

Model Paper

Roll No.....	B.Tech. II Sem. 2021-22 Mid Term I (Section A CSE) Engineering Chemistry 1FY1-03	Total no. of pages: 1 28-12-2021
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Time: 1 hr.

Maximum marks: 15

Q.N.	CO Mapped	Blooms Taxonomy Level	Question	Marks
1	CO2	Understand	Define hardness of water. Name one salt each which causes temporary and permanent hardness.	1+1+1
2	CO3	Understand	Define Fuel. Give one example of each primary and secondary liquid fuel	1+1+1
3	CO2	Analyze	How hardness of water has been determined experimentally? Give the Principle and name of important reagents used?	1+1+1
4	CO3	Analyze	Compare main differences between solid, liquid & gaseous fuels (at least three differences)	1+1+1
5	CO1	Evaluate	A water sample has the analytical report as under (in ppm): $Mg(HCO_3)_2 = 73$, $Ca(HCO_3)_2 = 81$, $CaCl_2 = 55.5$, $Mg(NO_3)_2 = 37$. Calculate the temporary, permanent and total hardness of water in terms of Calcium carbonate equivalent along with multiplication factors of respective salts.	1+1+1

Model Paper

ANSWERS

Ans 1. When Soap does not produce lather with water but form insoluble precipitate/scum, then the water is said to be **hard water** and this property is called **hardness of water**. [1]

Temporary hardness caused by $\text{Ca}(\text{HCO}_3)_2$ [1]

Permanent hardness caused by MgSO_4 [1]

Ans 2. A fuel may be defined as any combustible substance, which on burning in the presence of oxygen releases large amount of energy that can be used economically for domestic and industrial purpose. [1]

Primary liquid fuel : Petroleum [1]

Secondary liquid fuel: Petrol [1]

Ans 3. The hardness of water has been determined experimentally by complexometric method. The hardness producing ions (Ca^{2+} & Mg^{2+}) form complex with ligand EDTA. So, the determination of hardness is carried out by titrating water sample with Sodium salt of Ethylene Diamine Tetra Acetic Acid (EDTA) using Eriochrome Black-T as an indicator and keeping the pH of the water at 9.0 - 10.0. The end point is the change in colour from **wine - red to blue**, when the EDTA solution complexes the calcium and magnesium salt completely. [1+1+1]

Ans 4.

S.N.	Property	Solid fuel	Liquid Fuel	Gaseous fuel
1.	Density	Very high	Intermediate	Very low
2.	Fluidity	Almost negligible	Flow easily	Flow very fast
3.	Kinetic energy	Very low	Intermediate	Very high
4.	Storage	Easily stored	Storage require precautions	Storage require sophisticated and special precautions
5.	Transportation	Easily transported by man power	Transported through liquid storage tanks	Transported through pipelines

Ans 5. First conversion into CaCO_3 equivalent:

Constituents	Amt. (ppm)	Multiplication factor	Hardness in terms of CaCO_3 eq.
$\text{Mg}(\text{HCO}_3)_2$	73	100/146	$73 \times 100/146=50$
$\text{Ca}(\text{HCO}_3)_2$	81	100/162	$81 \times 100/162=50$
CaCl_2	55.5	100/111	$55.5 \times 100/111=50$
$\text{Mg}(\text{NO}_3)_2$	37	100/148	$37 \times 100/148=25$

Temporary hardness (in terms of CaCO_3 eq.) due to $\text{Mg}(\text{HCO}_3)_2 + \text{Ca}(\text{HCO}_3)_2$

$$50 + 50 = 100 \text{ ppm}$$

Permanent hardness (in terms of CaCO_3 eq.) due to $\text{CaCl}_2 + \text{Mg}(\text{NO}_3)_2$

$$50 + 25 = 75 \text{ ppm}$$

Permanent hardness (in terms of CaCO_3 eq.) = **175 ppm**

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