

## 2. Give short answers.

### i. List the impurities present in rain water.

**Ans:** Rainwater contains pollutants, soil, plant parts, insects parts, bacteria, algae, and sometimes radioactive materials that the rain/snow has washed out of the air.

### ii. List toxic substances present in household wastes.

**Ans:** Household wastes include, human wastes, livestock wastes, soaps and detergents, paints and oil, food and vegetable wastes, garbage etc.

### iii. In what ways, industrial wastes pollute water.

#### **Industrial wastes:**

**Ans:** Industrial wastes may contain highly toxic compounds and heavy metals such as Pd, Cd, Hg, As, Sb etc.

Water from leather tanneries contains large quantities of chromium (VI) salts. Chromium (VI) ions are highly toxic and known to cause cancer. Water pollution occurs when pollutants are discharged directly or indirectly into water bodies without adequate treatment to remove harmful compounds.

### iv. What is water pollution?

#### **Ans: Water pollution:**

Water pollution is the contamination of water bodies (e.g. lakes, rivers, oceans, aquifers and groundwater). Water pollution occurs when pollutants are discharged directly or indirectly into water bodies without adequate treatment to remove harmful compounds.

**v. List some waterborne diseases.****Ans: i. Cholera****ii. Dysentery****iii. Jaundice****iv. Hepatitis****v. Typhoid****vi. what are pathogenic microorganisms?**

**Ans:** An organism of microscopic size, usually a bacteria or virus, that causes disease.

**Ans: hard water:**

Water that gives little lather or forms scum with soap is called hard water.

**Hard water is undesirable:**

"Hard" water- water with a lot of dissolved minerals- usually calcium, does not work with soaps or detergents. It is hard to "lather" with hard water, and you use more cleaning product to get the same effect. Second, the minerals can be deposited in pipes, fixtures and appliances, clogging or wearing them prematurely.

**4. List two ways in which lakes and streams become polluted.**

**Ans:** Industrial units generally discharge their wastes either to open land or into water bodies, lakes, ponds, rivers or oceans. Water from leather tanneries contains large quantities of chromium (VI) salts. Chromium (VI) ions are highly toxic and known to cause cancer. Industrial wastes cause irreversible degeneration of the environment causing serious health problems for public and marine life.

**5. Give chemical equations for the**

c) Reaction that occurs when temporary hard water is boiled.

d)  $\text{Ca}^{+2}$  ions interact with sodiumzeolite.

**Solution:**

a) Reaction of slaked lime with alum.



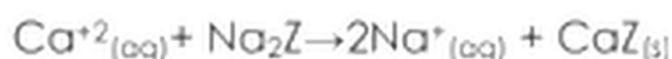
b) carbonated rain water with lime stone.



c) Reaction that occurs when temporary hard water is boiled.



d)  $\text{Ca}^{+2}$  ions interact with sodiumzeolite.



**6. How can buildings made of limestone be affected by acid rain?**

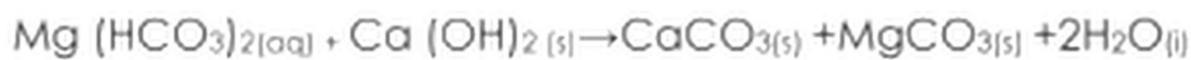
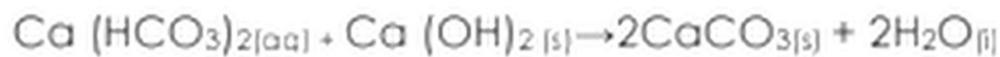
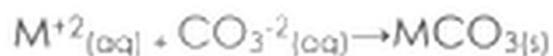
**Ans:** Acid rain has a corrosive effect on limestone or marble buildings or sculptures. It is well established that either wet or dry deposition of sulfur dioxide significantly increases the rate of corrosion on limestone, sandstone, and marble.

Sulfur dioxide plus water makes sulfurous acid. Therefore buildings made of limestone are effected by acid rain.

**7. Make a list of main methods of softening hard water. In each case write a chemical equation to summarize the chemical reactions involved.**

**i) By Boiling:**

Where  $M = \text{Ca}^{+2}$  or  $\text{Mg}^{+2}$

**ii) By adding slaked lime (Clark's method):****Methods to remove permanent hardness****i) By adding washing soda:**

Where  $M = \text{Ca}^{+2}$ ,  $\text{Mg}^{+2}$

**ii) By ion Exchange Resins:**

Where  $M = \text{Ca}^{+2}$ ,  $\text{Mg}^{+2}$

**8. list some advantages of water hardness.****Ans: Disadvantages of water hardness:**

- i. Hard water wastes a lot of soap, when used for washing.
- ii. The soap forms a scum with hard water, which adhere to the clothes being washed. Scum can soil the finish of some fabrics.
- iii. Cause kettle to fur.
- iv. Can cause hot water pipes, boilers and car radiators to block due to the formation of insoluble calcium and magnesium salts, causing great damage.

**Ans:** The four main sources of water are ground water, rivers or lakes, oceans and ice (glaciers).

### 10. How does hard water differ from soft water?

**Ans: soft water:**

Water that easily gives lather with soap and does not form scum is called soft water.

**Hard water:**

Water that gives little lather or forms scum with soap is called hard water.

**Note:**

Most common hardness is results of  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  ions in ground or surface water. Soft water on the other hand, contains lower levels of calcium and magnesium.

### 11. What is the purpose of coagulation in water treatment?

**Ans: Coagulation:**

It is the process in which water is treated with slaked lime and alum. These materials react to form a gelatinous mass of aluminum hydroxide.



The aluminum hydroxide carries down dirt particles and bacteria.

### 12. Explain how hard water hampers the cleansing action of soap.

**Ans: Effect of Hard Water:**

Hardness minerals (calcium or magnesium ions) combine with soap to form an

similar to the difficult-to-clean residue found on bathroom tubs, sinks, and tile in hard water areas.

Hardness also tends to counteract soap's alkalinity, which reduces its cleaning ability and requires the use of greater quantities to get laundry clean.

### **13. Why are municipal water supplies treated with aluminum sulphate and slaked lime?**

#### **Ans: Coagulation:**

It is the process in which water is treated with slaked lime and alum. These materials react to form a gelatinous mass of aluminum hydroxide.



The aluminum hydroxide carries down dirt particles and bacteria.

#### **OR (Second Answer)**

#### **Aluminium sulphate:**

The chemical formula for aluminium sulphate is  $\text{Al}_2(\text{SO}_4)_3$ . Frequently, it is known as filter alum. In water purification, a mixture of 48 percent filter alum in a water solution is combined with the raw incoming water at a rate of 18-24 milligrams per liter. Alums are found in many house hold products such as deodorant and baking powder.

However, in water purification processes it is as a coagulant. A coagulant binds extremely fine particles suspended in raw water into larger particles that can be removed by filtration and settling.

This allows for the removal of unwanted color and cloudiness (turbidity). Additionally, the process removes the aluminum itself.

#### **Slaked lime:**

Hydrated lime's chemical name is calcium hydroxide, and its chemical

Filter alum is an acidic salt that lowers the pH of water undergoing purification. Adding hydrated to this process between the sedimentation and filtration steps at the rate of 10 to 20 milligrams per liter neutralizes the effect of filter alum on the processing water.

**14. What are some health effects of biological contamination of water?**

**Ans:** bacterial contents may cause infectious diseases such as cholera, jaundice, hepatitis, typhoid, dysentery etc.

Cause	Water-borne diseases
Bacterial infections	Typhoid, Cholera, paratyphoid fever, Bacillary dysentery
Viral infections	Infectious hepatitis (jaundice), poliomyelitis
Protozoal infections	Amoebic dysentery

**15. Write a word and balanced chemical equation to show the effect of heat on magnesium hydrogen carbonate in an aqueous solution.**

**Ans: Word equation:**

Magnesium hydrogen carbonate → Magnesium carbonate + carbon dioxide + water

**Chemical equation:**



## Think-Tank

### 16. Why is it cooler near a lake than inland during summer?

**Ans:** Since rate of evaporation increases with the increase in temperature during summer. Since evaporation cause cooling therefore it is cooler near a lake than inland during summer. (Rate of evaporation  $\propto$  temperature)

### 17. Evaluate the option, ion exchange resins can be used to remove temporary hardness.

**Ans:** Ion exchange resins can be used to remove both temporary and permanent hardness from water. Ion exchange method involves the use of porous solids ion exchangers.

The principle of this method is that, the ions, i.e.  $\text{Ca}^{+2}$ ,  $\text{Mg}^{+2}$  or  $\text{Fe}^{+2}$ , which because hardness are removed from water by exchanging them with other cations from the ion exchangers which do not cause hardness – by this, the water is free from hardness.

### 18. Public health depends on water quality. Give arguments.

#### **Ans: Drinking Water:**

Public health depends on provision of adequate quantities of drinking water free of harmful concentrations of human pathogens and chemical pollutants.

Provision of clean, safe drinking water depends on the quality of both the source water and the treatment and distribution systems. Thus, assigning the appropriate use designation and then meeting water quality standards in source waters in the first step in providing safe drinking water.

Water is essential to human life and the health of the environment. Water quality is important not only to protect public health. Water provides ecosystem habitats, is used for farming, fishing and mining, and contributes to recreation and tourism.

If water quality is not maintained, it is not just the environment that will suffer. The commercial and recreational value of our water resources will also diminish.

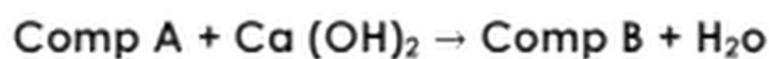
This water quality information can then be used to develop management programs and action plans to ensure that water quality is protected. Thus, public health depends on water quality.

**19. Hard water causes kettles to fur. This fur can be removed by using an acid explain why?**

**Ans:** Using hard water in kettles produces calcium carbonate scale or fur. Hydrochloric acid can be used to clean calcium carbonate (fur) deposits from kettles.



**20. The following chemical equation is about a calcium compound.**



**a) Name and give the formula of**

- i. Compound A**
- ii. Compound C**

- b) Describe with the aid of a balanced chemical equation. What happens when compound C is heated?
- c) Compound C is soluble in water. Write a balanced chemical equation to show what happens when its aqueous solution is treated with washing soda?

**Solution:**

**a) i. Compound A**



Therefore, compound A is calcium hydrogen carbonate  $\text{Ca (HCO}_3\text{)}_2$

**ii. Compound C**



Therefore, compound C is calcium hydrogen carbonate  $\text{Ca (HCO}_3\text{)}_2$



**21. How chemistry helps maintain a clean swimming pool? Explain.**

**Ans:** Water in swimming pools is purified from pathogenic organisms by aeration and chlorination. Chlorination is probably the best and the cheapest method of sterilization of water and it is the most effective in destroying pathogenic bacteria. For chlorination, liquid chlorine may be added directly in the swimming pool water.

**22. Why it is advisable to wash hands well with soap after using bathrooms?**

**Ans:** If your hands are not clean and you touch your face or public surfaces, you may be infecting yourself and others by spreading germs and disease. Colds, flus, and infectious diarrhea are all known to be spread by hand-to-hand contact.

Washing your hands regularly can help keep you and those around you healthy by controlling the spread of germs (bacteria and viruses).

### 23. Differentiate between raw water treatment and sewage water process.

#### Ans: i. Raw water treatment:

The raw water is treated in municipal water purification plant, to make it fit for drinking and domestic purposes. Various stages in this treatment are;

#### Sedimentation:

It is the process in which water is allowed to stand in a reservoir. The suspended matter sinks to the bottom.

#### Coagulation:

It is the process in which water is treated with slaked lime and alum. These materials react to form a gelatinous mass of aluminum hydroxide.



The aluminium hydroxide carries down dirt particles and bacteria.

#### Filtration:

The water is then filtered through sand and gravel. Sometimes it is filtered through charcoal to remove colored and odorous compounds.

#### Chlorination:

In the final step, chlorine is added to kill any remaining bacteria. Chlorine reacts with water to form hypochlorous acid HClO which kills bacteria.



Flow sheet diagram for water purification plant

## **ii. Sewage Water Treatment:**

In many countries, sewage water is passed through certain treatment stages before it is discharged into a lake, stream, river or ocean. This treatment involves following steps.

### **1. Primary sewage Treatment:**

Primary treatment removes some of the solids as sludge. For this purpose waste water is allowed to stand in a large sedimentation tank to remove suspended particles.

### **2. Secondary Sewage Treatment:**

Effluent from the primary treatment is passes through sand and gravel filters. There is some aeration in the step, and aerobic bacteria convert most of the organic matter to stable in organic materials.

### **3. Activated Sludge Treatment:**

The sewage is then placed in tanks and aerated with large blowers. This results in the formation of large, porous clumps which absorbs contaminants. The aerobic bacteria further convert the organic material to sludge. This sludge is stored on land or sometimes used as fertilizer.

### **4. Chlorination:**

The effluent from sewage plant is treated with chlorine to kill any remaining pathogenic microorganisms.

## **24. Evaluate the advantages of waste water treatment.**

**Ans: Advantages of waste water treatment:**

1. Saving of extra water.
2. Recycling of water.

3. Ground water, surface water source is safe from pollution due to treatment of waste water.
4. Treated water is used for vegetation.
5. Cost of transportation of polluted water is saved.
6. Air pollution is limited to treatment plant.

**25. Water borne diseases are no longer common in developed countries. Defend this statement.**

**Ans:** Most waterborne diseases occur worldwide. In developed (western) countries, contagion (infections) is prevented by drinking water purification and by hygienic measurements.

But even in developed countries, people can fall ill from waterborne diseases. This is caused by using insufficiently disinfected water, by implementing non-hygienic food preparation and by insufficient personal hygienic.

