to the outside of the body

Penis: An external organ that transfers sperm into female reproductive tract.

Q.8: Describe the functions of the major parts of the female reproductive system.

Ans. Female Reproductive System: It consists of the following main parts:

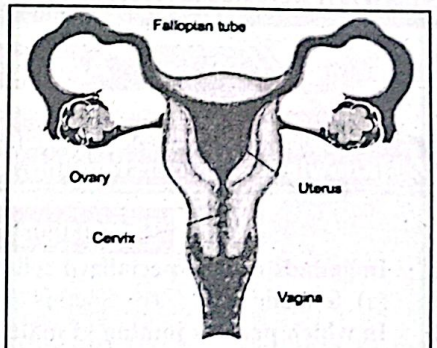
1. **Ovaries:** Pair of almond-shaped glands that produce eggs (ova) and hormones like oestrogen and progesterone.

Fallopian Tubes: Two tubes that transport eggs from the ovaries to the uterus. Fertilization occurs here.

Uterus: A hollow, muscular organ where a fertilized egg implants and develops into a foetus during pregnancy.

Cervix: The lower, narrow part of the uterus.

Vagina: A muscular canal that connects the cervix to the outside.



Female Reproductive System

6.4 Sexually Transmitted Diseases

Q.9: Explain AIDS as an example of sexually transmitted diseases.

Ans. Acquired Immunodeficiency Syndrome (AIDS):

AIDS is a serious and life-threatening disease caused by the Human Immunodeficiency Virus (HIV). HIV primarily attacks and weakens the body's immune system, making it difficult to fight infections and certain cancers.

Causes: The HIV spreads mainly through unprotected sexual contact, sharing of contaminated needles, transfusion of infected blood, and from an infected motherto her child during childbirth or breastfeeding.

> **Q.** What is the reason for increasing HIV cases in Pakistan?
> **Ans.** In Pakistan, HIV cases are increasing, particularly due to unsafe injections, unregulated blood transfusions, and lack of awareness among youth.

Signs and Symptoms: Early signs and symptoms are fever, fatigue, swollen lymph nodes, and skin rashes. As the disease progresses, individuals become vulnerable to severe infections, weight loss, chronic diarrhoea, pneumonia, and certain cancers.

Treatment: There is no cure for AIDS. Antiretroviral therapy (ART) can control the virus, strengthen the immune system, and help patients live longer, healthier lives.

Q.10: What are sexually transimtted discases? Explain.

Ans. Sexually transmitted diseases (STDs) are the infections which are primarily transmitted through sexual contact. These diseases can be caused by bacteria, viruses, or parasites. STDs often affect the genital, urinary, and reproductive organs. Common STDs include HIV/AIDS, syphilis, herpes etc. Many STDs can be asymptomatic, meaning individuals may carry and spread the infection without showing signs.

If STDs are left untreated, they can lead to serious health complications such as infertility, organ damage, and other infections.

Objective Type Questions

Additional MCQ's

Multiple Choice Questions prepared in the light of new Examination Techniques
(Knowledge, Understanding, Application, Analytical & Conceptual)

6.1 Formation of Gametes and Fertilization

1. **In gonads which specialized cells are formed?**
   (a) Somatic cells (b) Sperms (c) Eggs (d) Gametes
2. **In which process joining of male and female gametes takes place?**
   (a) Asexual reproduction (b) Sexual Reproduction
   (c) Fertilization (d) Budding
3. **The process of formation of gametes in animals is known as:**
   (a) Fertilization (b) Mitosis (c) Gametogenesis (d) Embryogenesis
4. **The type of cell division responsible for reducing the number of chromosomes in gametes to haploid (1n) is:**
   (a) Mitosis (b) Binary Fission (c) Meiosis (d) Budding
5. **In males, the specific organs where gametes are produced are called:**
   (a) Ovaries (b) Seminiferous tubules (c) Testes (d) Follicles
6. **Spermatogenesis occurs in:**
   (a) Follicles (b) Seminiferous tubules
   (c) Oocytes (d) Pituitary gland
7. **Which hormone produced by the anterior pituitary gland, stimulates the production of sperms?**
   (a) Testosterone (b) Insulin
   (c) Oestrogen (d) Follicle Stimulating Hormone (FSH)
8. **How many haploid spermatids are formed from a single diploid primary spermatocyte after Meiosis-I?**
   (a) One (b) Two (c) Three (d) Four
9. **Which of the following cell is diploid (2n)?**
   (a) Secondary spermatocyte (b) Spermatid
   (c) Primary oocyte (d) Second polar body
10. **The process of formation of female gametes (egg or ovum) is called:**
    (a) Spermatogenesis (b) Oogenesis (c) Fertilization (d) Ovulation
11. **Oogenesis occurs in:**
    (a) Seminiferous tubules (b) Ovary (c) Bladder (d) Ureter
12. **Which gland release follicle stimulating hormone?**
    (a) Anterior lobe of pituitary gland (b) Posterior lobe of pituitary gland
    (c) Adrenal gland (d) Thyroid gland
13. **Primary oocyte divides by:**
    (a) Mitosis (b) Meiosis (c) Budding (d) Binary fission

14. **The immediate result of fusion of a male and a female gamete is:**
    (a) Embryo (b) Zygote (c) Ocyte (d) Ovulation
15. **In humans, where does fertilization typically occurs?**
    (a) Outside the body (b) Inside the ovary
    (c) Inside body of female (d) In the acrosome
16. **What guides the sperm to move towards the egg cell?**
    (a) Physical touch (b)Chemical signals (c) Gravity (d) Temperature changes
17. **A cap-like structure on the head of sperm is:**
    (a) Ovule (b) Ocyte (c) Zygote (d) Acrosome
18. **The process of releasing an egg cell from the ovary is known as:**
    (a) Fertilization (b) Fusion (c) Digestion (d) Ovulation

6.2 Role of Hormones In Sexual Development

19. **Which hormone is primarily responsible for the development of male secondary sexual characteristics such as deepening of the voice and facial hair?**
    (a) Follicle-stimulating hormone (b) Luteinizing Hormone
    (c) Testosterone (d) Oestrogen
20. **What is the specific function of Luteinizing Hormone (LH) in the male reproductive system?**
    (a) Stimulates the growth of body hair (b)Stimulates the production of testosterone
    (c) Stimulates the testes (d) Initiates the deepening of voice
21. **Which part of the brain releases Gonadotropin-Releasing Hormone (GnRH)?**
    (a) Pons (b) Cerebellum (c) Hypothalamus (d) Thalamus
22. **Oestrogen is primarily produced by:**
    (a) Pituitary gland (b) Ovaries (c) Hypothalamus (d) Uterus
23. **Which hormone is responsible for the development of female secondary sexual characteristics?**
    (a) Testosterone (b) Oestrogen (c) Luteinizing hormone (d) Gonadotropin
24. **_____ is produced by the ovaries after ovulation.**
    (a) Follicle-Stimulating Hormone (b) Luteinizing Hormone
    (c) Progesterone (d) Oestrogen
25. **Function of Follicle stimulating Hormone (FSH):**
    (a) Maitain pregnancy (b) Stimulate the production of oestrogen
    (c) Stimulates the production of testosterone
    (d) Prepares uterus walls for implantation
26. **Which hormone stimulates the pituitary to release LH and FSH in females?**
    (a) Progesterone (b) Oestrogen (c) Testosterone (d) Gonadotropin

6.3 Reproductive Systems

27. **How many sperms are produced by males per second?**
    (a) 1000 (b) 1200 (c) 1400 (d) 1500
28. **Following are the parts of male reproductive system except:**
    (a) Testes (b) Penis (c) Epididymis (d) Cervix
29. **A long, coiled tube attached to each testis is known as:**
    (a) Vas deferns (b) Seminal vesicles (c) Epididymis (d) Urethra

30. **Two small glands behind the bladder that produce a sugary fluid are:**
(a) Prostate glands (b) Testes (c) Vas deferens (d) Seminal vesicles

31. **Which is an external organ that transfers sperm into female reproductive tract?**
(a) Testes (b) Penis (c) Vagina (d) Ovaries

32. **Pair of almond-shaped glands that produce egg (ora) and hormones are:**
(a) Cervix (b) Uterus (c) Ovaries (d) Testes

33. **Where does fertilization typically occurs in the female reproductive system?**
(a) Ovaries (b) Fallopian Tubes (c) Uterus (d) Vagina

34. **Which organ is described as a hollow, muscular structure where a fertilized egg implants and develops?**
(a) Cervix (b) Fallopian tube (c) Ovary (d) Uterus

35. **A muscular canal that connects the cervix to outside is:**
(a) Penis (b) Cervix (c) Epididymis (d) Vagina

6.4 Sexually Transmitted Diseases

36. **What is the primary cause of spread of HIV?**
(a) Coughing (b) Sexual contact
(c) Using public rest rooms (d) Insect bites

37. **STDs can be caused by:**
(a) Viruses (b) Bacteria (c) Parasites (d) All of these

38. **STDs often affect:**
(a) Genital organs (b) Urinary organs (c) Reproductive organs (d) All of these

39. **What is the significant factor in the increase of HIV causes in Pakistan?**
(a) Lack of specialized hospitals (b) Genetic predispositions
(c) Unsafe injections (d) Over-consumptions of antibiotics

40. **A serious and life threatening disease caused by HIV is:**
(a) AIDS (b) Hepatitis (c) Cancer (d) Typhoid

41. **HIV virus primarily attacks the:**
(a) Digestive system (b) Respiratory system
(c) Immune system (d) Urinary system

42. **All are causes of AIDS except:**
(a) Unprotected sexual contact (b) Sharing contaminated needles
(c) Transfusion of infected blood (d) Allergens

43. **The possible treatment of AIDS is:**
(a) Antibiotics (b) Vaccines (c)Medications (d)Antiretroviral therapy

Answers

1.	(d)	2.	(b)	3.	(c)	4.	(c)	5.	(c)	6.	(b)	7.	(d)
8.	(b)	9.	(c)	10.	(b)	11.	(b)	12.	(a)	13.	(b)	14.	(b)
15.	(c)	16.	(b)	17.	(d)	18.	(d)	19.	(c)	20.	(b)	21.	(c)
22.	(b)	23.	(b)	24.	(c)	25.	(b)	26.	(d)	27.	(d)	28.	(d)
29.	(c)	30.	(d)	31.	(b)	32.	(c)	33.	(b)	34.	(d)	35.	(d)
36.	(b)	37.	(d)	38.	(d)	39.	(c)	40.	(a)	41.	(c)	42.	(d)
43.	(d)												

Additional Short Questions

Short Answer Questions prepared in the light of new Examination Techniques (Knowledge, Understanding, Application, Analytical & Conceptual)

6.1 Formation of Gametes and Fertlization

1. **Differentiate between sexual and asexual reproduction.**

Ans. **Sexual reproduction:** Sexual reproduction involves the joining (fusion) of male and female gametes.
The offspring show variation.
Asexual Reproduction: Asexual reproduction involves only one parent and no gamete fusion.
The offsprings are genetically identical to the parents.

2. **Name the gonads of males and females.**

Ans. The gonads in males are called testes.
The gonads in females are called ovaries.

3. **Define the process of gametogenesis.**

Ans. **Gametogenesis:** The process of formation of gametes is called gametogenesis.

4. **Name the parts of testis and ovaries where the gamete formation takes place.**

Ans. **In testis:** The process of gametes formation takes place in seminiferous tubules of testis.
In ovaries: The formation of female gametes (egg or ovum) occurs in a small, fluid-filled sac called a follicle.

5. **How spermatids are formed?**

Ans. In seminiferous tubules, the diploid gamete mother cells called primary spermatocytes are present. Each primary spermatocytes divides by meiosis-I and forms two haploid secondary spermatocytes. Each secondary spermatocyte divides by meiosis-II. In this way, four haploid spermatids are formed.

6. **Which hormone stimulates the production of sperms?**

Ans. Sperms production is stimulated by Follicle Stimulating Hormone (FSH) and testosterone.

7. **What is a follicle and what is its role in oogenesis?**

Ans. **Follicle:** A follicle is a small, fluid-filled sac located in the ovary.
Role of follicle: It is the specific site where the diploid gamete mother cell (primary oocyte) develops into an egg.

8. **How does the division of primary oocyte differ from that of a primary spermatocyte?**

Ans. A primary spermatocyte divides into four equal spermatids while the primary oocyte undergoes unequal division. Meiosis results in one large secondary oocyte and one small polar body.

9. What are the final products of Meiosis-II in the female reproductive system?

Ans. In meiosis-II secondary oocyte produces two haploid cells a second polar body and an egg.

10. Define fertilization.

Ans. Fertilization: Fertilization means the fusion of male and female gametes to form a new cell called zygote.

11. What is the function of acrosome during fertilization?

Ans. The acrosome, a cap-like structure on the head of the sperm, releases enzymes which digest the egg's outer layers, allowing the sperm to reach the egg cell membrane.

12. Write down the steps of fertilization.

Ans. Steps of fertilizations: Fertilization occurs in following steps:

(i) Sperms move towards the egg.
(ii) Acrosome releases enzymes to break layers around the egg.
(iii) The sperm and egg cell membranes fuse.
(iv) Sperm nucleus enters the egg.
(v) The sperm and egg nuclei fuse.

6.2 Role of Hormones in Sexual Development

13. Discuss the role of testosterone in male sexual develpment.

Ans. Role of testosterone: Testosterone initiates and regulates the development of male secondary sexual characteristics during puberty. It is also essential for spermatogenesis.

14. Name the hormones which play their role in Male Sexual Development.

Ans. Hormones in Male Sexual Development:

(i) Testosterone
(ii) Follicle-Stimulating Hormone (FSH)
(iii) Luteinizing Hormone (LH)
(iv) Gonadotropin-Releasing Hormone (GnRH)

15. State the function of follicle stimulating hormone and luteinizing hormone.

Ans. Follicle-Stimulating Hormone (FSH): FSH stimulates the testes to produce sperm.

Luteinizing Hormone (LH): It stimulates the production of testosterone by the testes.

16. Write down the function of Gonadotropin-Releasing Hormone (GnRH) in females.

Ans. Gonadotropin-Releasing Hormone stimulates the pituitary to release LH and FSH.

6.3 Reproductive Systems

17. Name the parts of the male reproductive system.

Ans. Male reproductive system consists of following parts:

(i) Testes **(ii)** Epididymis **(iii)** Vas deferens
(iv) Seminal vesicles **(v)** Prostate gland **(vi)** Urethra **(vii)** Penis

18. What do you know about Epididymis and Vas deferens?

Ans. Epididymis: It is a long coiled tube attached to each testis where sperm are stored and matured.

Vas deferens: A muscular tube that transports mature sperm from the epididymis to the urethra.

19. What is prostate gland and urethra?

Ans. Prostate gland: It is a walnut sized gland below the bladder that adds protective fluid to the semen.

Urethra: A tube inside the penis that carries semen and urine to the outside of the body.

20. Name the parts of the female reproductive system.

Ans. Female reproductive system consists of the following parts:

(i) Ovaries **(ii)** Fallopian tubes **(iii)** Uterus **(iv)** Cervix **(v)** Vagina

21. In which part of female reproductive system fertilization occurs?

Ans. Fertilization occurs in the fallopian tubes.

22. Define cervix.

Ans. Cervix is the lower narrow part of the uterus.

23. Write down the functions of ovaries and fallopian tubes.

Ans. Ovaries: Ovaries are pair of almond shaped glands that produces eggs (ova) and hormones like oestrogen and progesterone.

Fallopian tubes: These are tubes that transports egg from the ovaries to the uterus. Fertilization occurs here.

6.4 Sexually Transmitted Diseases

24. What are sexually transmitted diseases? Write down their causes and effects.

Ans. Sexually Transmitted Diseases: STDs are the infections which are primarily transmitted through sexual contact.

Causes of STDs: These diseases can be caused by bacteria, viruses or parasites.

Effects of STDs: STDs often affect the genital, urinary and reproductive organs.

25. How STDs can be asymptomatic?

Ans. STDs can be asymptomatic meaning individuals may carry and spread the infection without showing symptoms.

26. What happens if STDs are left untreated?

Ans. If STDs are left untreated, they can lead to serious health complications such as infertility, organ damage and other infections.

27. Which virus causes AIDS?

Ans. AIDS is caused by the Human Immunodeficiency Virus (HIV).

28. Describe two ways through which HIV can be transmitted?

Ans. HIV can be transmitted through unprotected sexual contact and sharing of contaminated needles.

29. Discuss the signs and symptoms of AIDS.

Ans. Signs and Symptoms of AIDS: Signs and symptoms of AIDS are fever, fatigue, swollen lymph nodes, weight loss, chronic diarrhoea, pneumonia and certain cancers.

30. How AIDS can be treated?

Ans. There is no cure for AIDS. Antiretroviral therapy (ART) can control the virus, strengthen the immune system and help patients live longer, healthier lives.

Exercise Questions (Solved)

A. Select the correct answers for the following questions.

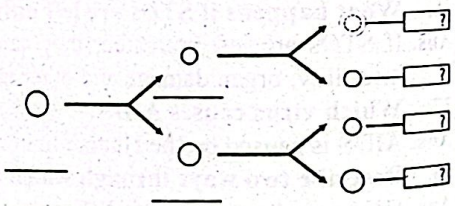
1. **In which part of the body oogenesis takes place?**
   a) Oviduct b) Ovary c) Uterus d) Fallopian tube
2. **Which of the following is NOT a part of the male reproductive system?**
   a) Testes b) Uterus c) Epididymis d) Prostate gland
3. **Which hormone directly triggers ovulation?**
   a) Oestrogen b) Progesterone
   c) Luteinizing hormone (LH) d) Follicle-stimulating hormone (FSH)
4. **Which hormone is responsible for the development of male secondary sexual characteristics?**
   a) FSH b) Oestrogen c) Testosterone d) LH
5. **What is the function of acrosome?**
   a) Guides the sperm towards egg cell
   b) Releases enzymes that help sperm penetrate the egg's outer layers
   c) Activates the egg for fertilization
   d) Helps in the fusion of sperm and egg nuclei
6. **What is the function of the Fallopian tubes?**
   a) Site of fertilization b) Storage of eggs
   c) Secretion of oestrogen d) Transport of sperm to testes
7. **Which hormone is primarily responsible for the development of female secondary sexual characteristics?**
   a) Oestrogen b) Testosterone c) Progesterone d) FSH

Answers

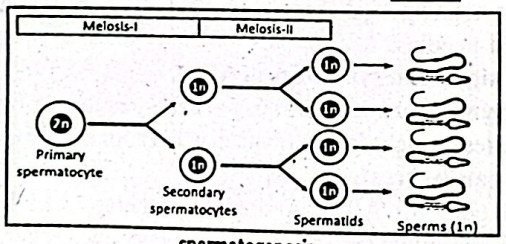
1. (b) 2. (b) 3. (c) 4. (c) 5. (b) 6. (a) 7. (a)

B. Write short answers.

1. **Complete the chart of spermatogenesis by mentioning the names of cells and number of chromosomes (2n or 1 n).**

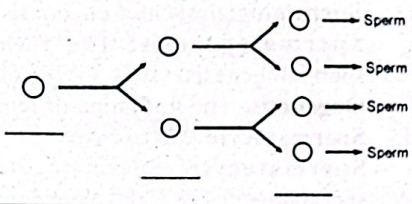


Ans.

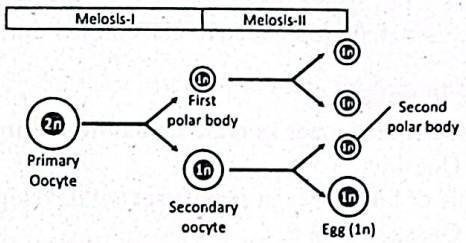


spermatogenesis

2. **Complete the chart of oogenesis by mentioning the names of cells and number of chromosomes (2n or 1 n).**



Ans.



Oogenesis

3. **Name the parts of the testis and ovary where gamete formation takes place.**

Ans. **In testis:** The process of gametes formation takes place in seminiferous tubules of testis.

In ovaries: The formation of female gametes (egg or ovum) occurs in a small, fluid-filled sac called a follicle.

4. **What happens to the egg after it is released from the ovary?**

Ans. After the egg is released from the ovary, it enters the fallopian tube, where it may be fertilized by a sperm. If it is not fertilized, the egg breaks down and is removed from the body during mensturation.

5. **Compare spermatogenesis and oogenesis in terms of the number of gametes produced.**

Ans. Spermatogenesis produces four functional sperms from one parent cell.
Oogonium produces only one functional ovum (egg) and three polar bodies from one parent cell.

6. **Describe two major ways through which HIV can be transmitted.**

Ans. HIV can be transmitted through unprotected sexual contact and sharing of contaminated needles.

7. **Differentiate between;**
   i. Oestrogen and progesterone ii. Spermatogenesis and oogenesis
   iii. Spermatocyte and oocyte

Ans. i. Oestrogen and progesterone:

Osterogen: Oestrogen produced mainly by the follicles in the ovary.

- It regulates the development of secondary sexual characteristics during puberty.
- It regulates the female reproductive cycle.

Progesterone: It is produced mainly by the ovaries after ovulation.

- It prepares the uterus walls for implantation of fertilized egg.
- It maintains pregnancy by preventing contractions of the uterus.

ii. **Spermatogenesis and oogenesis:**
Spermatogenesis: The formation of male gametes (sperms) is called spermatogenesis.
Oogenesis: The formation of female gametes (egg or ovum) is called oogenesis.

iii. **Spermatocyte and oocyte:**
Spermatocyte: Spermatocyte is a male reproductive cell formed during spermatogenes is. It develops into sperm.
Oocyte: Oocyte is female reproductive cell formed during oogenesis. It develops into an egg.

C. Write answers in detail.

1. Describe the role of hormones in male sexual development.

Ans. For answer See Question. No. 5

2. Describe the role of hormones in female sexual development.

Ans. For answer See Question. No. 6

3. Describe the process of spermatogenesis.

Ans. For answer See Question. No. 2

4. Describe the functions of the major parts of male reproductive system.

Ans. For answer See Question. No. 7

5. Describe the functions of the parts of female reproductive system.

Ans. For answer See Question. No. 8

6. Explain AIDS as an example of sexually transmitted diseases.

Ans. For answer See Question. No. 9

D. Inquisitive Questions

1. Why only one egg is usually produced from one primary oocyte?

Ans. Only one cell is produced because during oogenesis the cytoplasm divides unequally, forming one large ovum and three small polar bodies.
The ovum keeps most of the cytoplasm so it has enough nutrients for early embryo development, while the polar bodies do not develop further.

2. How does the structure of a sperm cell relate to its function?

Ans. Head: Head contains the nucleus with 23 chromosomes and an acrosome that releases enzymes to helps the sperm to penetrate the egg.
Middle piece: It has many mitochondria to provide energy for movement.
Tail (flagellum): It helps the sperm to swim towards the egg.

3. What steps can individuals take to prevent HIV transmission?

Ans. A individual should:fo

- Use safe sexual practices
- Using sterile needles, avoid sharing needles.
- Get tested and encourage partners or family members to get tested when needed.
- Follow medical advice and safety guidlines.
- Pregnant women living with HIV can take specific medication.

CHAPTER 7 Inheritance

Students Learning Outcomes

After Studying this chapter, students will be able to:

- Sketch the structure of chromosomes.
- Define genotype and phenotype, allele, homozygous, heterozygous, dominant, recessive
- Illustrate Mendelian inheritance laws through monohybrid and dihybrid cross.
- Outline function of DNA as carrier of hereditary information
- Describe briefly the structure of RNA as single stranded macromolecule made of nucleotides with nitrogenous base overhangs.
- Outline the function of RNA as aid in converting hereditary information into useful proteins.
- Outline how information in the DNA is converted to information on RNA and then into proteins.

Subjective Type Questions

Long Questions prepared in the light of new Examination Techniques (Knowledge, Understanding, Application, Analytical & Conceptual)

7.1 Structure of Chromosome

Q.1: Breifly explain Inheritance. Where does the information stored within a cell?

Ans. An organism is made up of many structural and behavioural characteristics. Organisms are able to pass these characteristics to their offspring. Offspring get some characteristics from each parent. They also get characteristics which are not present in their parents. The process by which characteristics are transferred from parents to offspring is called inheritance or heredity.

Every cell in the body contains the instructions for making characteristics. Inside the cells, this information is present in long molecules of Deoxyribonucleic acid (DNA). The cells use the information in their DNA to produce particular proteins. The proteins made by a cell determine its characteristics.

Q2. Write a note on the structure and composition of chromosome.

Ans. Chromatin:

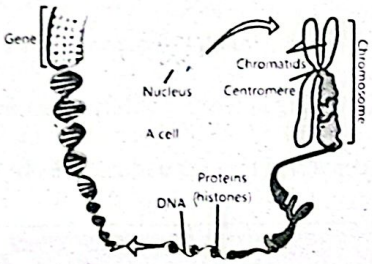
- In eukaryotes, chromosomes are made up of thread-like material called chromatin.
- Chromatin consists of DNA and histone proteins.
- In chromatin, a long molecule of DNA is wrapped around the bundles of histones.

Structural changes: When a cell is not dividing, chromatin appears as fine, thin threads, scattered in the nucleus. During cell division, chromatin coils and makes compact structures of chromosomes.

Anatomy of Chromosome:

- A chromosome is rod-shaped and consists of two identical halves. Each half of chromosome is called a chromatid.
- The two chromatids of a chromosome are attached at a point called centromere.
- The centromere holds the two chromatids together until they separate during cell division.

Chromosome in Prokaryotes: The prokaryotes have only one chromosome which is made of a circular DNA molecule. It is not bound by a nuclear envelop and is present in cytoplasm.



Chemical Composition of chromosome

Q. What does it mean for a body cell to be diploid (2n)?

Ans.
- All the cells of the organisms of a species have a constant number of chromosomes.
- The body cells are diploid (2n). It means that the chromosomes are in pairs (homologous chromosomes).

Q. How DNA ensures that daughter cells receive the correct information?

Ans. Before cell division, the DNA makes a copy of itself. In this way, chromatids are formed. When the cell divides, each daughter cell receives one chromatid from each chromosome.

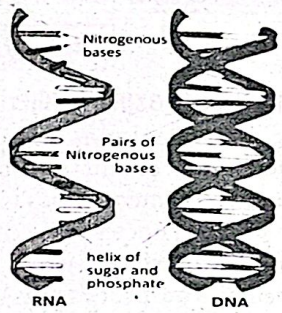
7.2 DNA and RNA

Q.3: Compare DNA and RNA on the basis of their structure.

Ans. DNA:

Deoxyribonucleic acid is a double-stranded, helical molecule. Each nucleotide of DNA is made of a deoxyribose sugar, a phosphate group and a nitrogenous base (adenine, thymine, cytosine or guanine). The two strands are held together by base pairing (A with T, and C with G)

RNA: RNA is single-stranded chain of nucleotides. Its nucleotide have a sugar called ribose, a phosphate group and nitrogenous base (adenine, uracil, cytosine and guanine).



RNA and DNA

Q4. Describe how DNA and RNA take part in the synthesis of a protein.

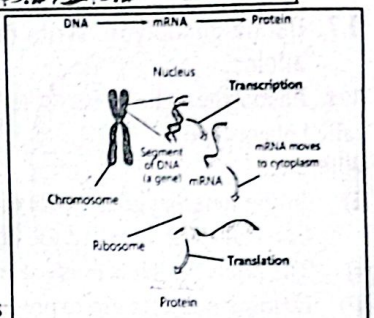
Ans: Functioning of DNA and RNA:

Gene: A gene is a segment of DNA that has the information for making a particular protein. The following processes occur for making a proteins according to the information present in a gene:

(i) The segment of DNA (gene) acts as a template. A type of RNA, called messenger RNA (mRNA), is synthesised according to this template. In this way, DNA transfers the information to mRNA. This process is called transcription. mRNA acts as aid in converting information into proteins.

(ii) The mRNA moves out into the cytoplasm. Here, ribosome attaches with mRNA. The ribosome joins amino acids according to the information present on mRNA. In this way, a protein is produced. This process is called translation.

This concept of the working of a gene is called central dogma and is symbolized as;



Working of a gene (central dogma)

Q5. Discuss the relationship between Gene and allele.

Ans. Gene: A gene is a segment of DNA that contains the information for a hereditary character. For example, the gene for eye colour, gene for earlobe shape, and gene for the hair texture. Genes are located on chromosomes. The locations or positions of genes on chromosomes are known as loci (singular locus). Like chromosomes, genes are also in pairs.

Allel: The alternate (different) forms of a gene are called its alleles.

The pair of genes on homologous chromosomes may not contain identical genes. The homologous chromosomes may have different forms of the same gene. For example, the gene of hair colour can have two alleles. One allele makes hair pigments while the other does not make pigments.

Q.6: What is Genotype? Describe its types.

Ans. Genotype: The combination of the alleles is called genotype.

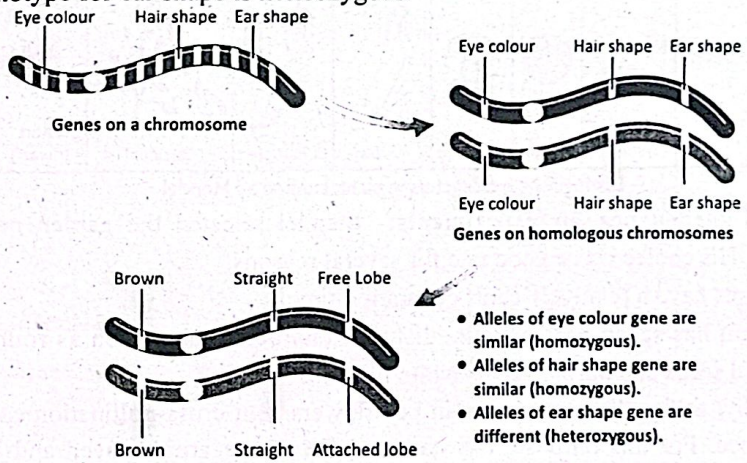
Homozygous genotype: The genotype, in which both alleles are same is called homozygous.

Heterozygous genotype: The genotype in which both alleles are different, is called heterozygous.

Homozygous example:

When both alleles of the eye colour gene are similar, the genotype is homozygous.

Heterozygous example: The alleles of the ear shape gene make different characteristics. One allele makes free earlobe while the other allele makes attached earlobe. It means that the genotype for ear shape is heterozygous.



Alleles and genotype

Q.7: Define phenotype. Write down the difference between dominant and recessive alleles.

Ans. Phenotype: The observable outcome of genotype, in the form of characteristic, is called phenotype.

Difference:

(i) In the heterozygous genotype one allele may mask the working of the other allele. Such an allele is called the dominant allele.

(i) The allele which is masked (not expressed) is called recessive allele.

(ii) Dominant alleles are expressed by Capital letters the recessive alleles are expressed by lowercase letters.

(i) In the pair Tt, the dominant alleles T is responsible for tall plant the recessive allele t is for dwarf plant.

7.3 Mendel's Law of Inheritance

Q8. Why Mendel choose pea plants for his genetic experiment?

Ans. Gregor Mendel was an Austrian monk, working in monastery. From 1856 to 1863, he performed experiments on garden pea. The results of these experiments cleared the views of heredity.

	Flower colour	Seed colour	Seed shape	Pod colour	Pod shape	Flower position	Plant height
Character 1	Purple	Yellow	Round	Green	Flat	Axial	Tall
Character 2	White	Green	Wrinkled	Yellow	Constricted	Terminal	Short (dwarf)

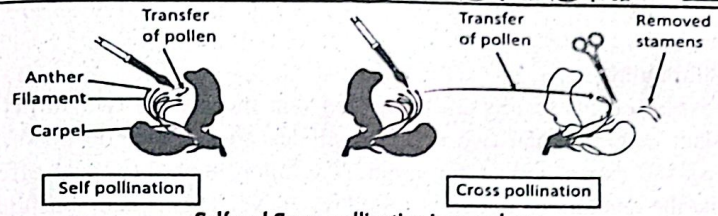
Distinguishing characters in plant, studied by Mendel

Selection of garden pea for experiments: Mendel selected the garden pea for his experiments. His choice was a good one for several reasons.

(i) Pea plants have a relatively short generation time.

(ii) Pea plant has seven easily distinguishable characteristics, such as round versus wrinkled seeds and purple versus white flowers.

(iii) Normally, self-pollination occurs in pea flowers. But cross-pollination can also be performed. For this purpose, the stamens of a flower are removed and its pollen grains are transferred to the flower of another plant.



Self and Cross-pollination in pea plants

Q9. What is monohybrid cross? Give the experimental verification of monohybrid cross.

Ans. True Breeding Plant:

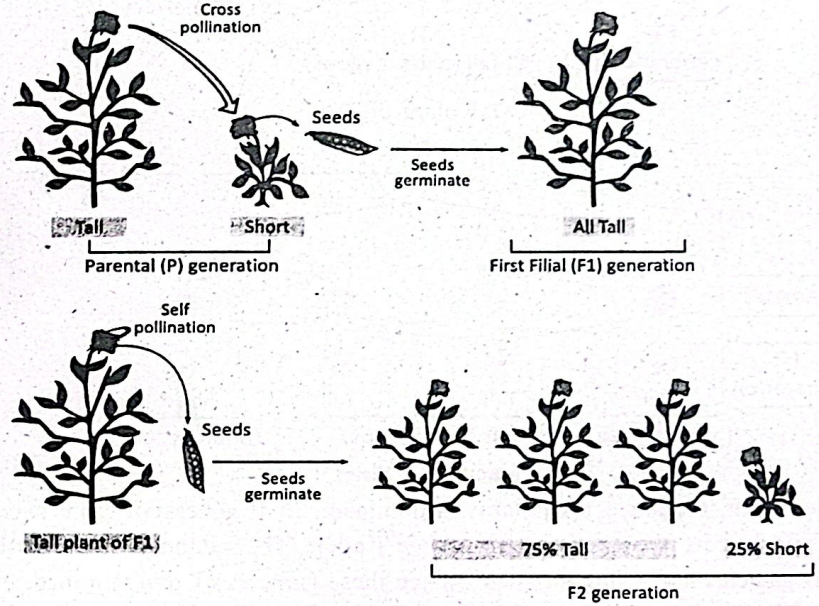
If a plant with a characteristic produces offspring with the same characteristic on self pollination, it means that the plant is true breeding for that characteristic.

Monohybrid cross: It is a cross in which only one characteristic is studied.

Experiment: Mendel crossed a true-breeding tall plant with a true-breeding short plant. He called these true-breeding parents as P generation. The offspring of this cross were called the first filial generation, or F1 generation. All offspring of F1 were all tall.

> **Q.** What did most people beleive about inheritence during mendel's time?
> **Ans.** During Mendel's time, most people believed that characteristics of both parents are mixed together and are passed to offspring. For example, if a short plant is crossed with a tall plant, the offspring will be medium sized.

Next, Mendel allowed the tall plants of F1 generation to self-pollinate. He called the next generation as F2 generation. He found that 75% of F2 offspring were tall, while 25% were short.



Mendel's experiment

Mendel found the same results over and over again with all the characteristics.

Conclusions

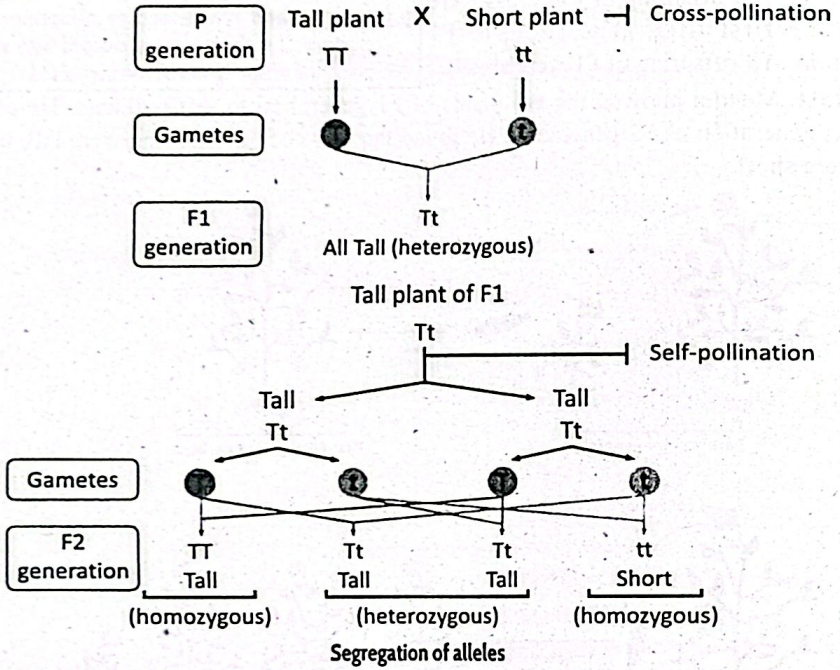
Concept of Dominance:

Mendel explained his results and proposed that there were two forms (alleles) of the gene of plant height. When two different alleles are together in an organism, one allele may mask the expression of the other. The allele that shows its effect is called dominant, while the one that is hidden is called recessive. This is called as the concept of dominance.

Q.10: Discuss how Mendel proved the law of segregation.

Ans. Law of Segregation:

Mendel explained that each parent has two alleles of a gene. But a parent can only pass one allele to the offspring. During gamete formation, the alleles separate and there is only one allele in each gamete. When fertilization occurs, the offspring has the two alleles again. It is called the law of segregation. It states that "the alleles are separated during gamete formation and each gamete receives one or the other allele, but not both".



Segregation of alleles

In pea plant, the allele for tallness is dominant. In P generation, one parent had alleles TT. Each of its gametes received a single T allele. The second parent had alleles tt. Each of its gametes had a single t allele. When these gametes (T and t) joined, the new plants in F1 plant received the pair as Tt. So, all F1 plants were tall. When self-pollination was allowed in F1 tall plant, the results were:

- 25% of the F2 generation received both alleles of shortness i.e., tt. So, they were short.
- 50% plants of F2 received one T allele and one t. So, they were tall (Tt).
- 25% plants of F2 received both alleles of tallness i.e., TT. So, they were also tall.

Q11. Describe Mendel's experiment on two-character inheritance and state the law he proposed.

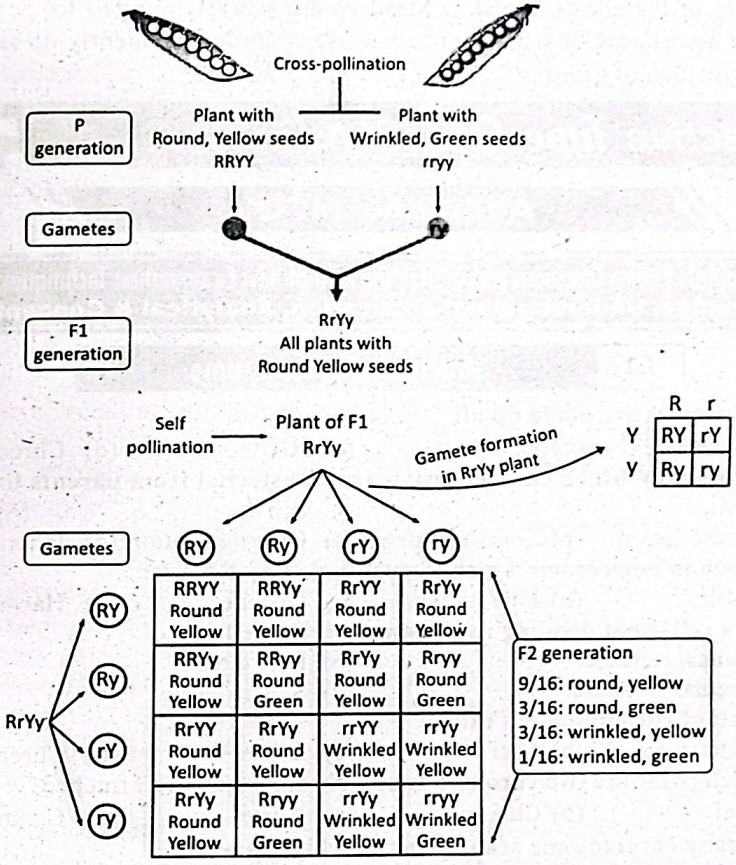
Ans. Dihybrid cross:

In a dihybrid cross, the inheritance of two characteristics is studied at the same time.

Experiment:

In this experiments Mendel studied the characteristics of seed shape (round or wrinkled) and seed colour (yellow or green). He first grew true-breeding varieties of pea plants. One plant had round yellow seeds and the other had wrinkled green seeds.

Mendel crossed these true-breeding plants. All F1 plants produced round



Independent assortment of alleles

yellow seeds. It proved that the allele for round seeds (R) is dominant over the allele for wrinkled seeds (r). Similarly, the allele for yellow seeds (Y) is dominant over the allele for green seeds (y). All the F1 plants were heterozygous for both seed shape and seed colour (genotype: RrYy).

He allowed self-pollination in the F1 plants and got the F2 generation. The F2 generation had the following four phenotypes:

- 9/16 that have round, yellow seeds (genotypes: RRYY, RRYy, RrYY, and RrYy)
- 3/16 that have round, green seeds (genotypes: RRyy and Rryy)
- 3/16 that have wrinkled, yellow seeds (genotypes: rrYY and rrYy)
- 1/16 that have wrinkled, green seeds (genotype: rryy)

Conclusions:

Law of Independent Assortment: The F1 plants (RrYy), produced four types of gametes i.e., RY, Ry, rY, and ry. When these plants were allowed to self-pollinate, there were 16 combinations of alleles in F2 generation. It means that alleles R and r segregated independently of the alleles Y and y. Mendel's discovery is referred to as the law of independent assortment. It states that "alleles separate independently of one another during the formation of gametes".

Objective Type Questions

Additional MCQ's

Multiple Choice Questions prepared in the light of new Examination Techniques
(Knowledge, Understanding, Application, Analytical & Conceptual)

7.1 Structure of Chromosome

1. **Chromosomes are made up of:**
   (a) Proteins (b) DNA (c) RNA (d) Chromatin
2. **The process by which characteristics are transferred from parents to offspring is called:**
   (a) Transcription (b) Translation (c) Osmoregulation (d) Inheritance
3. **A protein in nucleosome which is surrounded by DNA is:**
   (a) Insulin (b) Interference (c) Histone (d) Haemoglobin
4. **When a cell is not dividing its chromatin is in the form of:**
   (a) Compact structure (b) Fine thread
   (c) Circular structure (d) Square shape
5. **The half of chromosome is called:**
   (a) Centromere (b) Loci (c) Allele (d) Chromatid
6. **At which point the two chromatids of a chromosome are attached?**
   (a) Loci (b) Chiasmata (c) Allele (d) Centromere
7. **How many chromosome are present in prokaryotes?**
   (a) One (b) Two (c) Three (d) Four

7.2 DNA and RNA

8. **A double-stranded, helical molecule is:**
   (a) RNA (b) DNA (c) Proteins (d) Carbohydrates
9. **Each nucleotide of DNA is made of:**
   (a) Deoxyribose sugar (b) Phosphate group
   (c) Nitrogenous base (d) All of these
10. **Chromatin material is made of:**
    (a) Protein (b) DNA
    (c) RNA and Protein (d) DNA and Protein
11. **A single stranded chain of nucleotides is:**
    (a) DNA (b) RNA (c) Protein (d) Lipids
12. **Genes consist of:**
    (a) RNA (b) mRNA (c) Protein (d) DNA
13. **All nitrogenous bases are present in DNA except:**
    (a) Adenine (b) Cytosine (c) Uracil (d) Guanine
14. **Formation of messenger RNA from DNA is called:**
    (a) Translation (b) Transcription (c) Transduction (d) Translocation
15. **The process of formation of protein is called:**
    (a) Translation (b) Duplication (c) Mutation (d) Replication
16. **In transcription, the specific sequence of DNA nucleotides is copied in the form of:**
    (a) rRNA (b) tRNA
    (c) mRNA (d) RNA-polymerase
17. **In DNA molecule adenine pairs with:**
    (a) Cytosine (b) Guanine (c) Uracil (d) Thymine
18. **Alternate form of gene is called:**
    (a) Chromatin (b) Locus (c) Chromosome (d) Allele
19. **Location of genes on chromosomes called:**
    (a) Alleles (b) Phenotypes (c) Genotypes (d) Loci
20. **_____ is a segment of DNA that contains the information for a hereditary character.**
    (a) Allele (b) Gene (c) Phenotype (d) Traits
21. **The combination of the alleles is called:**
    (a) Genotype (b) Phenotype (c) Mutation (d) Replication
22. **If an organism has two different alleles for a single trait, its genotype is said to be:**
    (a) Homozygous (b) Hemizygous (c) Heterozygous (d) Homologous
23. **The allele which is masked is known as:**
    (a) Dominant allele (b) Recessive allele (c) Phenotype (d) Zygous
24. **Dominant alleles are expressed by:**
    (a) Small letters (b) Capital letters (c) Full stop (d) Brackets
25. **Which of the following is observable outcome of genotype?**
    (a) Dominance (b) Heterozygous (c) Transcription (d) Phenotype

7.3 Mendel's Laws of Inheritance

26. Mendel performed experiments on:
(a) Tomatoes (b) Garden pea (c) Ants (d) Mice

27. Pea plant has:
(a) Relatively short generation time (b) Easily distinguishable characteristics
(c) Ability of self-pollination (d) All of these properties

28. A true breeding tall plant self-pollinates, it will always produce:
(a) Short plants (b) Tall plants
(c) Some short and some tall plants (d) None of these

29. A cross in which only one charactristic is studied is:
(a) Simple cross (b) Monohybrid cross (c) Dihybrid cross (d) Mutalism

30. What was the percentage of the Mendel's Monohybrid cross:
(a) 50:50 (b) 50:40 (c) 70:30 (d) 75:25

31. How many percent plants of F2 generation received one T allele and one t allele?
(a) 25% (b) 50% (c) 75% (d) 65%

32. According to the punett square for the F2 generation, what is the probability of an offspring having the genotype "rryy"?
(a) 9/16 (b) 3/16 (c) 1/16 (d) 4/16

33. Which of the following best describes the phenotypic ratio of the F2 geneation in a standard dihybrid cross?
(a) 3:1 (b) 1:2:1 (c) 9:3:3:1 (d) 1:1:1:1

34. "Alleles separate independently of one another during the formation of gametes." is the statement of:
(a) Law of segregation (b) Law of inheritance
(c) Law of independent assortment (d) Mendel's law

Answers

1.	(d)	2.	(d)	3.	(c)	4.	(b)	5.	(d)	6.	(d)	7.	(a)
8.	(b)	9.	(d)	10.	(d)	11.	(b)	12.	(d)	13.	(c)	14.	(b)
15.	(a)	16.	(c)	17.	(d)	18.	(d)	19.	(d)	20.	(b)	21.	(a)
22.	(c)	23.	(b)	24.	(b)	25.	(d)	26.	(b)	27.	(d)	28.	(b)
29.	(b)	30.	(d)	31.	(b)	32.	(c)	33.	(c)	34.	(c)		

Additional Short Questions

Short Answer Questions prepared in the light of new Examination Techniques (Knowledge, Understanding, Application, Analytical & Conceptual)

7.1 Structure of Chromosome

1. Define inheritance.
Ans. The process by which characteristics are transferred from parents to offspring is called inheritance or heredity.

2. How would you differentiate between chromatin and chromosomes.
Ans. Chromatin: Chromatin is a thread-like material.
- Chromatin consists of DNA and special proteins called histones.
- In chromatin, a long molecule of DNA is wrapped around the bundles of histones.

Chromosomes: A chromosome is rod-shaped and consist of two identical halves. Each half of chromosome is called a chromatid.

3. What do you know about centromere? Write down its function.
Ans. Centromere: The two chromatids of a chromosome are attached at a point called centromere.
Function: The centromere holds the two chromatids together until they separate during cell division.

7.2 DNA and RNA

4. Write down the key differences between DNA and RNA.

Ans. DNA	RNA
• DNA is deoxyribonucleic acid.	RNA is ribonucleic acid.
• DNA is a double-stranded helical molecule.	RNA is a single-stranded chain of nucleotides.
• Each nucleotide of DNA is made of a deoxyribase sugar, a phosphate group and nitrogenous bases.	Each nucleotide of RNA is made of a ribose sugar, a phosphate group and nitrogenous bases.

5. Which nitrogenous bases are present in DNA and RNA? Name them.
Ans. Nitrogenous bases of DNA: Nitrogenous bases of DNA are adenine, thymine, cytosine or guanine.
Nitrogenous bases of RNA: Nitrogenous bases of RNA are adenine, uracil, cytosine and guanine.

6. How does DNA works?
Ans. DNA is the genetic material i.e. contains the instructions to direct all the functions of cells. It performs its role by giving instructions for the synthesis of specific proteins.

7. How strands of DNA are arranged?
Ans. The strands of DNA are coiled around each other and form a double helix structure. There is a phosphate-sugar backbone on the outside and the nitrogenous base on the inside.

8. Define the term "gene".
Ans. Gene: A gene is a segment of DNA that contains the information for a hereditary chracter.
For example: Gene of eye colour, gene for earlobe shape and gene for hair texture.

9. What is locus?
Ans. Locus: The locations or positions of genes on chromosomes are known as loci (singular locus).

10. What is central dogma?
Ans. The working method of a gene is called central dogma.
It is symbolized as:

DNA → RNA→ Protein

11. What is meant by transcription?

Ans. Transcription: Transcription is the process in which DNA make a copy of its information in the form of mRNA.

- It happens in the nucleus.

12. What is meant by translation?

Ans. Translation: Translation is the process in which the mRNA is read by ribosomes to make a protein.

- It happens in the cytoplasm at the ribosomes.

7.3 Mendel's Law of Inheritance

13. Why Mendel selected pea plant in his experiment?

Ans. Mendel selected the garden pea for his experiment due to the following reasons:

(i) Pea plants have a relatively short generation time.
(ii) Pea plant has seven easily ditinguishable chracteristics.
(iii) Normally, self pollination occurs in pea flowers but cross-pollination can also be performed.

14. How would you describe a true-breeding plant?

Ans. If a plant with a characteristic produces offsprings with the same characteristic on self-pollination, it means that the plant is true-breeding for that characteristic.

15. What will be genotype of plants produced as a result of cross between two plants having Genotype Rr?

Ans. It two Rr genotypes plants are crossed then the genotype of resulting plants will be 3:1. It means 75% are round shape seeds and 25% are wrinkled seeds will produce.

16. Why do some F2 pea plants turn out short even through their F1 parents were both tall?

Ans. This happens because the F1 parents are heterozygous (Tt), meaning they each carry a hidden recessive allele. During self-pollination, there is a 25% chance on offspring will inherit the tt genotype (one"t" for each parent), which results in a short plant.

17. What will be the four phenotypes of the Mendel's dihybrid cross?

Ans. The F2 generation had the following four phenotypes:

(i) 9/16 that have round, yellow seeds. (ii) 3/16 that have round, green seeds.
(iii) 3/16 that have wrinkled, yellow seeds. (iv) 1/16 that have wrinkled, green seeds.

Exercise Questions (Solved)

A. Select the correct answers for the following questions.

1. Chromosomes of eukaryotes are made of;

(a) Lipids and proteins (b) Lipids and DNA
(c) RNAand proteins (d) DNA and proteins

2. What is the relationship between a gene and an allele?

(a) Alleles are alternative forms of a gene
(b) Genes are alternative forms of an allele
(c) Genes mask the effects of genes (d) Alleles and genes are unrelated

3. Which molecule is formed during transcription?

(a) DNA (b) Protein (c) mRNA (d) Ribosome?

4. The central dogma of molecular biology is best represented by;

(a) DNA+ RNA= Protein (b) DNA → RNA → Protein
(c) DNA → RNA → Protein (d) Protein → RNA → DNA

5. What happens during transcription?

(a) A new polypeptide is created (b) RNA is scanned by a ribosome.
(c) A new copy of DNA is produced (d) A copy of RNA is made

6. What is the role of DNA in protein synthesis?

(a) Produces amino acids
(b) Provides the template for mRNA formation
(c) Transports proteins (d) Stores proteins

7. The allele that is expressed, when two separate alleles are inherited;

(a) Dominant (b) Recessive (c) Homozygous (d) Heterozygous

8. Which of these is a reason why pea plants were suitable for Mendel's experiments?

(a) Long lifecycle (b) Easy to cross-pollinate
(c) Few seeds produced per plant (d) No variation in traits

9. What does Mendel's Law of Segregation state?

(a) Genes are linked together
(b) Each allele separates during gamete formation
(c) Dominant traits appear in all generations
(d) Alleles blend together

10. In peas, allele for purple flower (P) is dominant over the allele for white flower (p). If a white flower is crossed with a heterozygous purple flower (Pp), what will be the ratio of offspring?

(a) 100% purple (b) 75% purple and 25% white
(c) 50% purple and 50% white (d) 100% white

Answers

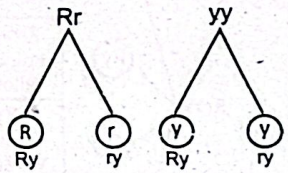
1. (d)	2. (a)	3. (c)	4. (b)	5. (d)
6. (b)	7. (a)	8. (b)	9. (b)	10. (c)

Write short answers.

1. Write down the combination of alleles in the gametes of a plant, which has genotype Rryy.

Ans. Gametes formation

According to the law of segregation that alleles separate during gamete formation, the possible combination are Ry and ry.



2. State Mendel's law of segregation.

Ans. Law of segregation: The alleles are separated during gametes formation and each gamete receives one or the other allele, but not both.

3. State Mendel's law of independent assortment.

Ans. Law of independent assortment states that: "Alleles separate independently of one another during the formation of a gametes".

4. Define monohybrid cross and a dihybrid cross and give an example of each.

Ans. Monohybrid cross: It is a cross in which only one characteristic is studied.

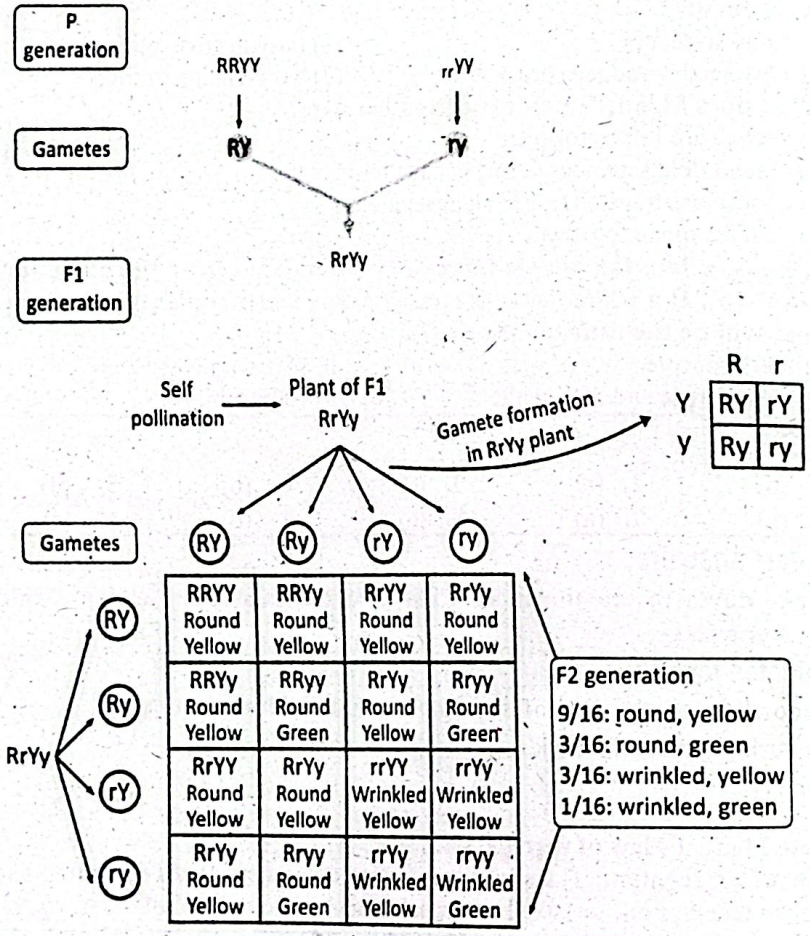
Example: Crossing tall (Tt) and short (tt) plants to study height only.

Dihybrid Cross: In a dihybrid cross, the inheritance of two characteristics is studied at the same time.

Example: Crossing plants difference in height (T/t) and seed colour (y/y) at the same time such as TtYy × TtYy.

5. Draw a cross between two pea plants. One of them has round green seeds (RRyy) while the other has wrinkled yellow seeds (rrYY).

Ans.



6. Differentiate between:

(i) Gene and allele **(ii) F1 and F2 generations**

(iii) Dominant and recessive **(iv) Homozygous and heterozygous**

(v) Genotype and phenotype

Ans. (i) Gene: A gene is a segement of DNA that contains the information for a hereditary character.

For example: Gene of eye colour gene for hair texture etc.

Allele: The alternate (different) forms of a gene are called alleles.

For example: The gene of hair colour can have two alleles. One allele makes hair pigments while the other does not make pigments.

(ii) F1 generation	F2 generation
• Set of offsprings produced by crossing P(parent) generation.	It is produced by allowing the F1 plants to self-pollinate.
• Only dominant trait is visible.	Both dominant and recessive traits appears.
• All offsprings are identical.	Offsprings show genetic variation.

(iii) Differentiate between dominant and recessive alleles.

Ans. Dominant allele: In the heterozygous genotype one allele may mask the working of other allele. Such an allele is called dominant allele.

- It is represented by capital letter (e.g. T)

Recessive allele: An allele that expresses only when two copies are present. The allele which is not expressed, is called reccessive allele.

- It is represented by small letters (e.g.t).

(iv) Differentiate between homozygous and heterozygous:

Ans. Homozygous: A genotype in which both alleles are same, is called homozygous.

Example: TT or tt

Heterozygous: A genotype in which both alleles are different, is called heterozygous.

Example: Tt.

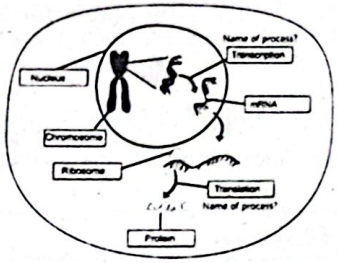
(v) Genotype: The combination of the alleles is called genotype. It is the genetic makeup of an organism. (like TT, Tt, tt).

Phenotype: Observable outcome of genotype in the form of characteristics is called phenotype. (like tall or short).

Example of Genotype and Phenotype: If a plant has the genotype Tt (one dominant tall and one recessive short allele), its phenotype will be tall, because the dominant T alleles expresses the trait.

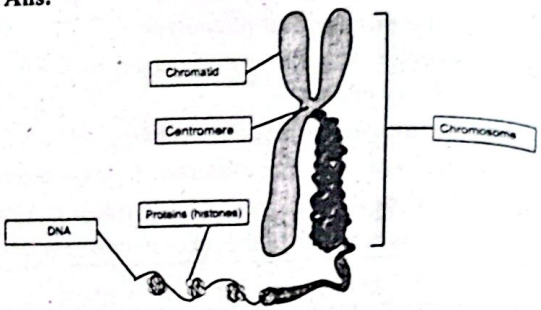
7. In the following diagram of a cell, label the components and the process.

Ans.



8. Label the components in the following diagram.

Ans.



C. Write answers in detail.

1. Write a note on the structure and composition of chromosome.

Ans. For answer see Q's 2

2. Why did Mendel choose pea plants for his genetic experiments?

Ans. For answer see Q's 8

3. Describe Mendel's experiment on two-character inheritance and state the law he proposed.

Ans. For answer see Q's 11

4. Describe Mendel's Law of Segregation? Give an example.

Ans. For answer see Q's 10

5. Describe how DNA and RNA take part in the synthesis of a protein.

Ans. For answer see Q's 4

D. Inquisitive questions

1. How do genes control the traits and characteristics of an organism?

Ans. Genes control traits because they carry instructions (DNA) to make proteins, which determine an organism's characteristics. Different alleles of a gene create variations in traits. Offspring's inherit alleles from parents and the combination (genotype) determines the observable trait (phenotype).

Example: In pea plant T(tall) is dominant and t(short) is recessive.

TT or Tt → tall tt → short.

2. Why can different alleles of the same gene lead to different physical traits??

Ans. Different alleles lead to different traits because they contain slightly different nucleotide sequence within the same gene. In this way the structure, function or amount of the protein produced by that gene changes.

CHAPTER 8 Biotechnology

Students Learning Outcomes:

After studying this chapter, students will be able to:

- Introduce biotechnology.
- Explain the role of yeast in the production of bread and ethanol.
- Understand that bacteria are useful in biotechnology and genetic modification.
- Describe the basic method of genetic engineering/genetic modification.
- Discuss potential advantages and risks of genetic modification.

Subjective Type Questions

Long Questions prepared in the light of new Examination Techniques (Knowledge, Understanding, Application, Analytical & Conceptual)

8.1 Introduction of Biotechnology

Q.1: Define Biotechnology. Write its brief introduction.

Ans. Biotechnology:

In 1919, Hungarian engineer Karl Ereky, first proposed the term "biotechnology".

"The use of living cells or organisms to create products or processes for specific purposes."

Role of this technology:

- The hereditary characteristics of organisms are modified.
- New organisms with desired characters are developed from a cell or a part of an organism.
- Any required substance is produced from the modified organism.

Modern biotechnology: Modern biotechnology emerged after the invention of the structure and function of DNA in 1953.

Q. Who was the leader of the research group that Cloned Dolly?
Ans. Sir Ian Wilmut is a British embryologist. He was the leader of the research group that in 1997 first produced a mammal (a lamb named Dolly) from an adult body cell.

Techniques used in biotechnology: The techniques being used in modern biotechnology include fermentation, recombinant DNA technology, cell culture, gene editing, genetic engineering and tissue culturing etc.

Q.2: Explain the role of yeast in the production of bread and ethanol.

Ans. Fermentation:

Fermentation is the process where microbes break down substances to produce useful products.

Importance of yeast in Fermentation: Yeast is a microscopic fungus that plays a crucial role in both bread making and ethanol production through a process called fermentation.

> Q. What is the oldest from of Biotechnology?
> Ans. Fermentation is the oldest form of biotechnology. It is used for making bread, beer, and yogurt thousands of years ago.

Role in Bread Making

Yeast ferments the sugars present in the dough and produces carbon dioxide (CO_2) gas. This gas forms bubbles in the dough, causing it to rise and become soft and airy. The alcohol produced during this process evaporates during baking.

Role in Ethanol Production

Yeast ferments sugars from crops like sugarcane or corn to produce ethanol (alcohol) and carbon dioxide. The ethanol is then purified and used as a biofuel or in alcoholic beverages.

Q.3: Discuss the role of bacteria in biotechnology and in genetic modification.

Ans. Importance of bacteria in biotechnology:

Bacteria are essential microorganisms used in biotechnology because they are simple, fast-growing and can easily accept new genetic material. Scientists use them for producing medicines, studying genes and creating genetically modified organisms (GMOs).

Role in Biotechnology:

- Certain Bacteria Produce important substances like antibiotics (e.g., streptomyces produces streptomycin).
- Many bacteria produce enzymes which scientists use in making cheese and detergents.
- Many bacteria produce vitamins (like vitamin B12).
- Scientists use bacteria to clean up oil spills and waste through bioremediation.
- Lactobacillus bacteria help in making yogurt and cheese by fermenting milk.

Role in Genetic Modification:

Scientists use special structures called plasmids (small loops of DNA found in bacteria) as carriers to introduce new genes into bacterial cells. In this way, the modified bacteria start producing proteins from that foreign gene. This method is used to produce:

- Human insulin for treating diabetes
- Human growth hormones for growth disorders.
- Vaccines against diseases.

Some bacteria are also used to introduce new genes into plant cells during the creation of genetically modified crops.

8.2 Genetic Engineering

Q.4: Describe genetic engineering and gene editing.

Ans. Genetic engineering:

Genetic engineering is defined as a process of altering (editing) the genes of

organisms or transferring the genes from one organism into other organism.

- In genetic engineering, special enzymes are used to cut and attach DNA at specific locations. As a result of genetic engineering, Genetically Modified Organisms (GMOs) are produced.

Gene Editing: Gene editing is a technique where scientists make changes in the DNA (genes) of an organisms.

- These can involve adding, removing or replacing specific parts of DNA.

Role of gene editing: It allows scientists to add, delete or change parts of the DNA.

- It is done to correct genetic abnormalities and to improve characteristics.

Q.5: Describe the advantages of gene editing.

Ans. Advantages of Gene editing:

(i) **Curing Genetic diseases:** Scientists are researching how gene editing can cure diseases caused by abnormal genes.

> Q. Why gene editing must be done very carefully?
> Ans. Gene editing is done very carefully because changes made to DNA can have unexpected effects.

Examples: Sickle cell anemia (a blood disorder), cystic fibrosis (a lung disease).

(ii) **Improving Crops:** Gene editing can create crops that grow faster, resist pests and diseases, and survive droughts better.

Examples: Virus resist varities of tomato and tobacco have been developed. Modified varities of Soybeans, corn, tomato and cotton have been produced which show resistance against herbicides.

(iii) **Producing Better Medicines:** Gene editing helps create bacteria that produce important medicines.

For Example: Insulin is used for diabetes.

Q.6: Define Gene Transfer. Enlist the steps for transferring a human gene into a bacterial cell.

Ans. Gene transfer: A technique in which foreign genetic material is introduced into host cell to alter their genetic makeup.

Vectors: Genetic engineers use special vectors to transfer genes into an organism. The most commonly used vectors to transfer genes into bacteria are plasmids and bacteriophages.

Plasmids: Plasmids are small, circular DNA molecules present in some bacteria.

Bacteriophages: These are the viruses that can enter bacteria.

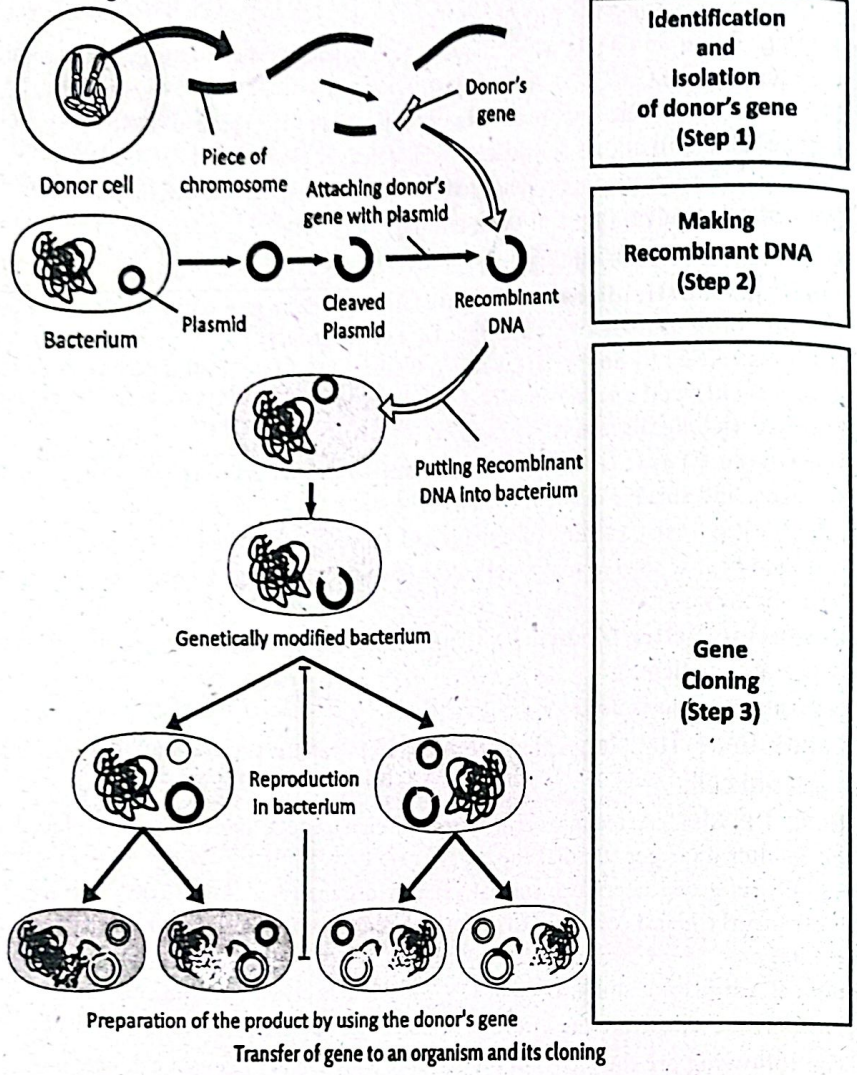
The following are the steps for transferring a gene into organism e.g. bacteria:

(i) The gene of donor organism is identified and isolated from its chromosome.

(ii) A plasmid is removed from a bacterial cell. The plasmid DNA is cut. Donor's gene is attached at the cut ends of the plasmid. The plasmid is now a combination of its original DNA and the new DNA (donor's gene). Now it is called recombinant DNA.

(iii) The recombinant DNA is transferred into a bacterial cell. When bacterial cell

reproduces to form a colony of cells, all genetically modified bacteria contain the recombinant DNA. In this way, the bacterial colony contains many copies of the donor's gene. This step is also called gene cloning.



Q.7: Explain with examples how gene transfer is used to produce few useful substances?

Ans. Production of useful substances:

(i) Human growth hormone is produced in genetically modified bacteria. It is used to treat dwarfism.

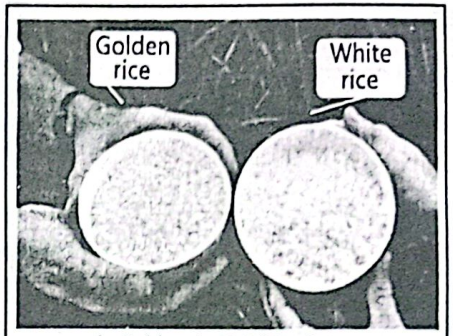
(ii) Interferon (anti-virus protein) is made in modified bacteria.

(iii) Vaccine against Hepatitis B virus has been produced from yeast through genetic modification.

Q. How do some COVID-19 vaccines are prepared?
Ans. Some COVID-19 vaccines are made by using mRNA. This mRNA carries instructions to make a harmless proteins of the corona virus, which trains the immune system to fight the real virus.

(iv) A gene from a bacterium is transferred into cotton and corn crops. The genetically modified crops then produce a natural toxin that kills insects but is safe for humans.

(v) Gene from a bacterium is transferred into rice plants. The rice produces beta-carotene, which the body converts into vitamin A. Such genetically modified rice help prevent blindness caused by vitamin A deficiency.



Golden rice & White rice

Products made by using Gene Transfer

Product	Genetic Material Transferred	Organism or Technology Used	Purpose
Insulin	Human insulin gene	Bacteria	Treat diabetes
Growth Hormone	Human growth hormone gene	Bacteria	Treat growth disorders
Interferon	Human interferon gene	Bacteria	Treat viral infections and boost immunity
Hepatitis B Vaccine	Surface protein gene of Hepatitis B virus	Yeast cells	Protect against Hepatitis B
Bt Crops	Bt toxin gene	Cotton, Corn plants	Insect resistance
Golden Rice	Beta-carotene producing genes	Rice plants	Prevent vitamin A deficiency

Q.8: Explain with examples that food biotechnology has advanced agriculture.

Ans. Food biotechnology has greatly improved agriculture by helping scientists develop crops that are more productive, nutritious. And resistant to diseases and pests. By using genetic engineering and modern techniques, farmers can grow better quality food with fewer losses.

(i) **Insect-resistant crops:** A gene for a bacterium is transferred into cotton and corn crops. The genetically modified crops then produce a natural toxin that kills insects

but is safe for humans.
This reduces the use of chemical pesticides and increases crop yield.

(ii) **Disease-resistant plants:** Some crops are genetically modified to resist viral or fungal diseases. This protects the plants and ensures better harvests.

(iii) **Drought-tolerant crops:** Biotechnology has helped develop plants that survive with less water. These crops grow well even in dry areas, helping formers in regions facing water shortage.

(iv) **Golden Rice:** Gene from a bacterium is transferred into rice plants. The rice produces bela-carotene, which the body converts into vitamin A. Such genetically modified rice help prevent blindness caused by vitamin A deficiency.

(v) **Improved food quality:** Biotechnology produces (SOP) with better taste, longer shelf Life and improved nutrition.

For example: Tomatoes are engineered to stay fresh longer.

8.3 Applications of Biotechnology

Q.9: Write down the applications of biotechnology in medical field?

Ans. Medical Biotechnology:

In medical field, biotechnology is helping in the following:

- Making proteins like hormones and enzymes used for treating various diseases.
- Developing vaccines to prevent viral and bacterial infections.
- Correcting defective genes responsible for genetic disorders.
- Production of targeted antibodies for disease diagnosis and treatment.
- Identifying inherited diseases and genetic conditions early.

Q. What has research in Pakistan achieved regarding rice varieties?
Ans. Research in Pakistan has led to the development of rice varieties that are resistant to certain diseases and pests.
Q. Which technology is used in Pakistan for the mass propagation of fruit crops?
Ans. Pakistan has also advanced in using tissue culture technology for the mass propagation of high-yielding fruit crops such as mangoes and citrus.
Q. How many disorders are estimated to be caused by errors in genes?
Ans. In humans, more than 3500 disorders are due to errors in genes. Biotechnologists are trying to remove such disorders through biotechnology.

Q.10:Explain with examples that medical biotechnology has advanced health care in diabetes and cancer.

Ans. Medical biotechnology has greatly improved healthcare by using genetic engineering and modern laboratory techniques to diagnose, treat and prevent diseases more effectively.
Two major examples are diabetes and cancer:

Q. What did biologists discovered from the Human Genome Project?
Ans. In Human Genome Project, biologists discovered the locations of all genes in human body. They also found the characteristics controlled by each gene.

(i) Diabetes:

Production of human insulin: Scientists transfer the human insulin gene into

bacteria. These genetically modified bacteria start producing pure human insulin. This insulin is collected purified and give to diabetic patients.

(ii) Cancer:

Production of interferon's: Genetically engineered cells produce interferons (anti-virus and anti-cancer proteins) which help the body detect and destroy cancer cells.

Targeted therapies:

Biotechnology helps create medicines that target only cancer cells without harming healthy cells.

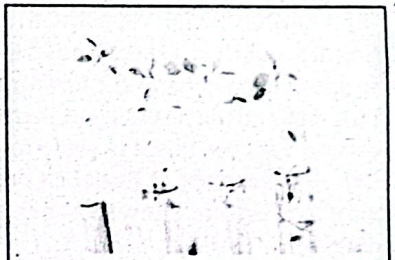
These biotechnology products have made disease management more effective, safer and more accessible for millions of patients.

Q.11:How biotechnology is helpful in solving environment issues?

Ans. Bioremediation:

Bioremediation is defined as the use of organisms such as bacteria, plants, or fungi to remove or neutralize pollutants from the environment. Genetically modified bacteria are used to break down the harmful chemicals present in waste matters and industrial discharge.

- Large number of saplings of different plants are produced through tissue culture. These saplings are planted to grow new forests in limited time.
- Modified bacteria are also used for extracting different minerals e.g., copper and uranium.
- Microbes such as bacteria, blue green algae and fungi are used to produce manure.


Saplings to grow forest

Q.12:Write a note marine biotechnology.

Ans. Marine Biotechnology

It deals with the marine organisms to develop new products, treatments, and technologies. For example:

- Genetic modifications in many fishes have led to faster growth rates.
- Compounds extracted from marine organisms (sponges, corals, and marine bacteria) are used to develop new cancer drugs, antibiotics and antiviral medicines.
- Certain marine bacteria are used to degrade oil spills, helping to clean up marine environments.
- Marine algae are cultivated in large quantities and processed into biodiesel, ethanol, and other types of renewable energy.
- Enzymes extracted from marine organisms are used in various industries. For example, an enzyme extracted from marine bacteria is used to produce high-fructose corn syrup (common sweetener in the food industry).

Q.13: Write down few applications of industrial biotechnology.

Ans. The following are the main applications of industrial biotechnology.

- Biofuels like ethanol, biodiesel, and biogas are produced. For example, yeast is used to ferment sugars from crops (corn, sugarcane) into ethanol. This ethanol can be blended with petrol to produce a cleaner fuel.
- Biodegradable plastic (bioplastic) is produced from fermented plant starch (usually corn or sugarcane)?
- Pharmaceutical products are made through microbial fermentation and genetic engineering. For example, the production of antibiotics, such as penicillin, involves the fermentation of specific molds like "Pénicillium". Similarly, human insulin is produced through bacteria.

8.4 Potential Risks of Biotechnology

Q.14: Discuss the potential risks of genetic modifications.

Ans. Potential risks of genetic modifications are as follow:

(i) Health Concerns: Some people worry that consuming genetically modified foods could cause allergic reactions or long-term health problems. There is also concern that new genes might interact with human cells in unexpected ways.

(ii) Environmental Impact: GM plants can sometimes cross-pollinate with wild plants. So, the modified genes can be spread in natural ecosystems. It can lead to create such species that may harm the environment.

(iii) Loss of Biodiversity: If farmers mostly grow GM crops, traditional and naturally diverse varieties might become rare or extinct. This can reduce biodiversity.

(iv) Development of Resistant Pests and Weeds: Pests exposed repeatedly to GM crops may evolve into "powerful pests" that are no longer affected by the crop's built-in defences.

(v) Ethical Issues: Many people feel that it is morally wrong to alter the natural genes of living organisms.

Objective Type Questions

Additional MCQ's

Multiple Choice Questions prepared in the light of new Examination Techniques (Knowledge, Understanding, Application, Analytical & Conceptual)

8.1 Introduction of Biotechnology

1. **Who is credited for first proposing the term "biotechnology" in 1919?**
   (a) Sir Ian Wilmut (b) Karl Ereky (c) James Watson (d) Francis Crick
2. **What major scientific breakthrough in 1953 paved the way for modern biotechnology?**
   (a) The cloning of Dolly sheep (b) The invention of the microscope
   (c) The discovery of structure and function of DNA.
   (d) The first successful use of fermentation in bread making.
3. **Which techniques are used in modern biotechnology?**
   (a) Fermentation (b) Recombinant DNA technology
   (c) Gene editing (d) All of these
4. **Sir Ian Wilmut is famous in the field of biotechnology for:**
   (a) Discovering yeast
   (b) Leading the team that produced Dolly sheep from an adult body cell.
   (c) Inventing the process of ethanol production
   (d) Proposing the term "biotechnology"
5. **Yeast plays a crucial role in:**
   (a) Bread making (b) Ethanol Production
   (c) Both a and b (d) None of these
6. **During the bread-making process, what causes the dough to rise and become soft?**
   (a) Ethanol (b) Water (c) Carbon dioxide (d) Oxygen
7. **In the production of ethanol for biofules, yeast ferments sugars found in crops such as:**
   (a) Wheat and barley (b) Sugarcane or corn
   (c) Potatoes and rice (d) Soybeans and Oats
8. **Yeasts ferments sugars from crops like sugarcane or corn to produce**
   (a) Ethanol (b) Carbon dioxide (c) Oxygen (d) Both a and b
9. **Essential tools in biotechnology are:**
   (a) Viruses (b) Bacteria
   (c) Fungi (d) Microorganisms
10. **Bacteria are used by the scientists for:**
    (a) Producing medicines (b) Studying genes
    (c) Creating (GMOs) (d) All of these
11. **Scientists use bacteria to clean up oil spills and waste through a process called.**
    (a) Biofertilization (b) Bioaccumulation (c) Bioremediation (d) Biopesticides
12. **Which bacteria helps in making yogurt and cheese?**
    (a) Streptomyces (b) Lactobacillus (c) Staphylococcus (d) Escherichia coli
13. **The special structures used to introduce new genes into bacterial cells:**
    (a) Bacteriophage (b) Plasmids (c) Injections (d) Pills
14. **Human insulin is used for:**
    (a) Cancer (b) Diabetes (c) Kidney failure (d) Pneumonia
15. **The oldest form of biotechnology is:**
    (a) Cloning (b) Genetic engineering
    (c) Gene editing (d) Fermentation

8.2 Genetic Engineering

16. **The process of altering (editing) the genes of organisms or transferring the genes from one organism into other organism is called:**
(a) Cloning (b) Genetic engineering
(c) Fermentation (d) Gene editing

17. **Gene editing involves:**
(a) Adding of DNA segment (b) Removing of DNA segment
(c) Replacing of DNA segment (d) All of these

18. **Which diseases can be cured by gene editing?**
(a) Anaemia (b) Cystic fibrosis (c) Malaria (d) Both a and b

19. **Which two vectors are most commonly used for transferring genes into bacteria?**
(a) Insulin and Growth Hormone (b) Plasmids and Bacteriophages
(c) Yeast and cotton (d) mRNA and Beta-carotene

20. **A small-circular DNA molecules present in some bacteria as:**
(a) Plasmid (b) Bacteriophage (c) Hormone (d) Vaccine

21. **When a donor gene is attached to the cut ends of a plasmid, the resulting combination is called:**
(a) Isolated DNA (b) Recombinant DNA
(c) Interferon (d) Bacteriophage DNA

22. **Which substance is produced in modified bacteria to help treat patients with dwarfism?**
(a) Insulin (b) Interferon
(c) Human growth hormone (d) Hepatitis B vaccine

23. **Human Insulin Gene was transferred into:**
(a) Algae (b) Virus (c) Bacteria (d) Yeast

24. **Interferon is a:**
(a) Anti-virus protein (b) Anti-bacterial protein
(c) Insect-killing (d) mRNA vaccines

25. **Which organism is used to produce human insulin through gene transfer?**
(a) Yeast cells (b) Rice Plants (c) Bacteria (d) Corn Plants

26. **The purpose of producing human growth hormone via biotechnology is to treat:**
(a) Diabetes (b) Growth disorders
(c) Viral Infections (d) Vitamin deficiency

27. **Which product is used to treat viral infections and boost immunity?**
(a) Insulin (b) Interferon (c) Bt toxin (d) Beta-carotene

28. **The primary purpose of Golden Rice is to prevent:**
(a) Diabetes (b) Vitamin deficiency
(c) Insect attacks (d) viral infection

29. **"Surface protein gene of Hepatitis B virus" is transferred into yeast cells to create:**
(a) Growth hormones (b) Bt crops
(c) Hepatitis B vaccine (d) Golden rice

8.3 Applications of Biotechnology

30. **Which of the following is NOT a goal of food biotechnology?**
(a) Developing virus-resistant crops (b) Developing drought-resistance crops
(c) Developing pest-resistant crops
(d) Creating synthetic meat in laboratories

31. **Enzymes extracted from certain microbes are primarily used for?**
(a) Textile production (b) Production of alcohol
(c) Plastic manufacturing (d) Paper recycling

32. **Biotechnologists use proteins like hormones and enzymes to:**
(a) Sterlize medical equipment (b) Treat various diseases
(c) Create artificial limbs (d) Increase the shelf life

33. **There are how many disorders in humans due to errors in genes?**
(a) 1000 (b) 1500 (c) 2500 (d) 3500

34. **Biologists discovered the locations of all genes in human body by using:**
(a) Genetic engineering (b) Gene editing
(c) Gene therapy (d) Human Genome Project

35. **Which process utilizes microorganisms to degrade or detoxify environmental pollutants in soil or groundwater?**
(a) Bioaugmentation (b) Bioremediation
(c) Biomining (d) Biopharming

36. **Compounds extracted from marine organisms are used to develop:**
(a) Cancer drugs (b) Antibiotics (c) Antiviral medicines (d) All of these

37. **Which biofules are produced in industrial biotechnology?**
(a) Ethanol (b) Biodiesel (c) Biogas (d) All of these

38. **Pharmaceutical products are made through:**
(a) Bacterial fermentation (b) Microbial fermentation
(c) Fungal fermentation (d) Viral fermentation

Answers

1.	(b)	2.	(c)	3.	(d)	4.	(b)	5.	(c)	6.	(c)	7.	(b)
8.	(d)	9.	(b)	10.	(d)	11.	(c)	12.	(b)	13.	(b)	14.	(b)
15.	(d)	16.	(b)	17.	(d)	18.	(d)	19.	(b)	20.	(a)	21.	(b)
22.	(c)	23.	(c)	24.	(a)	25.	(c)	26.	(b)	27.	(b)	28.	(b)
29.	(c)	30.	(d)	31.	(b)	32.	(b)	33.	(d)	34.	(d)	35.	(b)
36.	(d)	37.	(d)	38.	(b)								

Additional Short Questions

Short Answer Questions prepared in the light of new Examination Techniques
(Knowledge, Understanding, Application, Analytical & Conceptual)

8.1 Introduction to Biotechnology

1. Define biotechnology according to Karl Ereky.

Ans. In 1919, Hungarian engineer Karl Ereky first proposed the term biotechnology. It may be defined as:
"The use of living cells or organisms to create products or processes for specific purposes."

2. Which techniques are used in modern biotechnology?

Ans. The techniques used in modern biotechnology include fermentation, recombinant DNA technology, cell culture, gene editing, genetic engineering and tissue culturing etc.

3. Define fermentation. Write down its uses in biotechnology?

Ans. **Fermentation:** Fermentation is the process where microbes break down substances to produce useful products.

4. Discuss the role of yeast in making bread.

Ans. Yeasts ferments the sugars present in the dough and produces carbon dioxide (CO_2) gas. This gas forms bubbles in the dough, causing it to rise and become soft and airy. The alcohol produced during this process evaporates during baking.

5. How bacteria acts as essential tools in biotechnology?

Ans. Bacteria acts as essential tools in biotechnology because they are simple, fast growing and can easily accept new genetic material. Scientists use them for producing medicines, studying genes and creating genetically modified organisms (GMOs).

6. How bacteria are helpful in biotechnology?

Ans. Bacteria are helpful in biotechnology as:

- Bacteria produce important substances like antibiotics.
- Bacteria produce enzymes which scientists use in making cheese and detergents.
- Many bacteria use vitamins (like vitamin B12).
- Lactobacillus bacteria help in making yogurt and cheese by fermenting milk.

7. List three medical products that modified bacteria can produce.

Ans. 1. Human insulin for treating diabetes.
2. Human growth hormones for growth disorders.
3. Vaccines against diseases.

8.2 Genetic Engineering

8. What is gene editing and what is the primary purpose of this technique?

Ans. **Gene editing:** Gene editing is a technique where scientists make changes in the DNA (genes) of an organism.
Purpose of gene editing: It allows scientists to add, delete or change parts of the DNA to correct genetic abnormalities and to improve characteristics.

9. Discuss any two applications of gene editing.

Ans. **(i) Curing genetic diseases:** Scientists are researching how gene editing can cure diseases caused by abnormal genes such as sickle cell anaemia and cystic fibrosis.
(ii) Improving Crops: Gene editing can create crops that grow faster, resist pests and diseases and survive droughts better.

10. Differentiate between plasmid and bacteriophage.

Ans. **Plasmid:** Plasmids are small circular DNA molecules present in some bacteria.
Bacteriophages: Bacteriophages are the viruses that can enter bacteria.

11. Write down any two examples (applications) of gene transfer.

Ans. Examples of gene transfer are:
(i) The human insulin gene is transferred into a bacterium. The modified bacteria produce insulin, which is collected for treating diabetes patients.
(ii) Vaccine against Hepatitis B virus has been produced from yeast through genetic modifications.

12. How golden rice are produced?

Ans. Gene from a bacterium is transferred into rice plants. The rice produces beta-carotene which the body convert into vitamin A. Such genetically modified rice help prevent blindness caused by vitamin A deficiency.

8.3 Applications of Biotechnology

13. Mention two ways biotechnology has improved crops.

Ans. Biotechnology has improved crops by:
(i) Developing varities that are resistant to viruses, pests and drought.
(ii) Creating crops that grow faster than natural varities.

14. Write two medical applications of biotechnology.

Ans. In medical field biotechnology is helping in:
(i) Developing vaccine to prevent viral and bacterial infections.
(ii) Correcting defective genes responsible for genetic disorders.

15. Define bioremediation.

Ans. Bioremediation is defined as the use of organisms such as bacteria, plants and fungi to remove or neutralize pollutants from the environment.

16. Write down two applications of marine biotechnology.

Ans. Applications of marine biotechnology are as follows:
(i) Compounds extracted from marine organisms are used to develop new cancer drugs, antibiotics and antiviral medicines.
(ii) Marine algae are cultivated in large quantities and processed into biodiesel, ethanol and other types of renewable energy.

17. State two industrial applications of biotechnology.

Ans. Industrial applications of biotechnology are as follow:
(i) Biofules pike ethanol, biodiesel and biogas are produced. For example yeast is used to ferment sugars from crops into ethanol. This ethanol can be blended with petrol to produce a cleaner fuel.

(ii) Biodegradable plastic (bioplastic) is produced from fermented plant starch (usually corn as sugarcane).

18. Discuss any two potential risks of biotechnology.

Ans. The potential risks of biotechnology are as follows:

Health concerns: Some people worry that consuming genetically modified foods could cause allergic reactions or long-term health problems. This is also concern that new genes might interact with human cells in unexpected ways.

Loss of Biodiversity: If farmers mostly grow GM Crops, traditional and naturally diverse varities might become rare or extinct. This can reduce biodiversity.

Exercise Questions (Solved)

A. Select the correct answers for the following questions.

1. Why are bacteria commonly used in genetic engineering for producing products?

(a) They naturally produces the required products
(b) They grow quickly and accept human genes
(c) They resist all infections
(d) They have a human-like immune system

2. In genetic engineering, the first step is:

(a) Inserting DNA into the organism (b) Cutting the desired gene from DNA
(c) Growing the modified organism (d) Making proteins from the gene

3. Which of these is often used as a vector in genetic engineering?

(a) Virus (b) Fungi (c) Yeast (d) Blood cell

4. In genetic engineering, the desired gene is usually inserted into a bacterium by using:

(a) Protein (b) Another bacterium (c) Vector (d) Enzyme

5. In genetic engineering, after inserting the gene, the host cell is allowed to:

(a) Mutate randomly (b) Die naturally
(c) Multiply and express the gene (d) Produce waste

6. In genetic engineering, "recombinant DNA" means:

(a) Natural DNA (b) DNA copied by mistake
(c) DNAjoined from two sources (d) DNA destroyed by enzymes

7. A gene for toxin production is inserted into a plant for:

(a) Reducing water need (b) Increasing vitamin content
(c) Resisting insect attacks (d) Speeding up flowering

8. Genetically modified bacteria produce the following products, except:

(a) Hepatitis B vaccine (b) Growth hormone
(c) Insulin (d) Interferon

9. Which biotechnology products help against viral infections?

(a) Antibiotics (b) Vaccines (c) Clotting factors (d) Growth hormone

10. Golden rice is a genetically modified plant to increase:

(a) Protein (b) Vitamin A (c) Iron (d) Calcium

Answers

1. (b)	2. (b)	3. (a)	4. (c)	5. (c)
6. (c)	7. (c)	8. (a)	9. (b)	10. (b)

B. Write short answers.

1. What is the relation between biotechnology and genetic engineering?

Ans. Biotechnology: Biotechnology is the use of living cells or organisms to create products or processes for specific purposes.

Genetic engineering: Genetic engineering is the process of altering (editing) the genes of organisms or transferring the genes from one organism into the other organism.

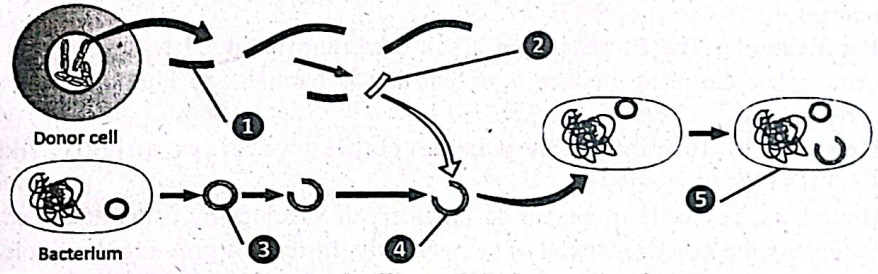
Relation: Biotechnology is a broad field that uses living organisms for useful purposes. Genetic engineering is a specific field of biotechnology that involves directly modifying DNA.

2. What is a plasmid? Why biologists use plasmids in genetic engineering?

Ans. Plasmid: Plasmids are small, circular DNA molecules present in some bacteria. Biologists use them as "carriers" or "vectors" to introduce new genes in bacterial cells.

3. The following diagram shows how a gene is transferred to bacterial cell. Identify the structures labelled as 1 to 5.

Ans. 1. Gene of interest 2. Donor's gene
3. Plasmid 4. Recombinant DNA
5. Genetically Modified baeterium



4. What do you mean by genetically modified organism?

Ans. Genetically modified organism whose DNA has been altered in a way that does not occur naturally by mating and natural recombination.

As a result of genetic engineering, Genetically Modified Organisms are produced.

5. List two types of medical products that can be produced using genetic engineering.

Ans. Two type of medical products that can be produced using genetic engineering are:

(i) **Human Insulin:** Used for the treatment of diabetes.
(ii) **Human Growth Hormone:** Used for treating growth disorders.

6. List two ways by which genetic engineering may improve crops.

Ans. The ways by which genetic engineering may improve crops are a:

(i) **Increasing growth rate:** Genetic engineering is used to create crops that grow

faster than natural varities.

(ii) **Enhancing Resistance:** It allows scientists to develop crops that are more resistant to pests, viruses and environmental stressors.

C. Write answers in detail.

1. Explain with examples that food biotechnology has advanced agriculture.

Ans. For answer See Q's 8

2. Explain with examples that medical biotechnology has advanced healthcare in diabetes and cancer.

Ans. For answer See Q's 10

3. Explain the role of yeast in the production of bread and ethanol.

Ans. For answer See Q's 2

4. Enlist the steps for transferring a human gene into a bacterial cell.

Ans. For answer See Q's 6

5. Describe the advantages of gene editing.

Ans. For answer See Q's 5

6. Discuss the potential risks of genetic modification.

Ans. For answer See Q's 14

D. Inquisitive questions:

1. How can inserting a gene into a plant make it pest-resistant?

Ans. Inserting a gene into the plant's DNA allows the plant to produce substances that are harmful to produce substances that are harmful to certain insects but not for humans.

For Example: The Bt gene from a soil bacterium is added to some crops. This gene makes the plant produce a protein that is harmless to humans but toxic to certain pests.

2. How can biotechnology help in developing vaccines quickly, like for COVID-19?

Ans. Biotechnology enables the rapid development of vaccines by using advanced tools to identify the genetic material of virus quickly. Instead of growing the whole virus scientists use mRNA to carry instructions directly into human cells.

For example: In COVID-19 scientists use mRNA technology, where a small piece of virus's genetic code was needed to trigger immunity.

3. Why is it important to carefully study the effects of genetically modified foods on health?

Ans. It is crucial to study these foods carefully because the processes of gene editing involves making precise changes of an organisms DNA. Which can sometimes lead to unexpected or unintended effects. Scientists must ensure that the modifications do not create new allergens, toxins or reduce the nutritional value, ensuring they are safe for human consumption and the environment.

CHAPTER 09 Diseases and Immunity

Students Learning Outcomes

After Studying this chapter, students will be able to:

- Describe infectious and non-infectious diseases and their types with examples.
- Define zoonotic diseases and give their types.
- Describe vector borne diseases with examples.
- Enlist allergies with some common types.

Subjective Type Questions

Long Questions prepared in the light of new Examination Techniques (Knowledge, Understanding, Application, Analytical & Conceptual)

9.1 Disease

Q1. Define disease. Describe infectious diseases with examples.

Ans. Disease:

Disease is defined as a specific condition that affects the normal functioning of the body or mind.

(i) Infectious diseases (ii) Non-infectious diseases

(i) **Infectious Diseases (infections):** infections disease are the communicable diseases that can spread from person to person or from the environment to person. Infectious diseases results from harmful organisms (pathogens) entering the body.

> Q. What is health according to WHO?
> Ans. According to the world health Organization (WHO), "health is a state of complete physical, mental, and social well-being and not merely the absence of disease or illness".

Biological agents responsible for infectious diseases:

Pathogens responsible for infectious diseases are viruses, bacteria, fungi, parasitic protozoans (e.g. plasmodium) and worms (e.g. tape worms).

Transmission of infectious diseases: Infectious diseases spread from person to person through contaminated food, water or bug bites.

Types of infectious diseases:

Following are the types of infectious diseases categorized by the specific pathogen:

(i) **Viral Infections:** Hepatitis, flu, dengue, measles, HIV and COVID-19.
(ii) **Bacterial Infections:** Typhoid, strep throat, cholera, tuberculosis.
(iii) **Fungal Infections:** Candidiasis (yeast infection).
(iv) **Infections by Parasitic Protozoan:** Malaria, Amoebiasis.
(v) **Infections by parasitic warms:** Round warm, tape warm infections.

Q.2. What are non infectious disease? Give examples.

Ans. Non-infectious diseases: Non-infectious diseases are non-communicable diseases. They do not transmit from one person to others.

Causes of non-infectious diseases: Such diseases result from heredity, unhealthy life styles, environmental factors, aging etc.

> **Q. What do you know about localized and systemic infections?**
> **Ans.** Infections can be localized (e.g., skin infection) and systemic (affecting multiple organs).

(i) Life style and mental health diseases: Many non-infectious diseases develop due to unhealthy life style. These include heart diseases, hypertension, diabetes, cancer and stroke. Mental health diseases like depression are also included in this category.

(ii) Genetic disease: Genetic diseases are caused by abnormalities in genes or chromosomes. Examples include haemophilia, thalassemia and muscular dystrophy.

(iii) Degenerative diseases: Some non-infectious diseases results from the gradual decline of body organs or tissues due to aging or other factors. Examples include Alzheimer's disease, parkinson disease and arthritis.

> **Q. How overuse of antibiotics is harmful?**
> **Ans.** Overuse of antibiotics by people has caused resistance in many bacteria. It is a major health risk.

Q3. Discuss zoonotic diseases with the help of examples.

Ans. Zoonotic Disease:

An infectious disease that is naturally transmitted from animals to humans is called zoonotic disease.

Zoonotic Pathogens: Zoonotic pathogens may be bacteria, virus or other parasites. Humans can get zoonotic pathogens through direct contact with animals or through food, water or the environment.

Bacillus anthracis

Influenza A virus

Ebola Virus

Causative agents of Anthrax, Bird flu and Ebola

Examples of zoonosis include:

(i) Anthrax: It is caused by bacterium Bacillus anthracis. The infection site may be skin, lungs or digestive system.

Transmission of Anthrax: Anthrax is transmitted to humans through contact with contaminated animal products (e.g wool, hides). Usually, anthrax bacteria enter the body through a wound in the skin, by eating contaminated meat or inhaling the spores of bacteria.

(ii) Bird-flu (Avian Influenza): It is caused by influenza a virus. The infection site includes nose, throat and lungs. Humans get bird flu through close contact with infected birds.

(iii) Ebola: It is caused by Ebola virus which targets sites in the body including liver, immune system and blood vessels.

Transmission of Ebola: The virus spreads through direct contact with body fluids, such as blood from infected humans and animals. It also spread from contact with contaminated objects.

> **Q. Which zoonotic disease become human only disease?**
> **Ans.** Some diseases, such as AIDS, began as a zoonosis but later became human-only diseases.

Q4. Describe vector-Borne diseases with examples.

Ans. Vector-Borne Diseases:

These are the infections that are transmitted by vectors i.e., living organisms to carry pathogens from one host to another.

Anopheles mosquito

Aedes mosquito

Ixodes ticks

Haemagogus mosquito

Causes: These diseases can be caused by bacteria, viruses or other parasites.

Examples of vector-borne diseases:

(i) Malaria: It is caused by a parasitic protozoan (Plasmodium). It primarily affects liver and then the RBCs. If untreated, it can lead to organ damage. It spreads from one human to other through Anopheles mosquito.

(ii) Dengue Fever: It is caused by Dengue virus that transmits through Aedes mosquito. Dengue fever affects multiple organs, including skin, blood vessels, and lymph nodes.

(iii) Lyme Disease: It is caused by bacteria Borrelia burgdorferi which spread through ticks. The infection affects the skin, joints, and nervous system.

(iv) Yellow Fever: It is an infection caused by yellow fever virus that spreads through Aedes or Haemagogus mosquitoes. The infection initially affects the liver, then involves the kidneys, heart, and nervous system.

Q5. What is allergy? Write name different types of allergy.

Ans. Allergy:

An allergy is an abnormal immunological response of the body against a foreign substance that's typically not harmful to the body.

Allergens: The foreign substances which cause allergies are called allergens. Common allergens include pollen, dust mites, certain foods, insect stings and certain medicines.

> **Q. Are diabetes and cancer caused only by life style?**
> **Ans.** Diabetes and cancers are not solely due to lifestyle choices. These diseases also have genetic basis. Lifestyle choices can however, delay the onset of such diseases.

Type of allergies:

There are five types of allergies

(i) Respiratory allergies **(ii)** Skin allergies **(iii)** Food allergies
(iv) Insect sting allergies **(v)** Drug allergies

Q.6. Briefly explain Respiratory allergies and skin allergies.

Ans. Respiratory allergies:

- **Allergic Rhinitis (Hay Fever):** It is caused by airborne allergens like pollen, dust mites etc. Symptoms include sneezing, itching, nasal congestion and runny nose.

- **Asthma:** A chronic condition where various allergens (ammonia, latex pesticides, fumes, metal or wood dusts etc) trigger inflammation and narrowing of the air ways. It leads to wheezing, shortness of breath, chest tightness and coughing.

Q. How anaphylactic shock occurs? Write down its causes.
Ans. Anaphylactic shock is a severe, life threatening allergic reaction. It can occur suddenly after exposure to an allergen such as certain foods, insect stings, or medicines. It causes difficulty in breating and sudden drop in blood pressure. It requires immediate medical treatment.

Skin Allergies:

- **Eczema (Atopic Dermatitis)** - Chronic skin condition characterized by itchy, inflamed patches of skin. Several allergens can trigger eczema. For example, dust mites, pollen, pet skin flakes, mold spores, certain fabrics, metals etc.
- **Contact Dermatitis** - Skin reaction resulting from direct contact with allergens like nickel, latex, or certain plants. Symptoms include redness, itching, and blisters.

Q.7. Wirte short note on following.

- **Food Allergies** • **Insect Sting Allergies** • **Drug Allergies:**

Food Allergies:

- **Common Food Allergies** - Range from mild (itching and swelling) to severe (difficult breathing, loss of consciousness etc.). Allergens may be peanuts, tree nuts, shellfish, fish, milk, eggs, soy, and wheat.

Insect Sting Allergies:

- **Venom Allergens** - Bee, wasp, and ant stings can trigger allergic reactions e.g., local pain and swelling, hives, and in severe cases, anaphylaxis.

Drug Allergies:

- **Common Drugs Allergies** - Range from mild rashes and itching to severe anaphylactic reactions. Allergens may be certain antibiotics aspirin, and Non-Steroidal Anti-Inflammatory Drugs (NSAIDs).

9.2 Pathogens

Q8. Define pathogens and write down various ways they can be transmitted to humans.

Ans. Pathogen:

A pathogen is a microorganism or agent that causes disease in its host. Pathogens include viruses, bacteria, fungi and other parasites like plasmodium.

Transmission of pathogens: Contact Pathogens can spread to humans through the five main ways:

(i) Air (ii) Food (iii) Water
(iv) Person-to-person (v) Bites of animals

Q.9 Classify the types of Pathogens. Give examples, the disease caused and modes of transmission.

Ans.

Type of Pathogen	Example	Disease Caused	Common Transmission Method
Virus	Influenza Virus	Influenza (Flu)	Airborne droplets Direct contact
	Human Immunodeficiency Virus (HIV)	AIDS	Sexual contact Blood transfusion Shared needles
	SARS-CoV-2	COVID-19	Airborne droplets Surface contact
Bacteria	*Streptococcus pyogenes*	Strep Throat	Respiratory droplets Direct contact
	Mycobacterium tuberculosis	Tuberculosis (TB)	Airborne droplets
	Escherichia coli	Food Poisoning	Contaminated food/ water
Fungi	*Candida albicans*	Candidiasis (Yeast Infection)	Fungal growth in warm, moist areas Direct contact
	Tinea pedis	Athlete's Foot	Contaminated surfaces
	Aspergillus fumigatus	Aspergillosis	Inhalation of fungal spores
Parasitic Protists	*Plasmodium falciparum*	Malaria	*Anopheles* mosquito bites
	Giardia lamblia	Giardiasis	Contaminated water Contaminated food
	Entamoeba histolytica	Amoebiasis	Contaminated food/water

9.3 Immunity

Q10. Describe the roles of T-cells and B-cells in immunity.

Ans. T-cells and B-cells are the primary components of aquired immunity also known as third line of defence. While both are types of lymphocytes.

(i) **T-cells:** The direct attackers and regulators. T-cells are a type of white blood cell involved in non-specific and specific cellular responses.

Natural killer cells: These are a specific type of T-lymphocytes that acts in the second line of defence. They kill body cells that have been infected by pathogens and also detect and kill cancer cells.

Cellular Interaction: Unlike B-cells some T-cells directly interact with infected cells to eliminate threats.

Response to fever: The activity of these and other phagocytes increases during a fever, which helps to slow down bacterial and viral growth.

(ii) **B-cells the antibody producers:** B-cells are central to active immunity, which is a component of the body's third line of defence.

The primary role of B-cells is to prepare antibodies. These antibodies are specialized proteins designed to target and kill specific pathogens.

Active immunity: This process occurs during active immunity which can be acquired naturally or artificially through vaccination.

Contrast with passive immunity: B-cells create long-lasting active immunity, "passive immunity" involves being get ready-made antibodies, which provides only short lived protection.

Q.11. Write a note on First line of Defence.

Ans. First Line of Defence

It is nonspecific defence against any pathogen, regardless of the pathogen's identity. It includes the skin and mucous membranes.

(i) Skin serves as a physical barrier to pathogens. In addition, the oil and sweat glands present in skin inhibit the growth of many microbes.

(ii) Mucous membranes are epithelial tissues that protect the interior surfaces of the body e.g., respiratory and digestive systems, the urethra. Mucous membranes secrete mucus that traps pathogens.

Q.12. Define Immunity. Write down types of Immunity.

Ans. Immunity is the ability of the body to defend itself against disease-causing organisms. The following are the types of immunity:

(i) **Innate Immunity:** This type of immunity is present in body by birth. It includes the first line of defence and second line of defence.

(ii) **Acquired Immunity:** It is acquired during life time. It includes the third line of defence.

Q.13. Explain Second line of Defence in detail.

Ans. Second Line of Defence:

The second line is also a non-specific defence. It includes:

(i) **Killer cells of blood:** move through the blood stream to detect and destroy pathogens. For example:

- **Macrophages** develop from monocytes (a type of WBCs). They ingest bacteria and kill them.
- **Neutrophils** are a type of WBCs. They do phagocytosis (engulfing the pathogen and killing it). They also release killing chemicals on pathogens. They also release network of fibres which bind with pathogens and kill them.
- **Natural killer cells** are a type of T-lymphocytes. They kill the body cells that are infected by pathogens. They also detect and kill cancer cells.

A macrophage attacking microbes

(ii) **Protective proteins** also provide non-specific defences. For example:

- **Special proteins** form a ring-shaped structure that punctures the membranes of infected cells, causing the cells to die.
- **Interferon** is another protective protein. It is released by cells infected with viruses. Interferon causes nearby cells to make a protein that helps them resist viral infection.

(iii) **Inflammation:** Infected or injured cells release chemicals called histamines which cause local expansion of blood vessels. It results in heat, redness and swelling. This condition is called inflammation. This response is often strong enough to stop the spread of microbes.

(iv) **Fever:** Fever is also a second line of defence. When macrophages attack the pathogens, they release chemicals called pyrogens in blood. When pyrogens reach the brain, the temperature regulating part of the brain raises the body's temperature above the normal value of 37 °C (98.6 °F). It results in the rise in body temperature. The higher-than-normal body temperature is known as fever. It increases the activity of phagocytes and slows bacterial and viral growth.

Q14. Write a note on blood clotting.

Ans. Blood Clotting:

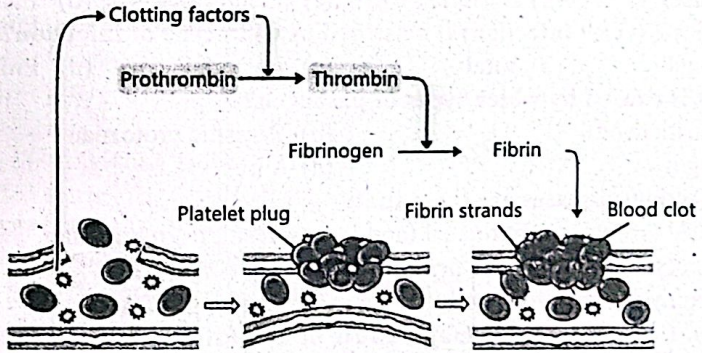
Blood clotting, or coagulation, is a process that prevents excessive bleeding when a blood vessel is injured. The following are the main steps:

(i) When a blood vessel is injured, the exposed collagen fibres activate the blood platelets. Activated platelets adhere to the collagen and the damaged walls of blood vessel. In this way, a temporary "platelet plug" is formed.

(ii) Platelets release special proteins called clotting factors which convert prothrombin (a plasma protein), into thrombin.

(iii) Thrombin converts fibrinogen, another plasma protein, into fibrin strands. Fibrin strands weave through the platelet plug, forming a blood clot.

(iv) Platelets within the clot contract and reduce the size of wound. Once the vessel is repaired. A plasma protein breaks down the fibrin clot, dissolving the clot and restoring normal blood flow.



Formation of Blood Clot

Objective Type Questions

Additional MCQ's

Multiple Choice Questions prepared in the light of new Examination Techniques
(Knowledge, Understanding, Application, Analytical & Conceptual)

9.1 Disease

1. **According to WHO which is a state of complete physical, mental and social well-being?**
   (a) Health (b) Disease (c) Disorder (d) Syndrome
2. **A specific condition that affects the normal functioning of the body or mind is defined as:**
   (a) Symptom (b) Pathogen (c) Health (d) Disease
3. **Diseases include:**
   (a) Infections (b) Metabolic disorders
   (c) Auto immune diseases (d) All of these
4. **The term "illness" refer to:**
   (a) The biological cause of a virus
   (b) The individual's subjective experience of being unwell
   (c) A localized skin infection only
   (d) The genetic basis of a condition
5. **Infectious diseases are also known as:**
   (a) Non-communicable diseases (b) Hereditary diseases
   (c) Communicable diseases (d) Lifestyle diseases
6. **Which of the following is an example of a viral infection?**
   (a) Typhoid (b) Cholera (c) COVID-19 (d) Malaria
7. **Typhoid and tuberculosis are examples of infections caused by:**
   (a) Viruses (b) Bacteria (c) Fungi (d) Parasitic worms
8. **Candidiasis (yeast infection) is classified as what type of infection?**
   (a) Fungal (b) Viral (c) Bacterial (d) Protozoan
9. **Malaria is caused by which types of pathogen?**
   (a) Parasitic worm (b) Parasitic protozoan
   (c) Fungus (d) Virus
10. **Non-infectious diseases are those that:**
    (a) Spread through contaminated food (b) Result from bug bites
    (c) Do not transmit from one person to others
    (d) Are only caused by viruses
11. **Which of the following is a major cause of non-infectious diseases?**
    (a) Pathogens (b) Heredity (c) Bacteria (d) Fungi

12. **Which of these is NOT solely due to lifestyle choices but also have a genetic basis?**
    (a) Flu (b) Diabetes and cancers
    (c) Measles (d) Cholera
13. **Depression is categorized as:**
    (a) Viral infection (b) Bacterial infection
    (c) Mental health disease (d) Communicable disease
14. **Infectious diseases can spread through all of the following EXCEPT:**
    (a) Contaminated water (b) Bug bites
    (c) Genetic inheritance (d) Person-to-person contact
15. **Genetic diseases are primarily caused by abnormalities in:**
    (a) Bacterial infections (b) Genes or chromosomes
    (c) Lifestyle choices (d) Fungal pathogens
16. **Which is an example of genetic disease?**
    (a) Alzheimer's (b) Arthritis (c) Thalassemia (d) Anthrax
17. **A zoonotic disease is one that is naturally transmitted from:**
    (a) Humans to humans (b) Plants to humans
    (c) Animals to humans (d) Soil to plants
18. **Which bacterium is responsible for causing anthrax?**
    (a) Borelli burdorferi (b) Bacillus anthracis
    (c) Plasmodium (d) Influenza
19. **Living organisms that carry pathogens from one host to another are called:**
    (a) Allergens (b) Vectors (c) Antibodies (d) Hormones
20. **Malaria is caused by a parasitic protozoan called:**
    (a) Aedes (b) Ixodes (c) Plasmodium (d) Haemagogus
21. **Which mosquito is the primary vector for dengue fever?**
    (a) Anopheles (b) Aedes (c) Haemogogus (d) Culex
22. **Lyme disease is transmitted to humans through the bite of:**
    (a) Birds (b) Ticks (Ixodes) (c) Bees (d) Bats
23. **Which organs are initially affected by the yellow fever virus?**
    (a) Skin and joints (b) Heart and lungs (c) Liver (d) Immune system
24. **Hay fever is caused by:**
    (a) Airborne allergens (b) Eating shellfish
    (c) Bee stings (d) Genetic mutations
25. **Which of the following is listed as a common food allergy?**
    (a) Distilled water (b) Shellfish (c) Cooked rice (d) Bananas

9.2 Pathogens

9.3 Immunity

26. **Which of the following diseases is caused by a fungus and is commonly transmitted through contact with contaminated surfaces?**
    (a) COVID-19 (b) Athlete's foot (c) fever (d) throat infection

27. **Which of the following are categorized as "parasitic protists"?**
(a) SAR-COV-2 and HIV
(b) Aspergillus fumigatus and Tinea pedis
(c) Giardia lamblia and Entamoeba histolytica
(d) Mycobacterium tuberculosis and E.coli

28. **AIDs and COVID-19 can be transmitted through:**
(a) Contaminated water (b) Mosquito bites
(c) Bee'sdung (d) Direct contact or droplets

29. **_____ is the ability of the body to defend itself against disease causing organisms.**
(a) Syndrome (b) Disease (c) Pathogen (d) Immunity

30. **Which type of immunity is present in body by birth?**
(a) Acquired immunity (b) Innate immunity
(c) Both (a) and (b) (d) None of these

31. **Innate immunity includes:**
(a) First line of defence (b) Second line of defence
(c) Third line of defence (d) Both (a) and (b)

32. **Which type of immunity acquired during life time?**
(a) Acquired immunity (b) Innate immunity
(c) Active immunity (d) Passive immunity

33. **The "First Line of Defence" in the human immune system includes physical barriers such as:**
(a) Macrophages and neutrophils (b) Skin and mucous membranes
(c) Antibodies and B-cells (d) Interferon and pyrogens

34. **The role of mucus in the mucous membrane is:**
(a) To treat diseases (b) To trap pathogens
(c) To insulate skin (d) To ingest bacteria

35. **Natural killer cells specificially targets:**
(a) Healthy red blood cells
(b) Pathogen-infected cells and cancer cells
(c) Mucous membranes (d) Blood platelets

36. **Inflammation results in heat, redness and swelling due to release of:**
(a) Pyrogens (b) Histamines (c) Antibodies (d) Collagen

37. **The third line of defence is also known as:**
(a) Innate immunity (b) Acquired immunity
(c) Physical barrier (d) Passive immunity

38. **Active immunity can be developed naturally or artificially through:**
(a) Antibiotics (b) Vaccination
(c) Blood clotting (d) Histamine release

39. **Which of the following is a component of the third line of defence?**
(a) Skin (b) B-cells and antibodies

(c) Mucous membranes (d) Inflammation

40. **What is the purpose of coagulation?**
(a) Carry oxygen (b) Prevent excessive bleeding
(c) Fight viruses (d) Produce platelets

41. **Which protein convert prothrombin into thrombin?**
(a) Progens (b) Clotting factors (c) Histamines (d) Interferones

42. **Thrombin's main role is to convert:**
(a) Platelets into collagen (b) Fibrinogen into fibrin stands
(c) Fibrin into prothrombin (d) Blood into plasma

Answers

1. (a)	2. (d)	3. (d)	4. (b)	5. (c)	6. (c)
7. (b)	8. (a)	9. (b)	10. (c)	11. (b)	12. (b)
13. (c)	14. (c)	15. (b)	16. (c)	17. (c)	18. (b)
19. (b)	20. (c)	21. (b)	22. (b)	23. (c)	24. (a)
25. (b)	26. (b)	27. (c)	28. (d)	29. (d)	30. (b)
31. (d)	32. (a)	33. (b)	34. (b)	35. (b)	36. (b)
37. (b)	38. (b)	39. (b)	40. (b)	41. (b)	42. (b)

Additional Short Questions

Short Answer Questions prepared in the light of new Examination Techniques (Knowledge, Understanding, Application, Analytical & Conceptual)

9.1 Disease

1. **How would you differentiate between disease and illness?**

Ans. **Disease:** Disease is a specific condition that affects the normal functioning of the body or mind.

Examples: Examples of diseases include infectious, metabolic disorders, autoimmune diseases and genetic disorders.

Illness: Illness means the subjective experience of being unwell due to disease. This include individuals perception and response towards their health condition.

2. **How many basic types of diseases are there? Name them.**

Ans. **There are two basic types of diseases:**
i- Infectious Diseases ii- Non-infectious Diseases

3. **How infectious diseases can be transmitted?**

Ans. Infectious diseases spread through contaminated food, water or bug bites.

4. **What do you know about non-infectious diseases?**

Ans. **Non-infectious diseases:** These are non-communicable diseases. They do not transmit from one person to others.

Examples: Diabetes, thalassemia and parkinson's disease are the examples of

non-infectious diseases.

5. Through which factors non-infectious diseases can be transmitted?

Ans. Non-infectious diseases can be transmitted due to heredity, unhealthy lifestyles, environmental factors and aging.

6. Which non-infectious diseases develop due to unhealthy lifestyle and mental health?

Ans. Many non-infectious diseases develop due to unhealthy lifestyle. These include heart diseases, hypertension, diabetes, cancer and stroke. Mental health diseases include depression.

7. Name the diseases occurs due to heredity and aging.

Ans. **Non-infectious diseases due to heredity:** These diseases include haemophilia, thalassemia and muscular dystrophy.

Non-infectious diseases due to aging: These diseases include Alzheimer's disease, Parkinson's disease and arthritis.

8. How humans can get zoonotic pathogens?

Ans. Humans can get zoonotic pathogens through direct contact with animals or through food, water or the environment.

9. Discuss Avian Influenza.

Ans. Avian influenza is also called bird flu. It is caused by influenza A virus. The infection site include nose, throat and lungs. Humans get bird flu through close contact with infected birds.

10. What are vectors?

Ans. Vectors are the living organisms that carry pathogens from one host to another.

11. Write down the examples of vector-Borne diseases.

Ans. Examples of vector-borne diseases include Malaria, Dengue Fever, Lyme disease and yellow fever.

12. Write a note on yellow fever.

Ans. Yellow fever is an infection caused by yellow fever virus that spreads through Aedes or Haemogogus mosquitoes. The infection initially affects the liver, then involves the kidneys, heart and nervous system.

13. Which bacteria causes Lyme disease?

Ans. Lyme disease is caused by bacteria Borrelia burgdorferi which spread through ticks.

14. Discuss insect sting allergies.

Ans. **Venom Allergens:** Bee, wasp and ant stings can trigges allergic reactions e.g. local pain and swelling, hives and in severe cases anaphylaxis.

9.2 Pathogens

9.3 Immunity

15. Define a pathogen and list two examples of different types.

Ans. **Pathogens:** A pathogen is a microorganism or agent that causes diseases in its host.

Examples of pathogens: Pathogens include virus, bacteria and fungi.

16. Identify two bacterial pathogens and the specific diseases they cause.

Ans. The bacterial pathogens are mycobacterium tuberculosis which cause tuberculosis (TB) and Escherichia coli which cause food poisoning.

9.3 Immunity

17. What is immunity?

Ans. **Immunity:** Immunity is the ability of the body to defend itself against disease causing organisms.

18. Differentiate between the roles of macrophages and neutrophils in the defence mechanism.

Ans. **Macrophages:** Macrophages develop from monocytes (a type of WBCs). They ingest bacteria and kill them.

Neutrophils: Neutrophils are a type of WBCs. They do phagocytosis. They also release killing chemicals on pathogens. They also release network of fibres which bind with pathogens and kill them.

19. What is an "interferon", and how does it help nearby cells?

Ans. Interferon is a protective protein. It is released by cells infected with viruses. Interferon causes nearby cells to make a protein that helps them resist viral infection.

20. Differentiate between active immunity and passive immunity.

Ans. **Active immunity:** In active immunity a type of lymphocytes called B-cells prepare antibodies to kill the pathogen. It may be a natural or artificial (vaccination).

Passive Immunity: In passive immunity, the individual is given antibodies to combat specific microbes. Passive immunity is short-lived.

35. Define blood clotting.

Ans. Blood clotting or coagulation, is a process that prevent excessive bleeding when a blood vessel is injured.

Exercise Questions (Solved)

A. Select the correct answers for the following questions.

1. A doctor finds bacteria in a patient's blood sample. What type of disease is the patient suffering from?

(a) Infectious disease (b) Non-infectious disease
(c) Genetic disorder (d) Nutritional deficiency

2. Which of the following is an example of an infectious disease?

(a) Diabetes (b) Hypertension (c) Influenza (d) Osteoporosis

3. A person develops rabies after being bitten by a dog. This is an example of:

(a) Non-infectious disease (b) Food-borne illness
(c) Zoonotic disease (d) Genetic disorder

4. Which of the following is a vector-borne disease?

(a) AIDS (b) Malaria (c) Tuberculosis (d) Diabetes

5. **A person develops dengue fever after a mosquito bite. In this case, the mosquito acts as:**
(a) Host (b) Pathogen (c) Vector (d) Reservoir

6. **Which of the following is the first line of defence against pathogens?**
(a) Antibodies (b) Skin and mucous membranes
(c) T cells (d) B cells

7. **Skin is categorized as;**
(a) Non-specific defence (b) Specific defence
(c) Acquired immunity (d) Passive Immunity

8. **What triggers an allergic reaction?**
(a) Pathogens (b) Allergens (c) Antigens (d) Antibodies

Answers

1. (a) 2. (c) 3. (c) 4. (b) 5. (c)
6. (b) 7. (a) 8. (b)

B. Write short answers.

1. **Define infectious diseases.**

Ans. Infectious diseases: Infectious diseases are communicable diseases. They can spread from person to person or from the enviornment to person.
Infectoius diseases results from pathogens entering the body.
Examples: Hepatitis, typhoid and malaria are infectous diseases.

2. **Define zoonotic diseases. Also give examples**

Ans. Zoonotic Diseases: An infectious disease that is naturally transmitted from animals to humans is called zoonotic disease.
Examples: Examples of zoonosis include anthrax, bird flu and ebola.

3. **Enlist allergies with some common types.**

Ans. Ans. Allergy: An allergy is an abnormal immunological response of the body against a foreign substance that's typically not harmful to the body.
Types of Allergies:
Types of allergies are:
(i) Respiratory Allergies (ii) Skin Allergies (iii) Food Allergies
(iv) Insect sting Allergies (v) Drug Allergies

4. **Differentiate between innate and acquired immunity.**

Ans. Innate Immunity: This type of immunity is present in body by birth. It includes the first line of defence and second line of defence.
Acquired Immunity: It is acquired during life time. It includes the third line of defence.

5. **Describe the role of skin as a component of defence system.**

Ans. Ans. Skin serves as a physical barrier to pathogens. In addition, the oil and sweat glands present in skin inhibit the growth of many microbes.

6. **State the role of mucous membranes in defence.**

Ans. Mocous membranes are epithelial tissues that protect the interior surfaces of the

body e.g. respiratory and digestive systems, the urethra. Mucous membranes secrete mucus that traps pathogens.

C. Write answers in detail.

1. **Describe infectious and non-infectious diseases and their types with examples.**

Ans. See Q.1 and 2 for answer

2. **Describe vector borne diseases with examples.**

Ans. See Q.4 for answer

3. **Describe the roles of T-cells and B-cells in immunity.**

Ans. See Q.10 for answer

4. **Write a note on blood clotting.**

Ans. See Q.14 for answer

D. Inquisitive questions

1- **Why do infectious diseases spread faster in crowded places?**

Ans. Infectious diseases spread rapidly in crowded environments because pathogens have more opportunities to move from person-to-person.
Modes of transmission: Many pathogens like influenza virus or mycobacterium tuberculosis are spread through airborne droplets released when an infected person cough or sneezes. In a crowd, these droplets are easily inhaled by others nearby.
Direct and surface contact: Crowded places increase direct person-to-person contact or surface touching (like doors handles) which are common transmission method.

2- **How can genetics increase a person's risk of developing non-infectious diseases?.**

Ans. Genetics can increase a person's risk of developing non-infectious diseases when faulty or mutated genes are passed from parents to their children. These genes may make the body more prone to problems such as high blood pressure, weak metabolism or uncontrolled cell growth. As a result, a person with these inherited genes has a higher chance to developing conditions like diabetes, hypertension or cancer.
Not only the genes increase the risk of diseases, the disease usually develop when genetic factors combine with unhealthy lifestyle or environmental factors.

3- **Why do some people develop allergies while others do not??**

Ans. Some people develop allergies while others do not because their immune systems react differently to certain substances. Some people get allergies because their immune system is extra sensitive often due to inherited genes from their parents. Their body overreacts to harmless things like dust or pollen. Other do not develop allergies because they do not have this sensitivity. Environment and exposure to allergens can also affect who develops allergies.

CHAPTER 10 Evolution

Student Learning Outcomes

After Studying this chapter, students will be able to:

- Explain the theory of evolution by natural selection with examples.
- Define species.
- Discuss briefly the observations Darwin made during his voyage on HMS Beagle.
- Describe sources of variation which can lead to speciation and evolution.
- Describe evidence of evolution with regards to the following:
- Paleontology (fossil record)
- Comparative anatomy (homologous structures, vestigial structures)
- Selective breeding

Subjective Type Questions

Long Questions prepared in the light of new Examination Techniques (Knowledge, Understanding, Application, Analytical & Conceptual)

10.1 Darwin's Observations

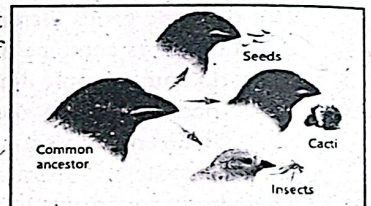
Q1. Define Evolution. Who laid the foundations of theory of Evolution by natural selection?

Ans. Evolution: Evolution is the change in heritable traits of population over the course of successive generations.

- It involves the gradual changes in characteristics passed from one generation to the next.

In 1850s, English naturalist Charles Darwin (1809-1882) He explained the mechanism of evolution in a comprehensive way. He went on five year trip around the world on his Majesty's Ship (HMS) Beagle.

During his voyage, Darwin made a lot of important observations that laid the foundations of his theory of Evolution by natural selection.



Finches with different beak sizes and shapes

Q2. Write a note on the observations Darwin made during his voyage.

Ans: Key observations made by Darwin:

The following are some important observations made by Darwin:

(i) Unique species: He observed a variety of unique plant and animal species in different regions. He observed that different islands and environments had their own distinct sets of species.

(ii) Variations in same species: Darwin observed variations among same species living in different environments.

He noticed that these were adaptations i.e., special variations in an organism's body or behaviour that help it survive in its environment. He was convinced on the role of adaptations in the survival of species.

Q. What is evidence of evolution of whale?
Ans. Some whales have tiny leg bones buried deep inside their bodies! These bones no longer serve a purpose in swimming. These are powerful clues to the whale's evolutionary past. They're like fossils inside the body.

(iii) Beaks of finches: On the Galapagos Islands, he noticed that different species of finches had different sizes and shapes of beaks in different islands. He noticed that different foods e.g., seeds, cacti and insects were available at different islands. The beaks of finches were suited according to the food sources available on specific island.

(iv) Fossils of extinct animals: When he observed the fossils of extinct animals, he found their resemblance with modern species. This suggested that species could change overtime.

After returning from his voyage, Darwin analysed his observations and gathered more evidence to support his ideas. Eventually, in 1859, Darwin published his work in the form of a book, "On the Origin of Species". In this book, he presented his "theory of evolution by natural selection".

10.2 Theory of Evolution By Natural Selection

Q3. Explain the theory of evolution by natural selection.

Ans. Natural Selection:

Natural selection is the process through which the individuals with better characteristics (variations) are more likely to live, reproduce and pass those variations to their offspring.

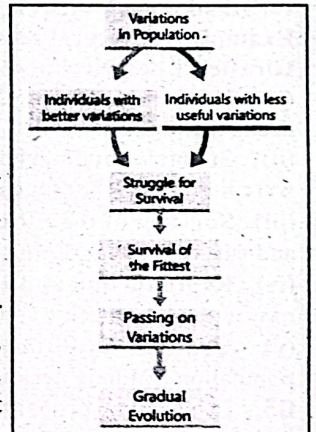
Steps of natural selection:

Natural selection works in following steps:

(i) Variations: In every species, individuals are slightly different from one another. These differences may be in colour, size, speed, strength or ability to find food.

For example: Some beetles are green and some are brown.

(ii) Struggle for Survival: Living things compete for limited resources such as food, water, space, and mates. Also, they face threats from predators, diseases, and harsh environments. For example: Birds eat beetles, so beetles must survive by hiding or blending in.

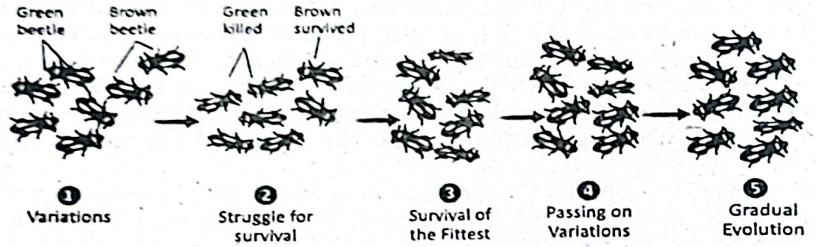


Mechanism of evolution

(iii) Survival of the Fittest: The individuals with better variations are more likely to live and reproduce. "Fittest" means best suited, not necessarily the strongest. For example: Brown beetles blend in with the soil better than green beetles. So, they will be difficult to be preyed upon by birds.

(iv) Reproduction and Passing on Variations: The surviving individuals reproduce and pass their useful variations to their offspring. Over time, these helpful variations become more common in the population. For example: More brown beetles are born because the green ones were eaten more often.

(v) Gradual Evolution Over Time: After many generations, small changes build up. The species slowly changes. If the environment continues to favour certain variations, new species may eventually form. For example: If only brown beetles survive and reproduce over many generations, the whole beetle population may become brown.



Process of natural selection

Q4. Define Natural Selection. Describe the process of natural selection using the example of giraffe.

Ans. Natural Selection: Natural selection is the process through which the individuals with better chracteristics (variations) are more likely to live, reproduce and pass these variations to their offspring.

Examples of Natural selection:

Giraffe's Long Neck:

(i) Variations: Some giraffes had slightly longer necks than others.

(ii) Struggle for Survival: Food (leaves on tall trees) were hard to reach, especially during dry seasons.

Q. Why do giraffes have such long necks?
Ans. It's not just about reaching high leaves. Some scientists suggest long necks also helped male giraffes fight each other.

(iii) Survival of the Fittest: Giraffes with longer necks could eat leaves from taller trees and survived better during harsh conditions.

(iv) Reproduction and Passing on Traits: These long-necked giraffes reproduced and passed the long-neck trait to their babies.

(v) Gradual Evolution Over Time: Over many generations, most giraffes in the population had long necks.

Q5. Explain the process of natural selection using the example of peppered moth during industrial revolution.

Ans. Peppered Moth (During Industrial Revolution in England)

(i) Variations: Some moths were light-coloured, and some were dark-coloured.

(ii) Struggle for Survival: Birds hunted the moths during the day as they rested on tree bark.

(iii) Survival of the Fittest: After pollution darkened the tree bark, dark- coloured moths blended in and survived better than light ones.

(iv) Reproduction and Passing on Variations: Dark moths reproduced more and passed on the dark colourtrait.

(v) Gradual Evolution Over Time: Over time, the population had more dark-coloured moths than light ones.

10.3 Species and Speciation

Q6. Write different types of speciation.

Ans. Types of speciation: There are two main types of speciation:

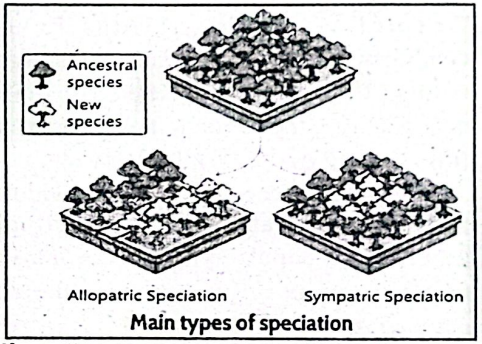
(i) Allopatric speciation **(ii)** Sympatric speciation

1. **Allopatric Speciation:** This speciation occurs when a population is geographically separated into two or more populations. The physical barrier (such as a mountain range, river, or ocean) prevents individuals from different groups from breeding. Over time, the isolated populations evolve differently and become distinct species.

For example: In the case of the finches of Galapagos Islands, different islands provided unique environment. Over time, populations of finches adapted to each environment, eventually becoming separate species.

(ii) Sympatric Speciation: This speciation occurs when reproductive isolation happens within the same geographical area due to habitat preference or behaviour.

For example: Groups of fishes of same species live in the same lake. Both the groups are reproductively isolated due to dietary preferences or mate selection. Over time, the groups remain reproductively isolated, resulting in the emergence of new species.



Main types of speciation

Q7. Explain briefly about species and speciation.

Ans. Species: A species is a group of organisms that can interbreed and produce fertile offspring under natural conditions. Members of the same species are similar and are reproductively isolated from other species. For example, Lions (Panthera leo) and Tigers (Panthera tigris) are distinct species. They do not naturally interbreed with each other.

Speciation: Speciation is the process by which new species arise by evolution.

10.4 Sources of Variations

Q8. Describe the sources of variations.

Ans. Variations:

Variations are the inheritable differences among individuals in a papulation on which natural selection can act.

Sources of variations: The following are the main sources of variations.

(i) Mutations:

Mutation is a permanent change in the DNA of an organism that can pass on to the offspring. Mutations can occur spontaneously or by environmental factors such as radiations or chemicals. Mutations result in new characteristics (variations) in organism. Most mutations are neutral or harmful. Some mutations can be beneficial and provide better variations to the organism.

Example: In a population of bacteria, a mutation may produce antibiotic resistance in some individuals. These resistant bacteria have more chances to survive and reproduce in the presence of antibiotics. They can pass on this variation to future generations.

Q. Why you don't look exactly same, to your parents?
Ans. You probably look similar to your parents and siblings. However, you don't look exactly the same, and this is due to variations.

(ii) Genetic Recombination:

In sexually reproducing organisms, genetic recombination occurs during the formation of gametes through meiosis. The mixing of genetic material from two parents produces offspring with new combinations of genes.

This results in variation by creating new combinations of characteristics.

Example: Human siblings have different combinations of characteristics (e.g., hair colour, eye colour) because of the genetic recombination that occurs during the formation of gametes in parents.

Q. Discuss Bananas have numerous mutations.
Ans. Many bananas are triploid, meaning they have three sets of chromosomes. It makes them sterile. They can't reproduce normally. So, every banana is a clone i.e., grown from a cutting of another plant.

(iii) Gene Flow (Migration):

Gene flow occurs when individuals from one population migrate to another and introduce new genes in that population. This can introduce new variations within a population. If these new variations prove better in the new population, they can spread through the population.

Example: When plants from one area cross-pollinate with plants from a different region, they introduce new characteristics into the population, such as improved drought resistance varieties.

(iv) Random Pairing of Gametes:

During sexual reproduction, the pairing (fusion) of egg and sperm is random. It means that any sperm can fertilize any egg. It increases variation by producing offspring with unique combinations of genes inherited from both parents.

Example: In humans, the random paring of an egg and one sperm from millions of possibilities leads to children in the same family having different characteristics, even though they share the same parents.

10.5 Evidences of Evolution

Q9. Justify how fossil record provides an evidence of evolution.

Ans. Palaeontology:

Palaeontology is the study of fossils, which serves as a primary tool for scientists to reconstruct the history of life an earth.

Q. What are fossils?
Ans. Fossils are the remains, impressions or traces of organisms that lived in the past. Most fossils are found in sedimentary rocks.

Visual record of change: Fossils provide a direct visual record of evolutionary changes that have occurred among various organisms over time.

Sequential observations: Palaeontologists use fossils to observe the specific sequence in which different groups of organisms appeared.

Vertebrate Evolution: The fossil record reveals a clear chronological sequence of vertebrate classes, starting with fishes, followed by amphibians, reptiles and then birds and mammals.

Bridging Evolutionary Gaps: Fossils show the characteristics of both ancestors and their subsequent generations acting as a "bridge" to fill gaps in evolutionary history.

Evidence of Gradualism: The study of these remains provides physical evidence of the gradual history of various species, proving that change happens over long periods rather than all at once.

For example: Fossils of archaeopteryx (a bird-like dinosaur) provides evidence that birds evolved from a tetrapod dinosaur (a reptile).

Archaeopteryx

Q10. Write a note an homologous structures as an evidence of evolution.

Ans. Evolution:

Homologous structures: The similar structures in different species that perform different functions are called homologous structures.

For example: The forelimbs of mammals (arm of human, legs of cat, flippers of whale and wings of bat) all have the same structure but different functions.

Conclusion: The basic similarity of structure of these forelimbs is the evidence that they evolve from a common ancestor.

Homologous structures

Q11. What are vestigial structures? Explain how they provide evidence of evolution.

Ans. Vestigial organs:

Vestigial organs are body parts that have no apparent function but were fully functional in a organism's ancestors.

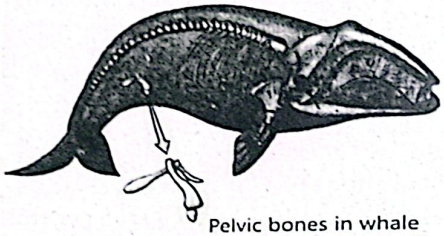
Examples of vestigial organs:

- **Human appendix:** It is a small, tube-like structure attached to the cecum. I humans, it is a vestigial structure. It might have played a more important role in th

digestive system of ancestors.

- **Ear muscles in humans:** In many animals, such as cats and dogs, ear muscles move their ears to detect sounds from different directions. However, in humans, these ear muscles are largely non-functional. So, these are vestigial structures in humans.
- **Pelvic bones in whales:** Modern whales have small, non-functional pelvic bones even though they do not have legs.
- **Wings in flightless birds:** Birds like ostriches have wings, but they do not use them for flight.

Human Appendix



Pelvic bones in whale

Vestigial Organs

Q12. What is selective breeding? Describe how humans use selective breeding in plants and animals.

Ans. Selective Breeding:

Selective breeding means the process in which humans select varieties of plants or animals and breed them to produce offspring with required characteristics.

Q. Difference between Homologous organs and Analogous organs.
Ans. Homologous organs are structurally same but functionally different. Analogous organs are functionally same but structurally different e.g. wings of bat, birds and insects etc.

Selective Breeding in Animals:

Breed: The varieties of animals which are selectively bred are called breeds.

Importance:

- Many breeds of sheep goat, cow hen etc. have been produced by selective breeding to increase the production of meat, milk, eggs, wool etc.

Different Breeds of Hen

Selective Breeding in Plants:

Varieties or cultivars: The varieties of plants which are selectively bred are known as varieties or cultivars.

Importance:

- Many plant varieties have been produced for better quantity and quality of food.
- This process has proved very successful for the improvement of yields in economically important plants like wheat, rice, potato and apple etc.

Varieties (cultivars) of Potato and apple

Q13. Write down the advantages of selective breeding.

Ans. Advantages of selective breeding:

Selective breeding:

(i) Improves desirable traits. (ii) Increases yield of crops and animals.
(iii) Produces disease-resistant varieties. (iv) Improves quality of products.
(v) Helps organisms adapt to environments.

Objective Type Questions

Additional MCQ's

Multiple Choice Questions prepared in the light of new Examination Techniques (Knowledge, Understanding, Application, Analytical & Conceptual)

10.1 Darwin's Observations

1. **_____ is the change in heritable traits of population over the course of successive generations.**
   (a) Genetics (b) Variations (c) Evolution (d) Respiration
2. **Charles Darwin explained the mechanism of evolution in a comprehensive way during which decade?**
   (a) 1750s (b) 1800s (c) 1850s (d) 1950s
3. **What was the name of ship Darwin traveled on during his five-year voyage?**
   (a) HMS victory (b) HMS endeavor (c) HMS Beagle (d) HMS Titanic
4. **Darwin observed that different islands had their own distinct sets of species. This falls under which observation category?**
   (a) Unique species (b) Selective breeding
   (c) Artificial selection (d) Instant mutation
5. **The "special variations" in an organism's body or behavior are known as:**
   (a) Mutations (b) Adaptations (c) Generations (d) Successions

6. **Darwin noticed that finch species had different beak sizes and shapes depending on:**
   (a) The age of the birds
   (b) The food sources available of specific Island
   (c) The colour of flowers on island (d) The temperature of island
7. **In which year did Charles Darwin finally publish his famous book?**
   (a) 1809 (b) 1850 (c) 1859 (d) 1882
8. **What is the title of the book Darwin published to present his findings?**
   (a) The descent of man (b) On the origin of species
   (c) The voyage of beagle (d) Natural selection and evolution

10.2 Theory of Evolution By Natural Selection

9. **According to the theory of natural selection "fittest" refers to organisms that are:**
   (a) The physically strongest in the group (b) The fastest runners in a population
   (c) Best suited to their environment (d) The largest in size
10. **Which of the following is the first step in the mechanism of evolution?**
    (a) Struggle for survival (b) Survival of the fittest
    (c) Variations in population (d) Gradual evolution
11. **Living things compete for resources:**
    (a) Food and water (b) Water and space (c) Space and food (d) All of these
12. **In a population of beetles, if birds prefer to eat green beetles, which beetles are most likely to survive and reproduce?**
    (a) Green beetles (b) Brown beetles
    (c) Both colors equally (d) None of these
13. **"Living things compete for limited resources such as food, water and mates". This statement describes:**
    (a) Variations (b) Struggle for survival
    (c) Passing on traits (d) Fossilizations
14. **"Passing on variations" directly leads to:**
    (a) Struggle for survival (b) Variations in population
    (c) Gradual evolution (d) Immediate mutation
15. **Variations in a species can include differences in:**
    (a) Colour and size (b) Speed and strength
    (c) Ability to find food (d) All of these

10.3 Species and Speciation

16. **Speciation begins when:**
    (a) Organisms migrate to same place
    (b) A population becomes reproductively isolated
    (c) All individuals share the same traits (d) Mutations stop occurring
17. **Allopatric speciation occurs mainly due to:**
    (a) Behavior differences (b) Geographical isolation
    (c) Change in diet (d) Change in chromosome number
18. **Which is an example of a geographical barrier in allopatric speciation?**
    (a) Mating season (b) Food preference

(c) River or mountain range (d) Aggressive behavior

19. **Darwin's finches on the Galapagos Islands are an example of:**
    (a) Artificial selection (b) Allopatric speciation
    (c) Breeding between species (d) Random pairing
20. **Sympatric speciation occurs when:**
    (a) Populations are separated by distance (b) Organisms migrate to new islands
    (c) Reproductive isolation happens within the same area
    (d) New predators appear
21. **Which of the following may cause sympatric speciation?**
    (a) Change in food preference (b) Change in climate
    (c) Physical barriers (d) Increase in predators

10.4 Sources of Variations

22. **Which one of the following are the inheritable differences among individuals in a population on which natural selection can act:**
    (a) Evolution (b) Mutations (c) Sources (d) Variations
23. **A mutation is best defined as:**
    (a) Temporary change in body features (b) Permanent change in DNA
    (c) Change in behavior (d) Change in population size
24. **Why do mutations create variations?**
    (a) They increase population size (b) They reduce genetic diversity
    (c) They introduce new traits into a population
    (d) They stop genetic recombination
25. **Genetic recombination happens during:**
    (a) Fertilization only (b) Mitosis
    (c) Formation of gametes during meosis (d) Aging
26. **Gene flow occurs when:**
    (a) Individuals migrate and interbreed with another population
    (b) Only mutation appears
    (c) Species become extinct (d) Gametes randomly fuse
27. **When plants cross-pollinate with plants from another region, they introduce:**
    (a) Chromosome damage (b) New genes into population
    (c) Less variation (d) No change
28. **Which of the following is NOT a source of variation?**
    (a) Mutation (b) Genetic recombination
    (c) Gene flow (d) Same environment

10.5 Evidences of Evolution

29. **Fossils are important in studying evolution because they:**
    (a) Show only the external shape of organisms
    (b) Provide a visual record of past life forms
    (c) Show only living species (d) Tell us about future species
30. **Which fossil is considered a link between reptiles and birds?**
    (a) Trilobite (b) Archaeopteryx (c) Ammonite (d) Pterodactyl

31. **Comparative anatomy helps scientists understand evolution by studying:**
(a) Behavior of organisms (b) DNA sequence only
(c) Similarities and differences in body structures
(d) Age of the Earth

32. **Homologous structures show evidence of:**
(a) Different ancestors (b) A common ancestor
(c) Identical functions (d) No relationship between species

33. **Which of the following is a vestigial organ in humans?**
(a) Heart (b) Appendix (c) Kidney (d) Stomach

34. **Analogous organs are:**
(a) Structurally same (b) Structurally different
(c) Functionally different (d) Both (a) and (b)

35. **Examples of analogous organs are:**
(a) Wings of bat (b) Wings of birds (c) Wings of insects (d) All of these

36. **Small pelvic bones in whales are evidence that whales:**
(a) Never had legs (b) Evolved from ancestors
(c) Use the bones for swimming (d) Are closely related to fish

37. **The varieties of animals which are selectively bred are called:**
(a) Varieties (b) Cultivars (c) Breeds (d) Vectors

38. **The varieties of plants which are selectively bred are called:**
(a) Breeds (b) Cultivars (c) Vectors (d) Breeders

39. **All are examples of cultivars except:**
(a) Wheat (b) Rice (c) Potato (d) Hen

Answers

1.	(c)	2.	(c)	3.	(c)	4.	(a)	5.	(b)	6.	(b)	7.	(c)
8.	(b)	9.	(c)	10.	(c)	11.	(d)	12.	(b)	13.	(b)	14.	(c)
15.	(d)	16.	(b)	17.	(b)	18.	(c)	19.	(b)	20.	(c)	21.	(a)
22.	(d)	23.	(b)	24.	(c)	25.	(c)	26.	(a)	27.	(b)	28.	(d)
29.	(b)	30.	(b)	31.	(c)	32.	(b)	33.	(b)	34.	(b)	35.	(d)
36.	(b)	37.	(c)	38.	(b)	39.	(d)						

Additional Short Questions

Short Answer Questions prepared in the light of new Examination Techniques (Knowledge, Understanding, Application, Analytical & Conceptual)

10.1 Darwin's Observations

1. **Define evolution.**

Ans. **Evolution:** Evolution is the change in heritable traits of population over the course of successive generations.

It involves gradual changes in characteristics passed from one generation to the next.

2. **Describe the journey that led Charles Darwin to his findings on evolution.**

Ans. English naturalist Charles Darwin (1809-1882) went on five-year trip around the world on his majesty's ship (HMS) beagle.
During his voyage, Darwin made a lot of important observations that laid the foundations of his theory of evolution by natural selection.

3. **What did Darwin observe regarding "unique species" on different islands?**

Ans. Darwin observed variety of unique plant and unique animal species in different regions. He observed that different islands and environments had their own distinct set of objects.

4. **Explain how the beaks of Galapagos finches varied according to their environment.**

Ans. Darwin noticed that finch specie had different sizes and shapes of beaks depending on the food sources available on their specific island such as seeds, cacti or insects.

5. **What conclusion did Darwin drawn from studying fossils of extinct animals?**

Ans. Darwin found that fossils of extinct animals shared a strong resemblance with modern species. This led him to suggest that species are not fixed and could change over long periods of time.

6. **State the name and publication year of Darwin's famous book.**

Ans. After analyzing his evidence for many years, Darwin published his work in 1859 in a book titled "on the origin of species". In this book, he presented his "theory of evolution by natural selection".

10.2 Theory of Evolution By Natural Selection

7. **State the theory of evolution by natural selection.**

Ans. The theory of evolution by natural selection states that "living things change over time. Those with helpful characteristics (variations) survive, reproduce and pass those characteristics to their young over many generations, these favourable characteristics become more common in the population. It lead to the evolution of new species."

8. **What is meant by variations in a species?**

Ans. Variations refer to slight differences between individuals of the same species. These differences may include colour, size, speed, strength or the ability to find food.

9. **Briefly explain the "survival of the Fittest" in natural selection.**

Ans. The individuals with better variations are more likely to live or reproduce. "Fittest" means best suited, not necessarily the strongest.
For example: Brown beetles blend in with the soil better than green beetles. So, they will be difficult to be prayed upon birds.

10. **How does natural selection explain the long necks of giraffe?**

Ans. Some giraffes had slightly longer necks than others. During dry seasons, food on tall trees was hard to reach, so long-necked giraffes survived better, reproduced and pass that trait to their babies.

10.3 Species and Speciation

11. What are species?

Ans. Species: A species is a group of organisms that can interbreed and produced fertile offspring's under natural condtions.

12. Define speciation. Write down the names of its two types.

Ans. Speciation: Speciation is the process by which new species arise by evolution.

Types of speciation: There are two main types of speciation:

i- Allopatric Speciation ii- Sympatric Speciation

10.4 Sources of Variations

13. Which are the main sources of variations?

Ans. The following are the main sources of variations:

i- Mutations ii- Genetic recombination
iii- Gene flow iv- Random pairing of gametes

14. How does mutation act as a source of variation?

Ans. A mutation is the permanent change in the DNA sequence of an organism. These changes are caused by environmental factors or errors during DNA replication. Most mutations are neutral or harmful some mutations can be beneficial.

15. How variation occurs through genetic recombination?

Ans. In sexually reproducing organisms, genetic recombination occurs during the formation of gametes through meiosis. The mixing of genetic material from two parents produces offspring's with new combinations of genes. This results in variations by creating new combinations of characteristics.

16. Discuss how gene flow effect the population?

Ans. When individuals from one population migrates to another they introduce new genes in the population. This can introduce new variations within a population. If these new variations prove better in a new population, they can spread through the population.

10.5 Evidences of Evolution

17. What is palaeontology?

Ans. Palaeontology: Palaeontology is the study of fossils.

18. Why palaeontologists study fossils?

Ans. Palaeontologist study fossils:

i- To observe evolutionary sequences ii- To track vertebrate history
iii- To link ancestors to new generations iv- To bridge evolutionary gaps
v- To provide evidence of gradual change

19. What is comparative anatomy?

Ans. Comparative anatomy involves the similarities and differences in the structures of different organisms.

20. What do you know about vestigial organs?

Ans. Vestigial organs: Vestigial organs are the body parts that have no apparent function but were fully functional in an organism's ancestor.

For example: Appendix is a vestigial structure in humans. It might have played a more important role in the digestive system of ancestors.

21. Differentiate between breeds and cultivars.

Ans. Breeds: The varieties of animals which are selectively bred are called breeds.

For example: Many breeds of sheep, goat and hen etc. have been produced by selective breeding to increase the production of meat, milk, eggs and wool etc.

Cultivars: The varieties of plants which are selectively bred are known as varieties or cultivars.

For example: Plants like wheat, potato, rice and apple are selectively bred.

Exercise Questions (Solved)

A. Select the correct answers for the following questions.

1. The survival and reproduction of individuals with advantageous traits is called:
(a) Mutations (b) Gene flow
(c) Natural selection (d) Asexual reproduction

2. A population is split by a river. After many generations, both population evolve into different species. What type of speciation may occur?
(a) Sympatric (b) Genetic drift (c) Mutation (d) Allopatric

3. Which characteristics in whales supports that their ancestors lived on land?
(a) Big body (b) Fins
(c) Pelvic bones (d) Stream-lined body

4. Farmers choose best cows to breed. It is an example of:
(a) Natural selection (b) Selective breeding
(c) Adaptation (d) Genetic mutation

5. Darwin's observation of finches proved that:
(a) Climate was same on all islands (b) All finches were identical
(c) They adapted to different foods on different islands
(d) Finches never migrated

6. A new variation appears suddenly and helps survival. What happens next?
(a) It disappears (b) It spreads through population
(c) It causes disease (d) It's removed by natural selection

7. Which of these is a vestigial structure?
(a) Human ear muscles (b) Wings of Sparrow
(c) Beak of duck (d) Tail of cat

8. Which pair are homologous structures?
(a) Bird wings and butterfly wings (b) Dolphin fins and shark fins
(c) Human arms and dolphin fins (d) bat wings and bird wings

9. Human appendix is a vestigial organ because it:
(a) Has a major digestive function (b) Is part of the immune system

(c) Is no longer useful for digestion (d) Helps in absorbing nutrients

10. **Artificial selection is similar to natural selection because;**
(a) Environmental conditions play role in both
(b) Both occur over millions of years
(c) Both are carried out by humans
(d) Both depend upon variations among individuals

Answers

1. (c)	2. (d)	3. (c)	4. (b)	5. (c)
6. (b)	7. (a)	8. (c)	9. (c)	10. (d)

B. Write short answers.

1. **Write a short note on selective breeding.**

Ans. **Selective Breeding:** Selective breeding means the process in which humans select varieties of plants or animals and breed them to produce offsprings with required characteristics.

- Selective breeding increases yield, improves quality and produce disease and pest resistance of plants and animals.

2. **What are the two types of speciation?**

Ans. **i- Allopatric speciation:** This speciation occurs when a population is geographically separated into two or more populations.

- The physical barriers are mountains, rivers or oceans.

Examples: Darwin's finches becoming different on different islands.

ii- Sympatric speciation: This speciation occurs when reproductive isolation happens within reproductive isolation happens within the same geographical area.

- It is due to habitat preference or behaviors.

Example: Group of fish in the same lake developing different dietary or mate preferences.

3. **Provide examples of homologous structures.**

Ans. Examples of homologous structures are forelimbs of mammals (arms of human, legs of cat) flippers of whale and wings of bat) all have some same structure but different functions.

4. **List the steps in the process of natural selection.**

Ans. Natural selection works in following steps:

i- Variations ii- Struggle for survival iii- Survival of the fittest
iv- Reproduction and passing on variations v- Gradual evolution over time

C. Write answers in detail.

1. **Explain the theory of evolution by natural selection.**

Ans. For answer see Q's 3

2. **Write a note on the observations Darwin made during his voyage.**

Ans. For answer see Q's 2

3. **Describe the sources of variation.**

Ans. For answer see Q's 8

4. **Justify how fossil record provides an evidence of evolution.**

Ans. For answer see Q's 9

5. **Write a note on homologous structures as an evidence of evolution.**

Ans. For answer see Q's 10

6. **What are vestigial structures? Explain how they provide evidence of evolution.**

Ans. For answer see Q's 11

D. Inquisitive questions

1- **Why is variation among individuals important for evolution?**

Ans. Variation is the raw material for evolution.

(i) It ensures that some individuals in a population possess traits that allow them to survive environmental changes such ase diseases or climate shifts.
(ii) Without variation all individuals would be identical
(iii) A population with high genetic variation is less likely to go extinct because it is more adaptable to diverse challenges.

2- **How do fossils help scientists understand the history of life on Earth?**

Ans. Fossils help scientist understand the history of life on earth because they provide direct evidence of organisms that lived millions of years ago. By studying fossils scientists can:

(i) Identify ancient species and compare them with present.
(ii) Understand how organism changed over time, showing patterns of evolution.
(iii) Determines the age of rock layers.
(iv) Reconstruct past environments such as whether an area was underwater, frosted or desert.
(v) Trace the appearance and disappearance of species, helping to understand extinction and the formation of new species.

3- **Why can isolation lead to the formation of new species??**

Ans. Isolation (especially geographic or allopatric isolation) is a key driver of speciation because:

Interruption of gene flow: When a population is split (e.g. by a river or mountain range), the two groups can no longer breed with each other, this stops the exchange of genetic information.

Independent Evolution: Each isolated group faces different environmental pressures and food sources. Each isolated group develop unique variations. Natural selection acts differently. Their traits gradually become more and more different.

Reproductive Incompatibility: Eventually, the genetic differences are so significant that even if the group meet again, they can no longer interbreed to produce fertile offspring's.

Pairing Scheme / Instructions for Preparation of Exam Paper of Biology for Class-10

The paper of Biology (General) for class 10 will consist of 60 marks. Timing of the paper will be two hours. The paper will be made as per following details:

Part-I: **Q-1:**

Objective: 12 Multiple Choice Questions. The detail is as follows: $1 \times 12 = 12$

Chapter	1	2	3	4	5	6	7	8	9	10
MCQs	1	1	1	2	1	1	1	1	1	2

Part-II: **Q-2:**

Subjective: 5 short answer questions have to be answered out of 8. The detail is as follow: $2 \times 5 = 10$

Chapter	1	2	5
No. of Short Questions	2	4	2

Q-3:

5 short answer questions have to be answered out of 8. The detail is as follow: $2 \times 5 = 10$

Chapter	3	4	6	7
No. of Short Questions	2	3	1	2

Q-4:

5 short answer questions have to be answered out of 8. The detail is as follow: $2 \times 5 = 10$

Chapter	8	9	10
No. of Short Questions	2	2	4

Part-III: **Subjective:** This section will contain three detailed question bifurcated in two-part **a** & **b** (carrying 5 & 4 marks each) and students have to attempt 2 questions. The detail is as follows: $2 \times 9 = 18$

Q-5:

Chapter	1	3
Part	a	b

Q-6:

Chapter	6	5
Part	a	b

Q-7:

Chapter	9	8
Part	a	b

Model Paper of Biology For Class-10

Time Allowed: 15 Min **Objective Type** **Max. Marks: 12**

Note: Four possible answers A, B, C and D to each question are given. The choice which you think is correct, fill that circle with marker or pen ink in the answer-book. Cutting or filling two or more circles will result in zero mark in that question.

1. Select the correct answer.

(i) The part of the stomach just after the oesophagus is called:
(a) Fundus (b) Pyloric end (c) ✓Cardiac end (d) Body

(ii) Which of these correctly orders the structures through which air passes during inhalation?
(a) Pharynx → trachea → larynx →bronchi
(b) ✓Pharynx → larynx → trachea →bronchi
(c) Larynx → pharynx → bronchi → trachea
(d) Larynx → pharynx → trachea → bronchi

(iii) Trace the correct pathway for deoxygenated blood from legs back to the heart:
(a) ✓Femoral veins → Inferior vena cava → Right atrium
(b) Femoral arteries → Inferior vena cava → Right atrium
(c) Femoral veins → Superior vena cava → Right atrium
(d) Femoral arteries → Superior vena cava → Right atrium

(iv) Ureter leaves the kidney through:
(a) pelvis (b) ✓hilus (c) papillary duct (d) collecting duct

(v) Tubular secretion is a/an:
(a) ✓active transport (b) diffusion (c) osmosis (d) passive transport

(vi) The function of glucagon is to:
(a) accelerates protein synthesis within cells
(b) ✓stimulates release of glucose from liver
(c) decrease release of glucose from liver
(d) slow down glucose formation from lactic acid

(vii) Fertilization usually occurs in the:
(a) uterus (b) vagina (c) ✓fallopian tube (d) cervix

(viii) If transcription is blocked, what will NOT form?
(a) ✓mRNA (b) Amino acids (c) Proteins (d) Ribosome

(ix) If a gene from bacteria is transferred into corn, the advantage is:
(a) larger corn size (b) ✓production of natural toxin
(c) more vitamins (d) faster growth

(x) Arrange the following in correct order:
1. Thrombin converts fibrinogen 2. Platelets form a temporary plug
3. Clotting factors convert prothrombin 4. Platelets contract to reduce wound size
(a) ✓2 → 3 → 1 → 4 (b) 1 → 2 → 3 → 4
(c) 3 → 2 → 4 → 1 (d) 4 → 3 → 2 → 1

(xi) What does "fittest" mean in evolution?
(a) Strongest (b) Largest (c) ✓Best suited (d) Fastest

(xii) In allopatric speciation, the main factor preventing gene flow is:
(a) climate (b) predation (c) ✓physical barrier (d) competition

Time Allowed: 1:45 Hrs

Subjective Type (Part I)

Max. Marks: 48

Q.2: Write short answers to any five (05) questions: (2 × 5 = 10)

(i) State two functions of the liver other than digestion.
(ii) Differentiate between bolus and chyme.
(iii) What is pleura? Write its function.
(iv) Write about the blood circulation in lungs.
(v) Mention the events during exhalation.
(vi) What are the causes and symptoms of emphysema?
(vii) Compare the functions of thalamus and hypothalamus.
(viii) Name any four hormones secreted by anterior lobe of pituitary gland.

Q.3: Write short answers to any five (05) questions: (2 × 5 = 10)

(i) Give the names and functions of any two proteins present in blood plasma.
(ii) What are agranulocytes? Write its types.
(iii) Differentiate between pressure filtration and tubular secretion.
(iv) What do you mean by lithotripsy?
(v) Define renal pelvis.
(vi) Compare the functions of estrogen and progesterone.
(vii) What is the composition of eukaryotic chromatin?
(viii) Why did Mendel choose pea plant as an experimental material? Give two reasons.

Q.4: Write short answers to any five (05) questions: (2 × 5 = 10)

(i) Mention the role of bacteria in Genetic Modification.
(ii) Write any two potential risks of biotechnology.
(iii) Name the infections caused by fungi and parasitic protozoan.
(iv) What are zoonotic diseases? Give two examples.
(v) Define vestigial structures. Give examples in humans.
(vi) How does mutation act as the main source of variation?
(vii) What is Sympatric Speciation? Give an example.
(viii) List the steps in the process of natural selection.

Subjective Type (Part II)

Note: Attempt any two questions (2 × 9 = 18)

Q.5. (a) Describe the absorption of food in small intestine.

(b) How does blood circulate in human heart?

Q.6. (a) What are sexually transmitted diseases? Explain with an example of AIDS.

(b) Describe the hormones with functions of the adrenal gland.

Q.7. (a) In what ways do killer cells and protective proteins contribute to the second line of defence?

(b) How does biotechnology help in medical field?

ہمدرد کتب خانہ

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ہمدرد امتحانی کتب برائے میٹرک کلاسز

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