STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI 600 086
(For candidates admitted from the academic year 2023-24)

B.Sc. DEGREE EXAMINATION, APRIL 2026
BRANCH IV - CHEMISTRY
SIXTH SEMESTER

COURSE : MAJOR-CORE
PAPER : PHYSICAL CHEMISTRY III
SUBJECT CODE : 23CH/MC/PC64
TIME : 3 HOURS MAX. MARKS :100

Q. No.	**SECTION A** **Choose the correct answer (15 x 1 =15 marks)**	CO	KL
1.	The unit of cell constant is a) m^{-1} b) m c) m^3 d) m^{-3}	1	1
2.	The role of catalyst is to change _____. a) Gibbs energy of reaction c) activation energy of reaction b) enthalpy of reaction d) equilibrium constant	1	1
3.	The half-life of radioactive sodium is 10.0 hours. It would take _____ hours for a 64 g sample to decay to one-eighth of its original concentration. a) 45 b) 60 c) 30 d) 15	1	1
4.	Cell potential is equal to E^o when a) K_{eq} is 1 b) K_{eq} is 10 c) K_{eq} is 100 d) K_{eq} is less than 1	1	1
5.	The law of independent migration of ions was given by a) Arrhenius b) Nernst c) Kohlrausch d) Ostwald	1	1
6.	Temperature coefficient of EMF is a) $\left(\frac{\Delta E}{\Delta T}\right)_P$ b) $\left(\frac{\Delta E}{\Delta P}\right)_T$ c) $\left(\frac{\Delta E}{\Delta T}\right)_V$ d) $\left(\frac{\Delta E}{\Delta T}\right)_S$	1	1
7.	In an adsorption process, select the correct thermodynamic parameters from the following – a) $\Delta H = -ve, \Delta G = -ve \; and \; \Delta S = -ve$ b) $\Delta H = -ve, \Delta G = -ve \; and \; \Delta S = +ve$ c) $\Delta H = +ve, \Delta G = -ve \; and \; \Delta S = +ve$ d) $\Delta H = +ve, \Delta G = +ve \; and \; \Delta S = +ve$	1	1
8	The ionic strength of 0.02M sodium chloride is _____ M. a) 0.02 b) 0.01 c) 0.005 d) 0.0025	1	1
9.	Which of the following electrolytes does not yield a straight line in its plot of $\boldsymbol{\lambda}_C$ verses $\sqrt{\boldsymbol{C}}$- a) NH_4Cl b) HCN c) KCl d) $NaNO_3$	1	1
10.	In the Freundlich adsorption isotherm, the slope of the straight-line graph between $log(x/m)$ and $logP$ for adsorption of a gas on a solid is a) $1/n$ b) $logk$ c) n d) k	1	1

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11.	The fraction of the total current carried by an ion is its _____. a) Ionic mobility b) Transport number c) Conductance d) Resistance	1	1
12.	The sign of the anode compartment of an electrochemical cell is a) negative b) positive c) neutral d) both ±	1	1
13.	In physical adsorption, the bonds associated are a) ionic bond b) covalent bond c) Vander Waal forces bond d) All of these	1	1
14.	The indicator electrode is a) SHE b) Calomel electrode c) Ag/AgCl electrode d) quinhydrone electrode	1	1
15.	How many layers are adsorbed in chemical adsorption? a) 1 or more b) one c) two d) three	1	1
Q. No.	**SECTION B** **Fill in the blanks (10x1=10 marks)**		KL
16.	The standard reduction electrode potential of SHE is _____.	2	2
17.	Ostwald's dilution law applies only to _____electrolytes.	2	2
18.	The increase in conductivity upon the application of very high-frequency alternating current is known as the _____ effect.	2	2
19.	The cell constant of a conductivity cell of following electrode dimensions, l = 0.95cm, b = 1.05cm and having a distance between the two electrodes as 0.50 cm is _____.	2	2
20.	Freundlich adsorption isotherm is _____.	2	2
21.	The relation between molar conductance (Sm^2/mol) and specific conductance(S/m) when concentration of electrolyte is in mole/m^3 is _____.	2	2
22.	The relation between E° and equilibrium constant K of an electrochemical cell is____.	2	2
23.	As concentration increases, the reaction rate _____.	2	2
24.	Quantum yield φ = _____	2	2
25.	The ionic strength is given by μ = _____.	2	2
	Answer in a line (5x1=5 marks)		2
26.	Give the Arrhenius equation.	2	2
27.	Represent a cell for the following cell reaction: $Pb(s) + Sn^{+4}(aq) \rightarrow Pb^{+2}(aq) + Sn^{+2}(aq)$	2	2
28.	Name any one enzyme used as a catalyst.	2	2

29.	What is half life time?	2	2
30.	Write the rate law for a reaction, A + 2B → 2C, which is first order with respect to A and B.	2	2
Q. No.	**SECTION C** **Answer any six of the following (6x5 = 30 marks)**		KL
31.	Derive the expression for the rate constant of a second-order reaction in which the initial concentrations of the reactants are the same. Also deduce an expression for half-life of the reaction.	3	3
32.	Discuss the Debye-Hŭckel theory of strong electrolytes	3	3
33.	Describe in detail the Standard Hydrogen Electrode.	3	3
34.	Enlighten on the application of Kohlrausch law in the determination of the dissociation constant of a weak acid. Given λ° of NH_4Cl, OH^- and Cl^- are 129.8, 174 and 65.6 $S.cm^2.eq^-$ respectively. Calculate the λ° of NH_4OH. (3+2)	3	3
35.	Explain kinetics of acid catalysed reaction with an example.	3	3
36.	i) Distinguish between Physisorption and Chemisorption. (4) ii) What is E^o for the following cell? (2) $Al(s)\| Al^{3+}(aq)\|\| Fe^{3+}(aq)\| Fe(s)$ Given: Standard Reduction Potential $Fe^{3+}(aq) + 2e– \rightarrow Fe(s)$ ----------+0.771 V $Al^{3+}(aq) + 2e– \rightarrow Al(s)$---------- –1.660V		
37.	Derive a relation for determining the pH of the solution using a quinhydrone electrode.	3	3
Q. No.	**SECTION D** **Answer any four of the following (4 x 5 =20 marks)**	CO	KL
38.	Describe the moving boundary method for the determination of the transport number of an ion.	4	4
39.	Discuss the kinetics of the photochemical reaction between hydrogen and chlorine.	4	4
40.	Derive a relation for the activity of Na_2SO_4. Evaluate the activity of 0.1M Na_2SO_4. Given: mean activity coefficient of sodium sulphate = 0.805. (5)	4	4

<table>
<tr><td>41.</td><td>What are concentration cells? Derive an expression for the EMF of a concentration cell (reversible with respect to an cation) with transference.</td><td>4</td><td>4</td></tr>
<tr><td>42.</td><td>The reaction $2NO_{(g)} + 2H_{2\,(g)} \rightarrow N_{2\,(g)} + 2H_2O_{\,(g)}$ was studied at 904 °C and the data in the table were collected.
<table>
<tr><th>Experiment</th><th>Initial [NO] mol/L</th><th>Initial [H_2] mol/L</th><th>Initial rate [N_2] mol/L/s</th></tr>
<tr><td>1.</td><td>0.420</td><td>0.122</td><td>0.136</td></tr>
<tr><td>2.</td><td>0.210</td><td>0.122</td><td>0.0339</td></tr>
<tr><td>3.</td><td>0.210</td><td>0.244</td><td>0.0678</td></tr>
<tr><td>4.</td><td>0.105</td><td>0.488</td><td>0.0339</td></tr>
</table>
Determine the order of each reactant. (2)
Write the rate equation. (1)
Calculate the rate constant at 904°C. (2)</td><td>4</td><td>4</td></tr>
<tr><td>Q. No.</td><td>SECTION E
Answer the following (2x 10 = 20marks)</td><td>CO</td><td>KL</td></tr>
<tr><td>43</td><td>i) Derive the Nernst’s equation for the emf of a galvanic cell. Hence, arrive at equations relating E^o_{cell} and thermodynamic parameters ΔG°, ΔH° & ΔS° of the system. (4)
ii) Describe the VantHoff differential method and Half-time method to determine the order of reaction. (3+3)</td><td>5</td><td>5</td></tr>
<tr><td></td><td>OR</td><td></td><td></td></tr>
<tr><td></td><td>i) Give a detailed account of the Langmuir adsorption isotherm. (7)
ii) The rate constant of a second-order reaction is $5.70\times10^{-5} dm^3 mol^{-} s^{-}$ at 25°C and $1.64\times10^{-4} dm^3 mol^{-} s^{-}$ at 40°C. Calculate the activation energy of the reaction. (3)</td><td>5</td><td>5</td></tr>
<tr><td>44.</td><td>i) Discuss in detail the collision theory of gaseous bimolecular reactions. (7)
ii) Explain the Freundlich adsorption isotherm. (3)</td><td>5</td><td>5</td></tr>
<tr><td></td><td>OR</td><td></td><td></td></tr>
<tr><td></td><td>Explain the following
i) Types of conductometric titration (Acid - Base)
ii) Types of adsorption isotherms. (5+5)</td><td>5</td><td>5</td></tr>
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