

Five Year Integrated M. Sc. Examination 2022
Semester-V
Course: CH-3-5-2
(Chemistry)

Time: Four Hours

Full Marks: 80

Questions are of value as indicated in the margin

Group-A

(Answer any ten Questions)

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|---|---|--------|
| 1 | (a) Calculate spin and parity of Fe-57 | 10 x 2 |
| | (b) Find out the geometric cross-section of Sn-125 (in barn unit). | |
| | (c) Write down the proton and neutron configuration of Li-6 and O-17. | |
| | (d) State and explain nuclear magnetic moment. | |
| | (e) Explain the term regioselective reaction with example. | |
| | (f) Why E ¹ reaction competes with SN ¹ ? | |
| | (g) What do you mean by α-elimination reaction? | |
| | (h) What do you mean by E ¹ CB mechanism? | |
| | (i) According to Kohlrausch's law, how will the molar conductance for a strong electrolyte changes with concentration. | |
| | (j) Write the factors that govern the electrical conductivity of a solution. | |
| | (k) Write the relationship between molar conductance and equivalent conductance of the electrolyte, A _x B _y . | |
| | (l) State the Walden rule for an electrolyte. | |

Group-B

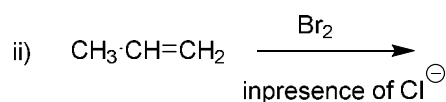
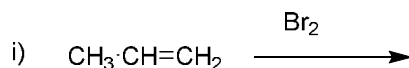
(Answer any four Questions)

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|----|---|---------|
| 2. | (a) Draw the neutron versus proton curve. | 2 + 3 |
| | (b) Discuss what happen when neutron: proton ratio is too high and too low?. | |
| 3. | (a) What do you mean by Geiger-Nuttal rule and neutron hypothesis? | 2.5+2.5 |
| | (b) Elucidate the term nuclear isomer and neutron spin isomer. | |
| 4. | (a) Discuss the nature and origin of nuclear force. | 2.5+2.5 |
| | (b) Differentiate packing fraction and packing efficiency. | |
| 5. | (a) What do you mean radioactivity? Mention its different units. | (1+1)+3 |
| | (b) Calculate the radioactivity of 1g Ra-226. Given $t_{\frac{1}{2}} = 1600$ years. | |
| 6. | (a) Define neutron capture cross-section and mention its importance. | (1+1)+3 |
| | (b) On continuous exposure of B-10 to a slow neutron flux of 1016 m ⁻² .s ⁻¹ , 3% weight fraction disappear in 3x10 ⁷ s. Calculate neutron capture cross-section in barn unit. | |

Group-C

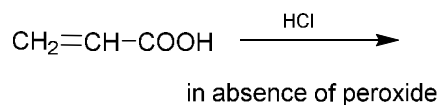
(Answer any four Questions)

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| 7. | (a) Predict the product(s) of the following reactions and explain your answer. | 3+2 |
|----|--|-----|



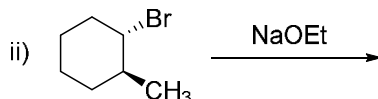
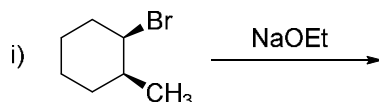
(b) What is the rate of addition reaction of $\text{CH}_3\text{CH}=\text{CH}_2$ and $\text{Ph-CH}=\text{CH}_2$? Explain your answer.

8. (a) Explain the formation of anti-Markovnikov's product of the following reaction. 3+2

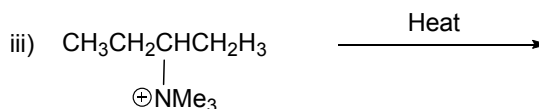
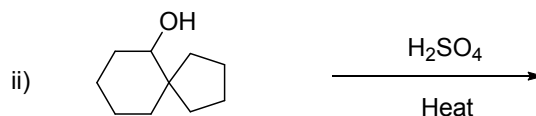
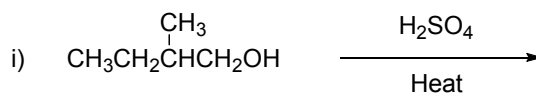


(b) Why peroxide effect is observed in case of HBr only?

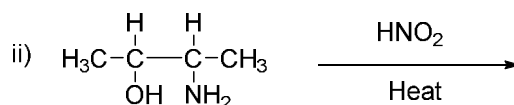
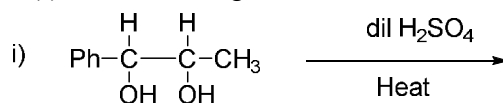
9. Suggest the major product(s) of the following reactions and explain your answer mechanistically. 2.5+2.5



10. Predict the all possible products of the following reactions and explain the major and minor one if applicable (any two). 2.5+2.5



11. (a) Predict the product(s) of the following reactions. 2+2+1



(b) What will be the observation if the above reactions is carried out in presence of D_2O ?

Group-D

(Answer any four Questions)

12. (a) Define the terms ‘weak electrolyte’ and ‘strong electrolyte’ with suitable examples. 2+3
(b) Calculate the molar conductance at infinite dilution for MgCl_2 . The ionic equivalent conductance values of Mg^{2+} and Cl^- ions are $0.0106 \text{ S.m}^2.\text{mol}^{-1}$ and $0.0076 \text{ S.m}^2.\text{mol}^{-1}$, respectively.
13. (a) Derive an expression that can be used to determine the molar conductance at infinite dilution as well as the dissociation constant of the weak electrolyte. 2+3
(b) For a 5 mmolL^{-1} aqueous solution of SrCl_2 at 25°C , the conductivity is $1.242 \times 10^{-3} \Omega^{-1}\text{cm}^{-1}$. Calculate the molar conductance (Λ_m) and equivalent conductance (Λ_{eq}) of this solution.
14. (a) What is the “cell constant” of a conductivity cell? 1+4
(b) A standard solution of KCl with conductivity (κ) equal to $1.06296 \times 10^{-6} \text{ S.m}^{-1}$ at 298K is employed to standardize the cell and a resistance of 4.2156Ω is measured. What is the cell constant? The same cell is filled with a solution of HCl and a resistance of 1.0326Ω is measured. What is the conductivity of the HCl solution?
15. (a) In general small inorganic ions in an aqueous solution at infinite dilution show mobilities in the range of $40 - 80 \times 10^{-5} \text{ cm}^2.\text{V}^{-1}.\text{s}^{-1}$. However, $\text{H}_3\text{O}^+(\text{aq})$ and $\text{OH}^-(\text{aq})$ show abnormally high mobilities. Explain why? 2+3
(b) Consider a 0.1 M NaCl solution at 25°C and 1 atm undergoing electrolysis with electric field strength of 15 V.cm^{-1} . (a) Find the drift speed of the Cl^- ions, (b) How many current carrying Cl^- ions cross a 1.0 cm^2 area plane parallel to the electrode in 1.0 s ?
16. (a) Define mobility of ions in an electrolytic solution. 1+4
(b) The moving boundary method was applied to a 0.02 M aqueous solution of NaCl at 25°C using CdCl_2 as the following solution. For a constant current of 1.6 mA , it was found that the boundary moves 10.0 cm in 3453 s in a tube of average cross-sectional area 0.1115 cm^2 . The conductivity of this NaCl solution at 25°C is $2.313 \times 10^{-3} \Omega^{-1}.\text{cm}^{-1}$. Calculate the transport number of Na^+ and Cl^- ions.