Water SLOs Questions

Q1:- Why water is used as a universal solvent?
Q2:- Describe anamalous behaviour of water.
Q3:- How chlorine acts as a disinfectant?
Q4:- Why ants are able to walk on the surface of water?
Q5:- Differentiate between soft and hardwater?
Q6:- What are the ~~mor~~ methods of removing hardness of water?
Q7:- Complete the following reactions:-

$Mg(HCO_3)_2 \longrightarrow ?$

$Mg(HCO_3)_2 + Ca(OH)_2 \longrightarrow ?$

$3Ca(OH)_2 + Al_2(SO_4)_3 \longrightarrow ?$

$Cl_2 + H_2O \longrightarrow ?$

$M^{+2} + Na_2Z \longrightarrow$ [illegible] ?

Q8:- What are the methods to remove temporary hardness? Explain briefly with reactions.
Q9:- What are the methods to remove permanent hardness? Explain briefly with reactions.
Q10:- How is permanent hardnes removed by the proces of ion exchange resins?

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Q. No. 2 (i) 1. **Water as a universal solvent:-**

Water has an ability to dissolve a wide variety of substances. This is because of its two properties; the polarity of water molecules and the ability of water molecules to form hydrogen bonds. Wales molecules are strongly attracted to ions and polar molecules with which water can form hydrogen bonds. If these attractions are strong enough, they overcome the attractions between the molecules or ions of the other substance and hence in this way the substance dissolves.

Conclusion:-

Thus, water dissolves a wide range of substances which may be ionic, polar substances and hydrogen bond compounds due to the polarity of water molecules and its ability to make hydr--ogen bonds.

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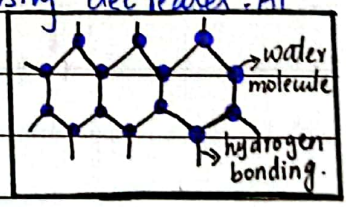
Q. No. 2 (ii) **Anamalous behaviour of water:-**

Water acts abnormally many times due to its unique behaviour. The density of most of liquids and solids increases when the temperature is decreased however water shows a unique behaviour in this regard.

→ when water is cooled below 4°C its density decreases. At 0°C density of water becomes 0.91 g/m³.

This happens because water expands on cooling and forms hexagonal structure forming a ring which is empty from the inside.



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Q. No. 2 (i) **Chlorine as a disinfectant:-**

Chlorine acts a disinfectant in swimming pools, raw water treatment and sewage water treatment. This is because kills bacteria and other pathogenic microorganisms by penetrating the cell membrane first which does structural damage and disrupts normal cell function. It reacts with essential enzymes and proteins and hinders the microorganism's ability to carry out vital proceses. This all combined ultimately leads to death of the microorganism and hence it becomes an effective disinfectant for water treatment, swimming pools and many other applications.

Q. No. 2 (ii) **Ants able to walk on surface of water:-**

Ants are able to walk on water due to the surface tension of water. The water molecules at the surface are attracted to eachother which helps ants to walk on it.

Ants legs are water repellent which allows them to stay dry, hence they dont get heavy with water. Also, ants are very light in weight due to which less pressure is exerted on the water's surface making them walk and not sink in the water.

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Q. No. 2 (i) 5

Soft water	Hard water
Definition	
Water that gives lather with soap is called soft water.	Water that doesnot give lather with soap is called hard water.
Scum formation	
Soft water doesnot form scum with soap.	Hard water forms scum with soap.
Concentration of minerals	
Soft water has low concentration of minerals such as calcium & magnesium	Hard water has a high concentration of minerals such as Calcium and Magnesium.
Uses	
It is good for household use and doing laundary.	It causes scaling in pipes and appliances and makes the coloured clothes dull & white clothes yellow.

Q. No. 2 (ii) 6

Methods of removing hardness of water:-

As using hardwater has many disadvantages so, we remove the hardness from water in following ways:-

1) For temporary hardness we use methods like boiling and adding slaked lime to the hard water. Boiling is an expensive method to be used as compared to the slaked lime method.

2) For removal of peemanent hardness we use methods such as adding washing soda ($Na_2CO_3.10H_2O$) in hard water and by the method of ion exchange resins in which Zeolite is used which is one of the natural ion exchanger.

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Q. No. 2 (i) 7 **Completing reactions:-**

(i) $Mg(HCO_3)_2 \longrightarrow MgCO_3 + CO_2 + H_2O$

(ii) $Mg(HCO_3)_2 + Ca(OH)_2 \longrightarrow CaCO_3 + MgCO_3 + 2H_2O$

(iii) $3Ca(OH)_2 + Al_2(SO_4)_3 \longrightarrow 2Al(OH)_3 + 3CaSO_4$

(iv) $Cl_2 + H_2O \longrightarrow HClO + H^+ + Cl^-$

(v) $M^{+2} + Na_2Z \longrightarrow 2Na^+ + MZ.$

Q. No. 2 (ii) 8 **Methods to remove temporary hardness:-**

There are two methods for removing temporary hardness:-

(i) **By Boiling:-** During boiling the soluble calcium and magnesium hydrogen carbonates are decomposed, forming insoluble carbonates. As, Ca^{+2} & Mg^{+2} are removed, water becomes soft, but this method is too expensive.

$M(HCO_3)_2 \rightarrow MCO_3 + CO_2 + H_2O$ ∴where $M = Ca^{+2}, Mg^{+2}$

(ii) **Clark's method:-** Temporary hardness from hardness at a large scale can be removed by adding an estimated amount of slaked lime in it. It reacts with hydrogen carbonates to form insoluble carbonates.

$Ca(HCO_3)_2 + Ca(OH)_2 \rightarrow 2CaCO_3 + 2H_2O$

$Mg(HCO_3)_2 + Ca(OH)_2 \rightarrow CaCO_3 + MgCO_3 + 2H_2O$

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Q. No. 2 (i) 9

Methods to remove permanent hardness:-

There are two ways to remove permanent haedness from water:-

(i) **By adding washing soda:-** On a large scale permanent haedness in water can be removed by adding washing soda ($Na_2CO_3 \cdot 10H_2O$). Ca^{+2} & Mg^{+2} ions are removed as their insoluble caebonates.

$$M^{+2} + CO_3^{-2} \longrightarrow MCO_3 \quad \therefore M = Ca^{+2}, Mg^{+2}$$

(ii) **By Ion Exchange Resins:-** The haedwater is passed through a containes filled with a suitable resin containing sodium ion. Zeolite is one of the natural ion exchanger. Chemically it is sodium alluminum silicate. It is usually written as Na_2Z. The ions causing haedness are exchanged with Na^+ ions in the resin.

$$M^{+2} + Na_2Z \longrightarrow 2Na^+ + MZ \quad \therefore M^{+2} = Ca^{+2}, Mg^{+2}$$

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Q. No. 2 (ii) 10

Ion Exchange Resins:-

This is amethod for removing peemanent haedness from haed water. In this method, haed watee is passed through a containes filled with a suitable resin containing sodium ions. Zeolite is one of the natural ion exchanger. Chemically, it is sodium aluminium silicate. It is usually written as Na_2Z. The Ca^{+2} or Mg^{+2} ions causing the haedness are ~~ext~~ exchanged with Na^+ ions in the resin.

$$M^{+2} + Na_2Z \longrightarrow 2Na^+ + MZ \quad \therefore M = Mg^{+2} \& Ca^{+2}$$

The used up zeolite can be regeneeated by heating with concentrated solution of NaCl. This makes the procen economical.

$$CaZ + 2NaCl \longrightarrow Na_2Z + CaCl_2$$

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