

**UNIT – I**  
**WATER AND ITS TREATMENT**  
**PART-A**

**1. Define hardness of water.**

Hardness is the property of water that prevents it from producing lather with soap.

**2. Distinguish between hard water and soft water.**

S.No	Hard water	Soft water
1.	Hard water does not produce lather with soap solution.	Soft water produces very good lather with soap solution.
2.	It gives wine red colour with EBT indicator.	It does not give colour with EBT indicator.

**3. What are the salts responsible for carbonate and non-carbonate hardness? [JAN-2018]**

Carbonate hardness (Temporary hardness):  $\text{Ca}(\text{HCO}_3)_2$  and  $\text{Mg}(\text{HCO}_3)_2$  Non-Carbonate hardness (Permanent hardness):  $\text{CaCl}_2$ ,  $\text{CaSO}_4$ ,  $\text{MgSO}_4$  and  $\text{MgCl}_2$

**4. List out the requirements of boiler feed water.**

- Boiler feed water should have zero hardness.
- It should be free from dissolved gases like  $\text{O}_2$ ,  $\text{CO}_2$ .
- It should be free from suspended impurities.
- It should be free from oil and turbidity.
- It should be free from dissolved salts and alkalinity.

**5. What are scales and sludges?**

Sludge:

If the precipitate is loose and slimy it is called sludge. Sludges are formed by substances like  $\text{MgCl}_2$ ,  $\text{MgCO}_3$ ,  $\text{MgSO}_4$  and  $\text{CaCl}_2$ .

They have greater solubility in hot water than cold water.

Scale: \_\_\_\_\_

On the other hand, if the precipitate forms hard and adherent coating on the inner walls of the boiler, it is called scale.

Scales are formed by  $\text{Ca}(\text{HCO}_3)_2$ ,  $\text{CaSO}_4$  and  $\text{MgCl}_2$ .

**6. Why is hardness expressed in terms of calcium carbonate equivalent?**

This is because, the molecular weight of  $\text{CaCO}_3$  is a whole number (Mol. Wt. 100) and it is the most insoluble salt. If the concentration of hardness producing salt is 'X' mg/L, then,

Amount equivalent to  $\text{CaCO}_3 = \frac{\text{X} * \text{molecular weight of } \text{CaCO}_3}{\text{molecular weight of hardness producing substance}}$

### **7. What are Zeolites?**

Zeolites are crystalline solids structures made of silicon, aluminum and oxygen that form a framework with cavities and channels inside where cations, water and/or small molecules may reside. They are often also referred to as molecular sieves.

### **8. What is Brackish water?**

Brackish water is water that has more salinity than fresh water, but not as much as seawater. Salinity expresses the saltiness or dissolved salt content of a body of water. Technically, brackish water contains between 500 and 30,000 ppm salt.

### **9. Why calgon conditioning is better than phosphate conditioning?**

In calgon conditioning, calgon forms highly soluble complex, but in phosphate conditioning, it gives sludge. So, periodical disposal of sludge is important in phosphate conditioning. But in calgon conditioning no problem of disposal.

### **10. Soft water is not demineralised water whereas demineralised water is soft water.**

#### **Justify.**

The soft water produced by lime-soda and zeolite process does not contain hardness producing  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  ions, but it will contain other ions like  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{SO}_4^{2-}$ ,  $\text{Cl}^-$ , etc.,. On the other hand, demineralised water does not contain both anions and cations.

## **PART-B**

**1. What are water quality Parameters? Explain its significance.**

**2. What is desalination? With a neat diagram, describe the 'reverse osmosis' method for the desalination of brackish water.**

**3. Describe the principle and procedure involved in the zeolite process for water treatment.**

**4. Explain the demineralisation of water by ion-exchange process**

**5. Explain the various steps involved in the municipal sewage water treatment process.**

**6. Discuss the Break point Chlorination**

**UNIT – 2**  
**NANOCHEMISTRY**  
**PART-A**

**1. Define Nanomaterials**

Nanomaterials are commonly defined as materials with an average grain size less than 100 nm. Nanomaterials have extremely small size with having at least one dimension 100 nm.

**2. Define Nanoscience.**

The study of phenomena and manipulation of materials at atomic, molecular and macromolecular scales where properties differ significantly from those at a larger scale is called nanoscience.

**3. Define Nanotechnology.**

The design, characterization, production and application of structures, device and system by controlling shape and size at nanometer scale is called nanotechnology.

**4. Define Nanocluster.**

Nanoclusters are fine aggregates of atoms or molecules. The size of which ranges from 0.1 to 10 nm. Of all the Nanomaterials, Nanoclusters are the smallest sized nanomaterials because of their close packing arrangement of atoms.

**5. Define Nanowire**

Nanowire is a nanomaterial having an aspect ratio ie. Length to width ratio greater than 20. Nanowires are also referred to as quantum wires

**6. Define Nanorod.**

Nanorod is two-dimensional cylindrical solid material having an aspect ratio ie. Length to width ratio less than 20.

**7. What is CVD?.**

CVD is Chemical Vapour Deposition. It is a process of chemically reacting a volatile compound of a material with other gases to produce a non volatile solid that deposits automatically on a suitably placed substrate.

**8. What are carbon nanotubes?**

Carbon nanotube is a tubular form of carbon with 1-3 nm diameter and a length of few nm to microns.

**9. List any four Nanomaterials?**

Carbon Nanotube  
Nanowire  
Quantum dots

Dendrimers

**10. Mention any two properties of Nanomaterials.**

Nanomaterials possess good electrical properties and thermal Properties

Nanomaterials possess extraordinary mechanical and optical properties.

**PART-B**

- 1. With a neat sketch explain sol-gel synthesis of Nanomaterials.**
- 2. Discuss the size dependent properties of Nanomaterials.**
- 3. Discuss the applications of Nanomaterials in energy, medicine, sensor and catalysis.**
- 4. Explain laser ablation process for Producing nanomaterials with a neat diagram.**
- 5. Explain the synthesis, properties and uses of Carbon Nanotubes.**
- 6. Write a short note on Electrodeposition.**