

Five Year Integrated M. Sc. Examination 2024

Semester-V

Paper: 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)

1. (a) Calculate spin and parity of Fe-57
(b) Find out the geometric cross-section of Sn-125 (in barn unit) ($R_0 = 1.4 \times 10^{-15} \text{m}$).
(c) Write down the proton and neutron configuration of C-14 and O-17.
(d) State and explain nuclear magnetic moment.
(e) What is Markonikoff's rule?
(f) Give the chemical reaction with stereochemistry when bromine reacts with *cis*-butene in syn fashion.
(g) What is Walden inversion?
(h) What do you mean by $E1_{CB}$ mechanism?
(i) Define mobility? What is its dimension?
(j) What is the cell constant of a conductometric bridge? Write its unit.
(k) What is molar conductivity and what is its dimension?
(l) The mobility of chloride ion in aqueous solution at 25°C is $7.91 \times 10^{-8} \text{ m}^2\text{s}^{-1}\text{V}^{-1}$. Calculate the molar ionic conductivity.

10 x 2

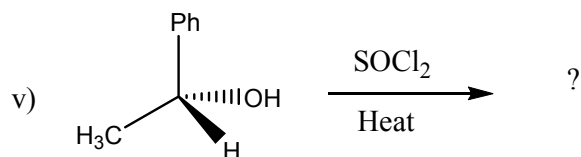
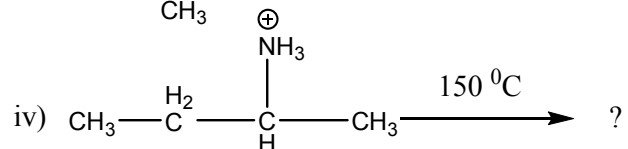
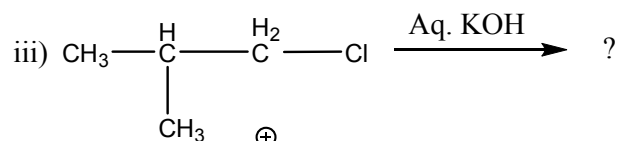
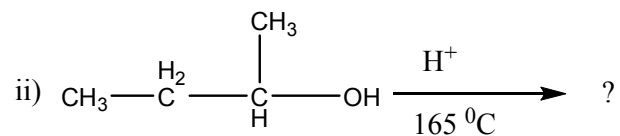
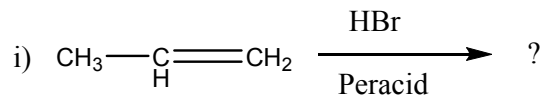
Group-B

(Answer any four Questions)

2. (a) Draw the neutron versus proton curve.
(b) Discuss what happens when neutron: proton ratio is too high and too low?
2+3
3. (a) What do you mean by Geiger-Nuttall rule and neutron hypothesis?
(b) Elucidate the term nuclear isomer and neutron spin isomer.
2.5+2.5
4. (a) Discuss the nature and origin of nuclear force.
(b) Differentiate packing fraction and packing efficiency.
2.5+2.5
5. (a) What do you mean radioactivity? Mention its different units.
(b) Draw nuclear shell diagram.
(1+1)+3
6. (a) Define neutron capture cross-section and mention its importance.
(b) On continuous exposure of B-10 to a slow neutron flux of $10^{16} \text{ m}^{-2}\text{s}^{-1}$, 3% weight fraction disappears in $3 \times 10^7 \text{s}$. Calculate neutron capture cross-section in barn unit.
(1+1)+3

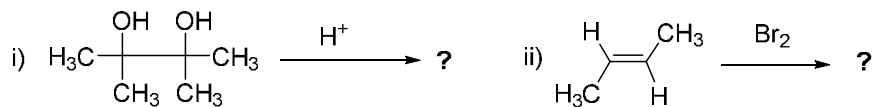
Group-C
(Answer any four Questions)

7. Predict the product(s) of the following reactions.



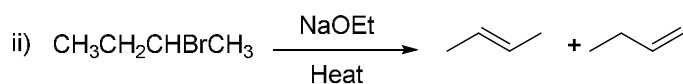
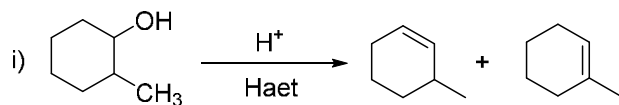
1 x 5

8. Write the major product of the following reactions with mechanism.



2.5+2.5

9. Give the mechanistic path of the following reactions



2.5+2.5

10. Write short notes on:
 i) Regioselectivity in addition reaction.
 ii) Stereochemistry for SN_2 reaction.
- 2.5+2.5
11. SN^1 and E_1 mechanism are always competitive. Do you agree with this statement? Justify your answer.

5

Group-D
(Answer any four Questions)

12. (a) Define strong and weak electrolytes with examples.
 (b) How can you measure the degree of dissociation of a weak electrolyte conductometrically? Derive an expression by which the dissociation constant of a weak electrolyte be measured.
- 1+(1+3)
13. (a) Define the law of independent migration of ions.
 (b) Is it possible to measure the molar conductance of a weak electrolyte at infinite dilution using Kohlrausch expression? Comment.
 (c) The limiting molar conductivities of HCl , NaCl , and $\text{Na}(\text{CH}_3\text{COO})_2$ are 426.16, 128.8 and 91.01 $\text{ohm}^{-1}\text{cm}^2\text{mol}^{-1}$, respectively at 25°C . Calculate the limiting molar conductivity of CH_3COOH at this temperature?
- (1+1)+3
14. (a) Draw a curve of the conductometric titration of a strong acid with strong base and explain its feature.
 (b) The mobility of a Rb^+ ion in aqueous solution is $7.98 \times 10^{-8} \text{ m}^2 \text{ s}^{-1} \text{ V}^{-1}$ at 25°C . The potential difference between two electrodes placed in the solution is 32.0 V. If the electrodes are 8.00 mm apart, what is the drift velocity of the Rb^+ ion at that temperature?
- 2.5+2.5
15. (a) Define molar conductance. Express the relationship between molar conductance and equivalent conductance for the electrolyte, $\text{Cu}_3(\text{PO}_4)_2$.
 (b) Write a short note on Walden Rule.
- 3+2
16. (a) What is relaxation effect? How does it affect the mobility of an ion under an applied field?
 (b) At 25°C the molar ionic conductivities of Li^+ , Na^+ , and K^+ are 3.87 $\text{mS m}^2 \text{ mol}^{-1}$, 5.01 $\text{mS m}^2 \text{ mol}^{-1}$, and 7.35 $\text{mS m}^2 \text{ mol}^{-1}$, respectively. What are their mobilities?

2+3