Electrochemistry | Chemical Kinetics Surface Chemistry
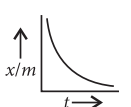
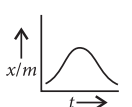Time Allowed : 3 hours
Maximum Marks : 70

GENERAL INSTRUCTIONS

(i)   All questions are compulsory.

(ii) Q. no. 1 to 5 are very short answer questions and carry 1 mark each.

(iii) Q. no. 6 to 10 are short answer questions and carry 2 marks each.

(iv) Q. no. 11 to 22 are also short answer questions and carry 3 marks each.

(v)   Q. no. 23 is a value based question and carries 4 marks.

(vi) Q. no. 24 to 26 are long answer questions and carry 5 marks each.

(vii) Use log tables if necessary, use of calculators is not allowed.

Previous Years Analysis						
	2016		**2015**		**2014**	
	Delhi	**AI**	**Delhi**	**AI**	**Delhi**	**AI**
VSA	1	1	1	2	1	1
SA-I	2	1	1	1	1	2
SA-II	3	2	2	2	2	2
VBQ	–	–	–	–	–	–
LA	–	1	1	1	1	–

1. Why in general a reaction does not proceed with a uniform rate throughout or why instantaneous rate is preferred over average rate?

2. What do you mean by degree of dissociation of an electrolyte?

3. For a reaction the half-life $(t_{1/2})$ is directly proportional to the initial concentration of reactant. What is the order of the reaction?

4. How is adsorption of a gas related to its critical temperature?

5. What is the relation between E_{cell} of hydrogen electrode and pH of the solution, when this half cell is connected with normal hydrogen electrode (NHE)?

6. Physical and chemical adsorption respond differently with a rise in temperature. What is this difference and why is it so?

(Physical adsorption)   (Chemical adsorption)

7. The thermal decomposition of HCOOH is a first order reaction with a rate constant of 2.4×10^{-3} s^{-1} at a certain temperature. Calculate how long will it take for three fourth of initial quantity of HCOOH to decompose. (log 4 = 0.6021)

8. What is demulsification? Name two techniques for demulsification.

OR

Explain shape-selective catalysis with a suitable example.

9. Resistance of a conductivity cell filled with 0.1 mol L^{-1} KCl solution is 100 Ω. If the resistance of the same cell when filled with 0.02 mol L^{-1} KCl solution is 520 Ω. Calculate the conductivity and molar conductivity of 0.02 mol L^{-1} KCl solution. The conductivity of 0.1 mol L^{-1} KCl solution is 1.29 S/m.

10. Calculate the emf of the cell in which the following reaction takes place :

$Ni_{(s)} + 2Ag^+(0.002\ M) \longrightarrow Ni^{2+}(0.160\ M) + 2Ag_{(s)}$

Given that $E°_{cell} = 1.05$ V

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11. **(i)** Why do colloidal solutions exhibit Tyndall effect?
    (ii) Why does sky look blue?

12. The reaction $SO_2Cl_2 \longrightarrow SO_2 + Cl_2$ is a first order reaction with $k = 2.2 \times 10^{-5}$ s^{-1} at 320°C. Calculate the percentage of SO_2Cl_2 that is decomposed on heating for 30 minutes.

13. Depict the electrochemical cell and calculate the $E°$ for each cell.
    (i) $2Ag^+ + Cd \longrightarrow Ag + Cd^{2+}$
    (ii) $Cl_{2(g)} + 2I^- \longrightarrow 2Cl^- + I_{2(s)}$
    Given $E°_{Ag^+/Ag} = 0.80$ V, $E°_{Cd^{2+}/Cd} = -0.40$ V
    $E°_{Cl_2/Cl^-} = 1.36$ V, $E°_{I_2/I^-} = 0.54$ V

14. **(i)** What is Helmholtz electrical double layer?
    (ii) How is dialysis carried out? Mention its one application.

15. Three electrolytic cells A, B, C containing solutions of $ZnSO_4$, $AgNO_3$ and $CuSO_4$, respectively are connected in series. A steady current of 1.5 amperes was passed through them until 1.45 g of silver deposited at the cathode of cell B. How long did the current flow? What mass of copper and zinc were deposited?
   (At. wt. of Ag = 108, Cu = 63.5, Zn = 65.3)

    OR

    The electrical resistance of column of 0.05 M NaOH solution of diameter 1 cm and length 50 cm is 5.55×10^3 ohm. Calculate its resistivity, conductivity and molar conductivity.

16. **(i)** The rate constants of a reaction at 500 K and 700 K are 0.02 s^{-1} and 0.07 s^{-1} respectively. Calculate the values of E_a and A.
    (ii) What is meant by an elementary reaction?

17. All energetically effective collisions do not result in a chemical change. Explain with the help of an example.

18. **(i)** When a bright silver object is placed in the solution of gold chloride, it acquires a golden tinge but nothing happens when it is placed in a solution of copper chloride. State reason for this behaviour of silver.
    (ii) What is the effect of change in concentration and temperature on the electrode potential of a given half cell?

19. **(i)** A colloidal solution of ferric oxide is prepared by two different methods as shown below.
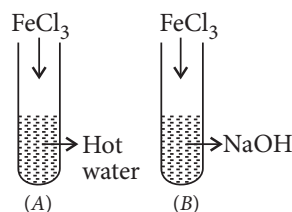
(a) What is the charge on colloidal particles in two test tubes (A) and (B).
(b) Give reasons for the origin of charge.
(ii) What is 'occlusion'?

20. Explain the terms with suitable examples.
    (i) Alcosol   **(ii)** Aerosol
    (iii) Hydrosol

21. **(i)** What is the significance of writing negative and positive sign before rate of reaction?
    (ii) What is the usefulness of initial rate method?

22. **(i)** The conductivity of a 0.20 M solution of KCl at 298 K is 0.0248 S cm^{-1}. Calculate its molar conductivity.
    (ii) If a current of 8A was passed for two hours through a solution of copper sulphate when 3.2 g of copper was deposited. Find the current efficiency.

23. Suresh, a chemistry student of class XII is suffering from fever. His mother consulted the doctor and took a medicine from store as prescribed by doctor. She added boiled water and cold water to the medicine and shook the content properly as per the instructions given on the bottle of medicine. His mother said that why they do not prepare this medicine so that it can be consumed as such. Suresh then explained to his mother why this medicine is available in this form.
    (i) Why the medicine is available in this form?
    (ii) Why it is instructed to shake the content well after addition of water in medicine?
    (iii) What are the values shown by Suresh?
    (iv) What is the name of process done by his mother to prepare medicine?

24. Consider the figure and answer the questions (i) to (v) given below.
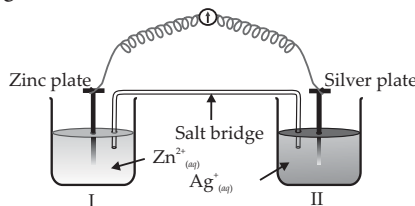
(i) Redraw the diagram to show the direction of electron flow.

(ii) Is silver plate the anode or cathode?

(iii) What will happen if salt bridge is removed?

(iv) How will concentration of Zn^{2+} ions and Ag^+ ions be affected when the cell functions?

(v) How will the concentration of Zn^{2+} ions and Ag^+ ions be affected after the cell becomes 'dead'?

<div align="center">**OR**</div>

An excess of liquid mercury is added to an acidified solution of 1.0×10^{-3} M Fe^{3+}. It is found that 5% of Fe^{3+} remains at equilibrium at 25°C. Calculate $E^{\circ}_{(Hg^{2+}/Hg)}$ assuming that the only reaction that occurs is $2Hg + 2Fe^{3+} \longrightarrow Hg_2^{2+} + 2Fe^{2+}$.
(Given $E^{\circ}_{(Fe^{3+}/Fe^{2+})} = 0.77$ V)

25. (i) In a reaction between *A* and *B*, the initial rate of reaction was measured for different initial concentration of *A* and *B* as given below :

A/mol L^{-1}	0.20	0.20	0.40
B/mol L^{-1}	0.30	0.10	0.05
r_0/mol $L^{-1}s^{-1}$	5.07×10^{-5}	5.07×10^{-5}	7.16×10^{-5}

What is the order of reaction with respect to *A* and *B*?

(ii) A reaction is 50% complete in 2 hours and 75% complete in 4 hours. What is the order of reaction.

<div align="center">**OR**</div>

(i) During nuclear explosion, one of the products is ^{90}Sr with half-life of 28.1 years. If 1 μg of ^{90}Sr was absorbed in the bones of a newly born baby instead of calcium, how much of it will remain after 10 years and 60 years if it is not lost metabolically?

(ii) The decomposition of a hydrocarbon follows the equation
$k = (4.5 \times 10^{11} s^{-1})e^{-28000K/T}$. Calculate E_a.

26. (i) Discuss the activity and selectivity aspects of solid catalysts.

(ii) Which of the following electrolyte is most effective for the coagulation of $Fe(OH)_3$ sol and why?

Na_3PO_4, Na_2SO_4, NaCl
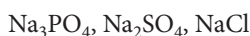
<div align="center">**OR**</div>

(i) What are micelles? Give an example of a micelle system.

(ii) What is the role of adsorption in froth floatation process used especially for concentration of sulphide ores?

(iii) Define gold number.

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