Question Paper

Exam Date & Time: 23-Mar-2024 (02:45 PM - 04:45 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

II SEMESTER B.TECH.
MID SEMESTER EXAMINATIONS, MARCH 2024

ENGINEERING CHEMISTRY [CHM 1071-CHM]

Marks: 30 **Duration: 120 mins.**

Part A: MCQ [Max time: 20 mins]

Q No	Question	Marks	CO	BL
Q1.	Identify the WRONG statement: (0.5) 1. **For dry corrosion, an electrolyte is essential 2. If one stops cathodic reaction, the corrosion reaction does not take place 3. Metals can undergo corrosion by dry oxygen 4. SO_2 gas can corrode metal or alloy	½	3	2
Q2.	Statement 1: Oxygen reduction is the most common cathode reaction in a wet corrosion. Statement 2: The oxidation of metal can take place with dry oxygen. (0.5) 1. **Both statements are true 2. Both statements are false 3. Statement 1 is true, while statement 2 is false 4. Statement 1 is false, while statement 2 is true	½	3	2
Q3.	In the case of the galvanic series, identify the CORRECT statement. (0.5) 1. Developed by studying the corrosion of metals and alloys in polluted seawater without their oxide films. 2. **developed by studying the corrosion of metals and alloys in unpolluted seawater without their oxide films. 3. Developed by studying the corrosion of metals and alloys in unpolluted seawater with their oxide films. 4. Developed by studying the corrosion of metals and alloys in polluted seawater with their oxide films.	½	3	3
Q4.	Galvanic corrosion is high when (0.5) 1. Both metals have having nearly same electrode potential 2. Both metals have nearly same area 3. **Both metals are placed far apart in galvanic series **4.** Both metals are placed close to each other in galvanic series	½	3	2
Q5.	In which among the following, corrosion rate is high? (0.5) 1. Large anodic area in contact with small cathodic area 2. **Small anodic area in contact with large cathodic area	½	3	2

	3. Equal anodic and cathodic area in contact with each other 4. Rate is independent of relative anodic and cathodic area			
Q6.	The corrosion rate can be minimised by (0.5) 1. Lowering hydrogen overvoltage at anode 2. **Increasing hydrogen overvoltage at cathode 3. Facilitate more hydrogen gas evolution at the cathode 4. Facilitate more hydrogen gas evolution at anode	½	3	2
Q7.	Corrosion rate is high when the corrosion product is a/an ___ layer (0.5) 1. Insoluble 2. Non-porous 3. **Unstable 4. Uniform	½	3	2
Q8.	During the process of rusting, what happens to oxygen in the presence of water? (0.5) 1. It gets oxidized to O^{2-} 2. It remains unreactive 3. It combines with hydrogen ions to form water molecules 4. **It is reduced to form hydroxide ions (OH^-)	½	3	2
Q9.	Which of the following statements about the electrochemical theory of corrosion is NOT true? (0.5) 1. It describes corrosion as a localized electrochemical process. 2. It involves the formation of small-scale galvanic cells on the metal surface 3. Oxidation occurs at anodic sites, while reduction occurs at cathodic sites 4. **The electrolyte is not involved in electrochemical corrosion	½	3	3
Q10.	Which among the following is characteristic feature of pitting corrosion? (0.5) 1. Uniform thinning of the metal surface 2. **Deep, localized holes or cavities in the metal 3. Formation of a volatile oxide layer on the surface 4. Intergranular attack along grain boundaries	½	3	2
	Part B [Descriptive]			
Q11.	Explain the concept of single electrode potential. A galvanic cell is constructed with zinc and silver electrodes. The concentrations of Zn^{2+} and Ag^+ ions are 0.01 M and 0.1 M, respectively. Calculate the potential and free energy change of the cell at 25 °C. The standard electrode potentials of Zn and Ag are -0.76 V and +0.80 V, respectively.	4	1	3
Q12.	Discuss the working principle of the glass electrode. Explain any two advantages and limitations of using the same for measuring pH.	4	1	3
Q13.	Suggest a method to minimise the following corrosions. (a) galvanic (b) intergranular, and (c) stress.	3	3	3
Q14.	Explain how the following factors influence the rate of corrosion. (a) concentration, (b) pH, and (c) temperature of the electrolyte.	3	3	2

<table>
<tr><td>Q15.</td><td>From the given table, answer the following questions.<table><tr><th>Electrochemical series</th><th>Galvanic series</th></tr><tr><td>Li</td><td>Li</td></tr><tr><td>Mg</td><td>Mg</td></tr><tr><td>Al</td><td>Zn</td></tr><tr><td>Zn</td><td>Al</td></tr></table>(a) When both Zn and Al metals are in contact with their metal ions and are connected, write the anodic reaction
(b) When Zn and Al metals are connected without metal ions, write the metal that undergoes corrosion reaction.
(c) Choose the metal combination that gives maximum emf.</td><td>3</td><td>1</td><td>3</td></tr>
<tr><td>Q16.</td><td>What are fuel cells? Enumerate the advantages and disadvantages of Li-ion batteries.</td><td>3</td><td>1</td><td>2</td></tr>
<tr><td>Q17.</td><td>What is the decomposition potential, and how is it determined experimentally?</td><td>3</td><td>1</td><td>3</td></tr>
<tr><td>Q18.</td><td>Write any two differences between dry corrosion and wet corrosion.</td><td>2</td><td>3</td><td>2</td></tr>
</table>

****

Scheme of evaluation

Q11. Explain the concept of single electrode potential. A galvanic cell is constructed with zinc and silver electrodes. The concentrations of Zn^{2+} and Ag^{+} ions are 0.01 M and 0.1 M, respectively. Calculate the potential and free energy change of the cell at 25 °C. The standard electrode potentials of Zn and Ag are -0.76 V and +0.80 V, respectively. (4)

Answer: Explanation of single electrode potential 1.5 M

Correct anode and cathode identification 0.5 M

E^{o} = 0.80 - (-0.76) = 1.56 V

$E = E^{o} - 0.0591 / 2 \log [(0.01) / (0.1)^{2}]$

E = 1.56 - 0 = 1.56 V 1 M

Free energy change = - 2 * 96500 * 1.56 = -301.1 KJ 1 M

Q12. Discuss the working principle of the glass electrode. Explain any two advantages and limitations of using the same for measuring pH. (4)

Answer: Cell representation 0.5 M

Working principle 1.5 M

Two advantages and 2 limitations 0.5 M each

Q13. Suggest a method to minimise the following corrosions

(a) galvanic (b) intergranular, and (c) stress. (3)

Answer: Galvanic, intergranular and stress corrorion – 1 M each

Q14. Explain how the following factors influence the rate of corrosion

(a) concentration, (b) pH, and (c) temperature of the electrolyte. (3)

Answer: All three factors – 1 M each

Q15. From the given table, answer the following questions.

Electrochemical series	Galvanic series
Li	Li
Mg	Mg
Al	Zn
Zn	Al

(a) When both Zn and Al metals are in contact with their metal ions and are connected, write the anodic reaction

(b) When Zn and Al metals are connected without metal ions, write the metal that undergoes corrosion reaction.

(c) Choose the metal combination that gives maximum emf. (3)

Answer: (a) $Al \rightarrow Al^{3+} + 3\ e^-$

(b) Zn

(c) Li and Zn

Q16. What are fuel cells? Enumerate the advantages and disadvantages of Li-ion batteries. (3)

Answer: Explanation of Fuel cell – 1 M

Any two advantages and two disadvantages – 0.5 M each

Q17. What is the decomposition potential, and how is it determined experimentally?. (3)

Answer: Explanation / definition of decomposition potential – 1M

Experimental determination – 2 M

Diagram – 0.5 M

Graph – 0.5 M

Explanation – 1 M

Q18. Write any two differences between dry corrosion and wet corrosion. (2)

Answer: Any two differences – 1 M each