

# Exercise

## Short questions

### 2. What are the living and nonliving characteristics of viruses?

#### Ans: Characteristics of viruses:

They show the characteristic of both living and nonliving things.

#### The living characteristics of viruses are:

- (I) Viruses occur in different varieties or strains.
- (II) They have their own genetic material in the form of either DNA or RNA that can undergo mutation.
- (III) They reproduce using the metabolic machinery of the host cell they infect.
- (IV) They enter living organism and cause disease i.e , intracellular obigate parasite.
- (V) They get destroyed by ultraviolet rays.

#### The nonliving characteristics of viruses are:

- (I) They lack cellular structure, coenzyme and enzyme system and do not have metabolic activity of their own.
- (II) They can be crystallized and stored in bottles.
- (III) They do not respire . Viruses behave as nonliving , inert infectious particles outside the host.
- (IV) They do not have a cellular structure , which is the basis of all life.

### 3. Give the classification of viruses based on their hosts.

#### Ans: Classification of Virus:

Virus classification is either based upon host organisms or on other structural characters such as morphology, genome type and mode of action in the host.

The internationally agreed system of virus classification is based on the structure and composition of the virus particle (virion). In some cases, the mode of replication is also important in classification.

#### Classification of viruses based upon host:

Viruses can be classified on the basis of their hosts e.g , bacteriophage , virus, plant viruses and animal viruses.

#### Bacteriophage virus:

It attacks bacteria. It is a DNA virus with a polyhedral tail.

#### Plant viruses:

More than 2,000 types of viral plant diseases are known.

- Most plant viruses discovered till to date including tobacco mosaic virus (TMV) having an RNA genome.
- Many viruses have rod shaped capsid like TMV e.g , potato yellow dwarf virus.

#### Animal viruses:

Animal viruses as parasites in animals.

- Viruses cause foot and mouth disease in livestock.
- Rous sarcoma virus causes cancer in animals.
- In many viral infections virus attack and destroy certain cells in the human body causing in the symptoms and diseases.
- Papovirus causes warts.
- Poxivirus causes small pox.

- Picornovirus causes polio , hepatitis A etc.
- **Paramyxovirus causes measles, mumps.**

#### **4.What are the parasitic natures of virus?**

##### **Ans: Parrastic Nature of Virus:**

Virus are parasitic in nature. They are highly specific to their host.

Bacteriophage infects only bacteria , the tobacco mosaic virus infects only tobacco plants and rabies virus infects only mammals.

Some certain viruses even specialize in a particular tissue. HIV will enter only certain types of white blood cells, the poliovirus reproduces in spinal nerve cells and hepatitis viruses infect only liver cells. Human cold viruses infect only the cells lining the upper respiratory tract.

Actually viruses have protein spikes on their surfaces which help them to attach with specific receptors on the host cells. The specificity of attachment determines the host range of the virus.

Some viruses have a narrow range , whereas others have quite a broad range. For example , poliovirus can enter the cells of only humans and other primates where as rabies virus can enter all mammalian cells.

#### **5. Justify why a virus must have a host cell to parasitize in order to complete its life cycle.**

##### **Ans: Viruses must require host cell to complete life cycle:**

A virus must haave a host cell to parasitize in order to complete itslife cycle because viruses are obligate intracellular parasites, which mean they cannot multiply outside a living cell. Viruses infect all sorts of cells, from bacterial cells to human cells.

An isolated virus is unable to reproduce or do anything else except infect an appropriate host cell.

Viruses lack metabolic enzymes, ribosomes, etc, etc, for making proteins. Therefore they need host cell to complete their life cycles.

**6. Explain how a virus survives inside a host cell, protected from immune system.**

**Ans: Survival of viruses inside a host cell:**

Host body has a strong defence against viruses but viruses surround the host immune response by:

- (I) Blocking complement activation.
- (II) Using complemented receptor to enter B lymphocytes.
- (III) Inhibiting interferon induced antiviral response.
- (IV) Blocking production of cytokines or response to cytokines.
- (V) Suppressing major histocompatibility complex.
- (VI) Reducing B-cell activation.
- (VII) Changing their own genetic constitution so rapidly that vaccines or antibiotics of host against them become ineffective.

These are different ways that how a virus survives inside a host cell, protected from immune system.

**7. Determine the method a virus employs to survive/passover unfavourable conditions when it does not have a host to complete the life cycle.**

**Ans: Viruses can pass unfavourable conditions outside the host:**

- i. Viruses unlike other "living" organisms do not need food to survive.
- ii. They remain dormant or inactive outside the host body. Being tiny, they are not threatened by the other microorganisms. Their only concern

would be the pH and temperature , as these would denature , the protein.

- iii. The virulence of the virus outside the host is maintained for a certain period of time and the time period depends on what virus is or pH and temperature Of the medium.
- iv. Viruses outside the host are nonliving. It can be said that they go under dormant period as they do not have any metabolic activity outside living host, however the genome of the virus remains viable for long time (in inactive form) outside the host.
- v. Non-enveloped viruses can in fact survive for long periods outside the host (up to several days) whereas enveloped viruses survive for shorter time periods. This is because many enveloped viruses rely on the proteins on the surface of the membrane to attach to the host cell, this envelope is generally sensitive to degradation to sunlight and normal cleaning procedures.

**8. Justify the name of virus i.e , "Human Immunodeficiency Virus" by establishing T-helper cells as the basis of immune system.**

**Ans:** Helper T cells regulate immunity by enhancing the response of other immune cells so , the decrease in the number of Helper T cells causes deficiency of the human immune system . The virus affects the human immune system , therefore, the virus has been named Human Immunodeficiency Virus (HIV).

**9. Reason out the specificity of HIV on its host cells.**

**Ans:** The initial step in the life cycle of HIV is absorption / attachment which is characterized by the binding of the virion glycoprotein 120 envelope proteins to the CD4 proteins (a receptor) on the surface of T4 cells . Next the fusion of the

viral envelope with the cell membrane takes place and virion enters the cell by endocytosis. Once inside the host cell, the HIV particle sheds its protective coat i.e., uncoating occurs. This leaves the single stranded viral RNA in the cytoplasm along with viral enzymes.

The enzyme called **reverse transcriptase** synthesizes a single stranded DNA complementary to virus RNA therefore, called **complementary DNA (cDNA)**.

### 10. What are the symptoms of AIDS.

#### Ans: Symptoms of AIDS:

An HIV infection can be divided into 3 stages: Asymptomatic carrier, AIDS Related Complex (ARC), Full Blown AIDS.

#### i. **Asymptomatic Carrier:**

In Asymptomatic Carrier symptoms that may include are fever, chills, aches, (continued pain), swollen lymph glands and an itchy rash. These symptoms disappear and there are no other symptoms for nine months or longer. Although the individual exhibit no symptoms during this stage, he or she is highly infectious. The standard HIV blood test for the presence of antibody becomes positive during this stage.

#### ii. **Aids Related Complex:**

The most common symptoms of Aids Related Complex are swollen lymph glands in the neck, armpit or groin that persist for months.

#### iii. **Full Blown AIDS:**

The Full Blown AIDS is the final stage. In it there is severe weight loss and weakness due to persistent diarrhoea and usually one of several opportunistic infections.

#### Some other symptoms:

Other symptoms includes night sweats , persistent cough, flu , and persistent diarrhoea , loss of memory , inability to think clearly , loss of judgment and depression.

### 11.Explain oppurtunistic diseases that may attack an AIDS victim.

#### Ans: Oppurtunistic Diseases:

HIV does not cause any disease nor kills any person. It only destrys T-cells of immune system , the decrease in the human system results in the inability of the body to fight diseases. Getting this opportunity of less or no immune system i.e , weak defence system a person suffering from AIDS is attacked by diseases called opportunistic diseases, e.g , Kaposi's sarcomo (cancer or lesion on skin), fungal infection , iral infection ,gastrointestinal diseases, respiratory diseases, nervous system and eye diseases.



This photograph shows the multiple lesions of the skin cancer , Kaposi's sarcoma , on the arm of a patient with AIDS.

### 12.What are the common control measures against the transmission of HIV?

#### Ans: Control Measures Against the Transmission of HIV:

AIDS can be controlled by preventing transfer of body fluid (blood, serum , seman, etc.) from patient to unaffected person.

The following behavior of precautionary measure will prevent AIDS.

- i. Do not use used syringes and needles.
- ii. For blood transfusion, blood must be used after proper screening for HIV.

- iii. Do not share toothbrushes, blades and towels with anyone. Special cares to be taken at barber's shop or hair cutting saloons, beauty salons.
- iv. Surgical instruments must be properly sterilized.
- v. AIDS is primarily a sexually transmitted disease. Refrain from immoral sexual activities and follow islamic teachings to pass healthy, neat and clean life.
- vi. Mother having HIV should not feed their babies. Shaking hands, hugging, coughing or sneezing and swimming in the same pool do not transmit HIV.  
One cannot get AIDS from inanimate objects such as toilets, door knobs, transmitted by mosquitoes and other insects.

### 13. What are the uses of bacteriophage in genetic engineering?

#### Ans: Uses of Bacteriophage in Genetic Engineering:

Genetic engineering is the field of biotechnology in which alteration in genetic material of an organism is carried out such as transfer of gene from one organism to another. Several biological tools have been used in genetic engineering to accomplish the required task.

The bacteriophages have also been used in number of ways in different approaches of genetic engineering. Some of them are outlined below:

- a) Beside bacterial plasmids the phage DNA has also been used as vector in genetic engineering techniques such as development of genomic library (a collection of bacteria or bacteriophage clones which contains multiple copies of all the genes of an individual's genome)
- b) Phage therapy is the application of genetically engineered phages that can kill pathogenic bacteria. Phage therapy has advantages over conventional antibiotic therapy. As phages are fairly narrow in their

spectrum of activity, meaning that with phage treatment it is possible to kill bacterial pathogens, while avoiding harming of normal bacterial flora, that is, our good bacteria.

- c) Bacteriophages have been used for many years as tools for the treatment of bacterial infections but recently a new application in the area of antibacterial nonmedicines has been discovered in which bacteriophages can be formulated as targeted drug-delivery vehicles.

**14. Describe the structure of prions and name any two diseases caused by them.**

**Ans: Prions:**

Prions, so-called because they are proteinaceous, are infectious particles, smaller than viruses, that contain no nucleic acids (neither DNA nor RNA).

**Structure of Prions:**

Electron microscopy reveals filaments rather than virus particles. Prions are much more resistant to inactivation by ultraviolet light and heat than are viruses.

Prions are composed of a single glycoprotein. This protein is encoded by a single cellular gene.

**Diseases Caused by Prions:**

Fatal neurodegenerative diseases, such as Kuru in humans and in cattle "mad cow disease" (bovine spongiform encephalopathy), were shown to be transmitted by prions.

**15. Describe the structure of viroids and name the diseases caused by them.**

**Ans: Viroids:**

**Structure of Viroids:**

Viroids are plant pathogens that consist of a short stretch (a few hundred nucleobases) of highly complementary, circular, single-stranded RNA without a protein coat or envelope. The RNA is quite small, Viroid RNA does not code for any protein. The replication mechanism involves RNA polymerase II, an enzyme normally associated with synthesis of messenger RNA from DNA, which instead catalyzes "rolling circle" synthesis of new RNA using the viroids's RNA as template. Some viroids are ribozymes, having catalytic properties which allow self-cleavage.

#### **Diseases Caused by Viroids:**

The only human disease known to be caused by a viroid is hepatitis D. they cause several plant diseases, e.g, in potato, coconut, apple, peach, etc.

#### **16. Define/Describe/Explain: virus, virology, virion, capsomers, antiviral therapy, prions, virions.**

##### **Ans:Virus:**

A virus is a small infectious agent that replicates only inside the living cells of other organisms. Viruses can infect all types of life forms, from animals and plants to microorganisms, including bacteria and archaea.

##### **Virology:**

By 1900, similar diseases producing substance had been discovered in both plants and animals. The name filterable viruses were given to these substances. In 1935 **W.M.Stanley** crystallized the infectious particle, now known as tobacco mosaic virus (TMV). Subsequently, many other viruses actually have been seen with the help of the electron microscope. The study of virus is called **virology**.

Or

**Virology** is the scientific discipline concerned with the study of the biology of viruses and viral diseases , including the distribution , biochemistry,physiology, molecular biology, ecology, evolution and clinical aspects of viruses.

#### **Virion:**

Viruses have a very simple structure. A complete viral particle is called virion. Primarily , it can be divided into two parts i.e , **core** and **coat**.

#### **Capsomers:**

The capsomers is a subunit of the capsid , an outer covering of protein that protects , the genetic material of a virus. **Capsomers** self-assemble to form the capsid.

#### **Antiviral Therapy:**

##### **Antiretroviral Therapy (ART):**

HIV is treated using a combination of medicines to fight HIV infection. This is called **antiretroviral therapy** (ART). ART is not a cure , but it can control the virus so that HIV positive person can live a longer , healthier life and reduce risk of transmitting HIV to others. ART is a highly effective treatment for HIV infection, preventing progression of the diseases in the vast majority of recipients. When ART is accessible and started early in the course of infection , the lifespan of HIV-positive people is typically very close to that of comparable HIV-negative people. But ART can have toxicities, is often costly, and requires strict daily pill taking that can lessen quality of life. Because of the limitations of ART , a cure for HIV infection remains a vital goal for research.

**Or**

Antiviral therapy is often used by cancer patients to treat viral infections.

#### **Prions:**

Prions , so-called because they are proteinaceous , are infectious particles, smaller than viruses, that contain no nucleic acids (neither DNA nor RNA).

Electron microscopy reveals filaments rather than virus particles. Prions are much more resistant to inactivation by ultraviolet light and heat than are viruses. Prions are composed of a single glycoprotein. This protein is encoded by a single cellular gene.

### **Virions:**

Viruses have a very simple structure. A complete viral particle is called virion. Primarily , it can be divided into two parts i.e , **core** and **coat**.

**Or**

A complete virus particle that consists of an RNA or DNA core with a protein coat sometimes with external envelopes and that is the extracellular infective form of a virus.

### **17.What do you mean by AIDS,HIV,ART,CLCuD and TMV?**

#### **Ans: AIDS:**

**AIDS** stands for Acquired Immune Deficiency Syndrome : Acquired means you can get infected with it , Immune Deficiency means a weakness in the body's system that fights diseases. Syndrome means a group of health problems that make upss a disease.

#### **HIV:**

Human immunodeficiency virus (HIV) is the causative agent of acquired immune deficiency syndrome or AIDS. It was identified in 1984 by research team from Pasture Institute in France and National Institute of Health in USA. In 1986 the virus was named HIV.

#### **ART:**

HIV is treated using a combination of medicines to fight HIV infection. This is called **antiretroviral therapy** (ART). ART is not a cure, but it can control the virus so that HIV positive person can live a longer, healthier life and reduce the risk of transmitting HIV to others. ART is a highly effective treatment for HIV infection, preventing progression of the diseases in the vast majority of recipients. When ART is accessible and started early in the course of infection, the lifespan of HIV-positive people is typically very close to that of comparable HIV-negative people. But ART can have toxicities, is often costly, and requires strict daily pill taking that can lessen quality of life. Because of the limitations of ART, a cure for HIV infection remains a vital goal for research.

### **CLCuD:**

#### **Cotton Leaf Curl Disease:**

Cotton leaf curl disease (CLCuD) is a serious of cotton.

**Cause :** The viruses associated with the CLCuD complex on the Indian subcontinent, five of which have been identified as begomoviruses.

**Transmission:** This disease is transmitted by the whitefly *Bemisia tabaci*.

**Symptoms:** The symptoms are initially characterized by a deep downward cupping of the youngest leaves. This is followed by development of cup-shaped, leaf-like structures.

#### **Treatment and Prevention:**

Control of CLCuD is mainly based on insecticide treatments against the insect vector (*Bemisia tabaci*).

### **TMV:**

In 1935 **W.M. Stanley** crystallized the infectious particle, now known as tobacco mosaic virus (TMV). Subsequently many other viruses actually have

been seen with the help of the electron microscope. The study of virus is called **virology**.

Most plant viruses discovered till to date including tobacco mosaic virus (TMV) , having an RNA genome. Many virus have rod shaped capsid like TMV e.g , potato yellow dwarf virus.

**Or**

Tobacco mosaic virus (**TMV**) is a positive-sense single stranded RNA virus, genus tobamovirus that infects a wide range of plants , especially tobacco and other members of the family Solanaceae. The infection causes characteristic patterns, such as "mosaic" like mottling and discoloration on the leaves (hence the name).

### **18.Distinguish between**

**(a) bacteriophage and flu virus**

**(b) flu virus and HIV**

**(c) lytic and lysogenic cycle of bacteriophage**

**(d) prions and virioids?**

**Ans: (a) bacteriophage and flu virus:**

#### **Structure of Bacteriophage:**

The bacteriophage or simply phage is the virus that attacks upon bacteria. It is generally a tapole shaped virus. It consists of head,neck and tail.

#### **Head:**

The head is icosahedral in shape. The inner core of head consists of a single stranded DNA genome.

#### **Narrow Neck or Collar:**

Below the head is narrow neck or collar which separate head and tail.

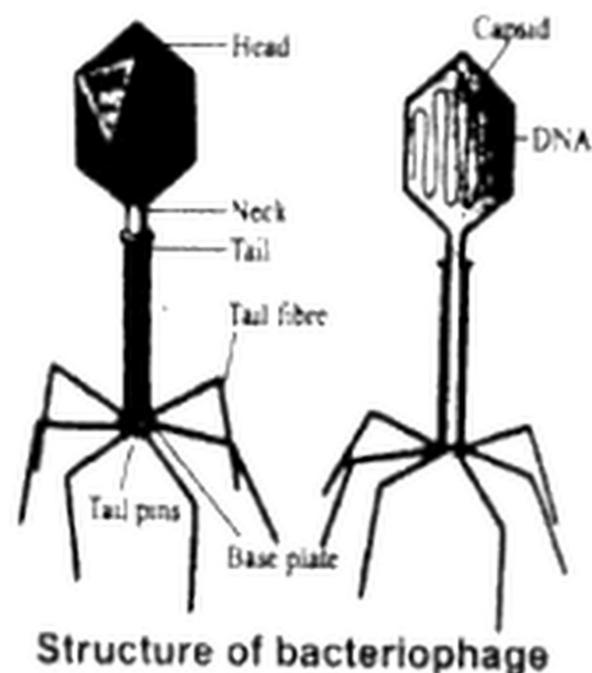
### Tail:

The tail is a hollow tube made up of proteins through which the nucleic acid passes during infection. The tail is surrounded by a contractile sheath, which contracts during infection of the bacterium.

### Basal Plate:

At the end of the tail a basal plate is present which possesses about six tail fibres around it and several tail pins or spikes at its lower surface. The tail fibres and tail pins are involved in the binding of the phage to the bacterial cell.

At the bottom of core tube of tail, an enzyme, the lysozyme is present which is released upon contraction of tail. It digests the portion of the host cell wall so that core tube can be penetrated into the host cell during infection.

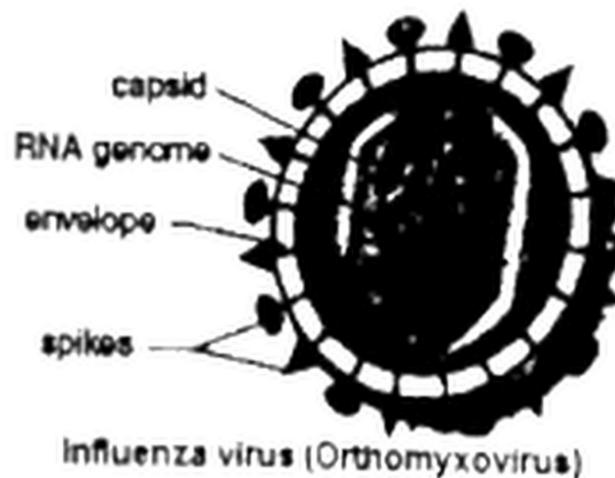


### Structure of Influenza or Flu virus:

Influenza virus exists in three forms called A,B,C.

### Composition of influenza virus:

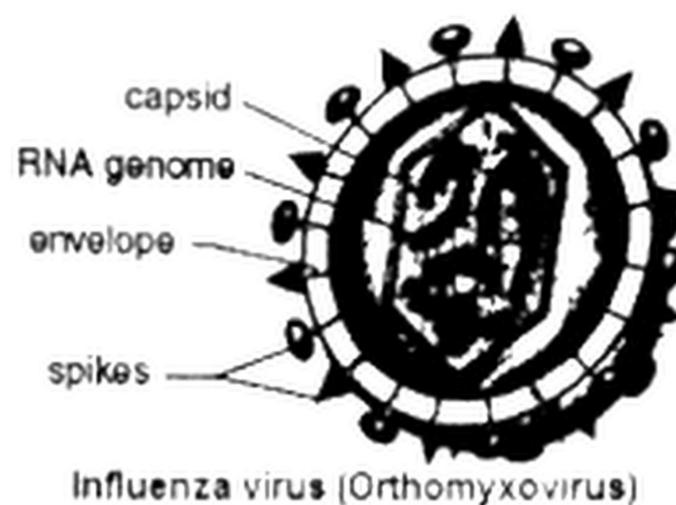
Influenza virus is composed of a segmented single-stranded RNA. A membranous envelope surrounds the capsid having spikes.



(b) flu virus and HIV:

**Ans: Structure of Influenza or Flu virus:**

Influenza virus exists in three forms called A,B,C. Influenza virus is composed of a segmented single-stranded RNA. A membranous envelope surrounds the capsid having spikes.



**Structure of Human Immunodeficiency Virus:**

human immunodeficiency virus (HIV) is a **retrovirus**. It is spherical in shape. The outer covering is a lipoprotein envelope which consists of two layers of lipids: different proteins are embedded in the viral envelope, forming "**spikes**" consisting of the outer **glycoprotein (gp 120)** and the **transmembrane gp 41**. The lipid membrane is borrowed from the host cell during the budding process

(formation of new particles), gp 120 is needed to attach to the host cell and gp 41 is critical for the cell fusion process . beneath envelope another protein shell is present which is made up of **matrix protein**. It lies between the envelope and capsid. The HIV capsid is somewhat conical shaped which is composed of capsomers. The viral core contains two single-strands of **HIV RNA** and the enzymes needed fro HIV replication, some as reverse transcriptase, integrase and profiase. The **reverse transcriptase** enzyme is use to convert viral RNA genome into viral DNA genome,integrase enzyme is use to incorporate viral DNA into host DNA while the protease enzyme is use to break large structural proteins into smaller units. These structural proteins are encoded by three out of the nine virus genes.



**(c) lytic and lysogenic cycle of bacteriophage:**

Lytic phase	Lysogenic phase
1.The viral genome does not integrate with host DNA.	1.The viral genome or its complementary DNA gets integrated with the host DNA. It is called prophage or provirus.

2. The host DNA is often hydrolysed in the lytic phase.	2. The host DNA is not hydrolysed during lysogenic phase.
3. The viral genome replicated repeatedly and forms a number of copies in the same host cell.	3. The prophage or provirus replicates only once along with the replication of host genome so that a single particle is transferred to a daughter cell.
4. The cellular machinery of the host is completely taken over by the viral genome.	4. The cellular machinery of the host is only slightly disturbed.
5. The virus is virulent.	5. The virus is non virulent or temperate.
6. The host cell undergoes lysis.	6. The host cell does not get lysed.
7. A number of virus particles are liberated when the host cell become lysed.	7. Virus particles are liberated only rarely.

**Or (Second Answer)**

<b>Lytic Cycle</b>	<b>Lysogenic Cycle</b>
1. This type of cycle exhibited by virulent phages (bacteriophage).	1. It is exhibited by temperate phages.
2. Here the phage genome becomes integrated with the bacterial genome.	2. In this case the phage genome does not integrate with bacterial genome, thus a prophage is performed.
3. This cycle is of short duration as the virulent phages replicated and causes immediate lysis of bacterial cell	3. This cycle is following longer duration as temperate phage does not replicated immediately after infection.

4.This does not cause the genetic recombination in bacteria.	4.This may cause genetic recombination among bacteria.
5. <b>Example:</b> T phage.	5. <b>Example:</b> phage.

**(d) prions and viroids:**

Prions	Viroids
Prions are infectious protein particles.	Viroids are small and naked infectious RNA molecules.
<b>Discovery:</b>	
Prions were discovered by Stanley B Prusiner.	Viroids were named by T.O Diener in 1971.
<b>Genetic Material:</b>	
Prions do not contain DNA or RNA	Viroids contain RNA
<b>Digestion by Proteinase K and Trypsin:</b>	
Prions can be digested by proteinase K and Trypsin.	Viroids cannot be digested by proteinase K and Trypsin.
<b>Digestion by Ribonucleases:</b>	
Prions are resistant to ribonucleases.	Viroids can be digested by proteinase K and Trypsin.
<b>Infections:</b>	
Prions infect animals.	Viroids infect higher plants.
<b>Common diseases:</b>	

Prions cause diseases such as mad cow disease in cows , scrapie disease in sheep and goats etc.	Viroids cause diseases such as potato spindle tuber disease, chrysanthemum stunt disease.
<b>Reproduction:</b>	
Prions are self propagate.	Viroids can reproduce only within a host cell.
<b>Size:</b>	
Prions are smaller than viroids.	Viroids are smaller than viruses.

**Or (Second Answer)**

<b>Prions</b>	<b>Viroids</b>
1. It is an infectious protein particle.	1. It is an infectious RNA particle .
2.It is formed of only proteins.	2. viroid is formed of only small single stranded circular RNA.
3. RNA or DNA is absent.	3.A protein coat is absent.
4. prions are inactivated by proteinase K and Trypsin digestion but resistant to ribonuclease treatment.	4. Viroids are inactivated by ribonuclease digestion but resistant to proteinase K and Trypsin digestion.
5.Mostly smaller than viroid.	5.Viroids has a smaller size than viruses.
6.Prions infects animals causing neurological degenerative diseases Mad cow disease (Bovine spongiform encephalopathy) in cow and Scrapie disease in sheep and goat.	6. Viroids infects only higher plants humans is similar to viroid] Common plant disease , Chrysanthemum stunt disease.



