Name: …………………………………

Roll No. …………………………….

Part – III   Time : 2 Hours

CHEMISTRY   Cool-off time : 15 Minutes

Maximum : 60 scores

General Instructions to Candidates :

- There is a 'Cool-off time' of 15 minutes in addition to the writing time.
- Use the 'Cool-off time' to get familiar with questions and to plan your answers.
- Read questions carefully before answering.
- Read the instructions carefully.
- Calculations, figures and graphs should be shown in the answer sheet itself.
- Give equations wherever necessary.
- Electronic devices except non-programmable calculators are not allowed in the Examination Hall.

Answer *any four* questions from 1 to 5. Each carry 1 score.   (4 × 1 = 4)

1. Number of moles of the solute per kilogram of the solvent is called …………

   (a) Mole fraction   (b) Molality   (c) Molarity   (d) Molar mass

2. What is the charge of 1 mol of electron?

3. Write the unit of rate constant for a zero order reaction.

4. The limiting molar conductivity of weak electrolytes can be calculated by which of the following law?

   (a) Faraday's law   (b) Kohlrausch law   (c) Henry's law   (d) Raoult's law

5. Name a first-row transition element which does not exhibit variable oxidation states.

Answer *any eight* questions from 6 to 15. Each carry 2 scores.   (8 × 2 = 16)

6. Write any one difference between primary cell and secondary cell. Write one example for each.

7. For intravenous injections only solutions with osmotic pressure equal to that of 0.9% (mass/volume) NaCl solution is used. Why?

(P.T.O)

8. The conversion of a molecule A to B follows second order kinetics.

   a) Write the rate equation for this second order reaction. (1)

   b) If the concentration of A is increased to three times, how will it affect the rate of formation of B. (1)

9. 0.4 g of a non-volatile, non-electrolyte solute dissolved in 20 g of benzene lowers its freezing point by 0.75 K. The freezing point depression constant for benzene is 5.12 K kg mol^{-1}. Calculate the molar mass of the solute.

10. Draw the structures of chromate and dichromate ions.

11. Derive an expression for the half-life period of a first order reaction.

12. What is reverse osmosis? Write any one of its applications.

13. Transition elements are used as catalyst in many reactions. What are the reasons for their catalytic property?

14. Calculate the limiting molar conductivity of acetic acid (HAc). Given that Λ^0_m for NaCl, HCl and NaAc are 126.4, 425.9 and 91.0 S cm^2 mol^{-1} respectively.

15. The standard electrode potential for Daniel cell is 1.1 V. Calculate the standard Gibbs Energy change for the reaction: $Zn_{(s)} + Cu^{2+}_{(aq)} \longrightarrow Zn^{2+}_{(aq)} + Cu_{(s)}$.

Answer *any eight* questions from 16 to 26. Each carry 3 scores. (8 × 3 = 24)

16. For ethanol-acetone mixture solute-solvent interaction is weaker than solute-solute and solvent-solvent interaction.

    a) Does this solution obey Raoult's law? (1)

    b) Draw the vapour pressure - mole fraction graph for this solution. (2)

17. The cell reaction in Daniel cell is $Zn_{(s)} + Cu^{2+}_{(aq)} \rightarrow Zn^{2+}_{(aq)} + Cu_{(s)}$ and Nernst equation for electrode potential for the general electrode reaction $M^{n+}_{(aq)} + ne^- \rightarrow M_{(s)}$ is

$$E_{M^{n+}|M} = E^0_{M^{n+}|M} - \frac{2.303RT}{nF} \log \frac{1}{[M^{n+}]}$$

Derive Nernst equation for Daniel cell.

18. a) What is abnormal molar mass? (1)

    b) Complete the following table by giving the values of van't Hoff factor 'i' for complete dissociation of solute. (2)

Salt	van't Hoff factor 'i' for complete dissociation of solute
KCl	
Al(NO$_3$)$_3$	
Na$_2$SO$_4$	
Al$_2$(SO$_4$)$_3$	

(P.T.O)

19. The rusting of iron can be considered as due to the formation of electrochemical cells on its surface.

(a) Write the anodic and cathodic reactions taking place during rusting. (2)

(b) Write any two methods used to prevent the corrosion of iron. (1)

20. How do you prepare $K_2Cr_2O_7$ from chromite ore?

21. Write any 3 differences between order and molecularity of a reaction.

22. (a) Describe about standard Hydrogen Electrode (SHE). (2)

(b) The emf of the cell obtained by coupling an electrode with SHE is 1.37V. If SHE is the negative electrode, find the electrode potential of the given electrode. (1)

23. The rate of a reaction quadruples when the temperature changes from 293 K to 313 K. Calculate the energy of activation of the reaction assuming that it does not change with temperature.

24. Among the following transition metal ions, identify the ions which are coloured in aqueous solution. Justify your answer.

$$Fe^{2+}, Sc^{3+}, Ni^{2+}, Cu^+$$

25. a) Name the two types of magnetic behaviour exhibited by transition metals. (1)

b) Calculate the 'spin only' magnetic moment of $M^{2+}_{(aq)}$ ion (Z = 27). (2)

26. a) What is pseudo first order reaction? Write one example. (2)

b) Examine the graph given below and identify the order of the reaction corresponding to it. (1)
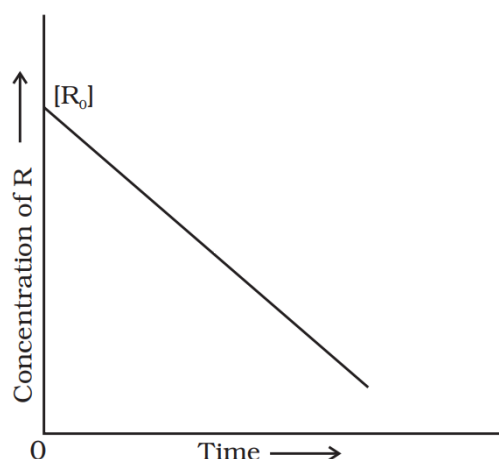
Answer *any four* questions from 27 to 31. Each carry 4 scores. (4 × 4 = 16)

27. a) What are colligative properties? (2)

b) Write the names of any two colligative properties. (1)

c) Which colligative property measurement is the best for determining the molar mass of proteins? (1)

28. a) What are fuel cells? (1)

b) Write the cathode and anode reactions of $H_2 - O_2$ fuel cell. (2)

c) Write any one advantage of fuel cell over other conventional cells? (1)

29. a) What are Azeotropes? (1)

b) Vapour pressure of pure chloroform ($CHCl_3$) and dichloromethane (CH_2Cl_2) at 298 K are 200 mm of Hg and 415 mm of Hg respectively. Calculate the vapour pressure of the solution prepared by mixing 24 g of chloroform and 17 g of dichloromethane at 298 K. (3)

30. a) Write Arrhenius equation. Explain the terms in it. (2)

b) Calculate the time required for the 90% completion of a first order reaction if k = 0.2303 s^{-1}.

(2)

31. a) What is Lanthanoid contraction? Give reason for it? (2)

b) Write any two consequences of Lanthanoid contraction. (2)