

Five Year Integrated M. Sc. Examination 2023
Semester-V
Course: CH-3-5-2 (2016)
(Chemistry)

Time: Four Hours

Full Marks: 80

Questions are of value as indicated in the margin

Group-A

(Answer any ten Questions)

1. (a) Q value for the reaction $^{13}\text{N} (n, p) \rightarrow ^{13}\text{C}$ is 3.236 MeV. Calculate the threshold energy (in MeV) for the reaction.
- (b) Calculate the geometric cross-section of Sn-125 (in barn) ($R_0 = 1.4 \times 10^{-15} \text{ m}$).
- (c) Differentiate ortho- and para- hydrogen.
- (d) Predict the radioactive decay modes of C-14 and O-14.
- (e) What is cross over experiment?
- (f) What is the intermediate in addition of bromine to 2-butene? Give the structure.
- (g) Give an example of anti-Markonikov's addition reaction.
- (h) What is the preferred orientation in β -elimination reaction and Why?
- (i) Write the relationship between molar conductance and equivalent conductance of the electrolyte, $A_x B_y$.
- (j) What is specific conductivity and what is its dimension?
- (k) Write the special features of the electrolytes used in the moving boundary method for measuring the transport number of an electrolyte.
- (l) What is the cell constant of a conductivity cell? It is always recommended to calibrate the conductivity cell with respect to a standard KCl solution. Explain why?

10 x 2

Group-B

(Answer any four Questions)

2. (a) Discuss the factors which control the nuclear stability.
 - (b) Elucidate phenomenon nuclear hybridization, nuclear isomer and nuclear spin isomer?
- 2+3
3. (a) What is neutron capture cross-section?
 - (b) On continuous exposure of B-10 sample to a slow neutron flux of $10^{16} \text{ m}^{-2}\text{s}^{-1}$, its 3% weight fraction disappears in $3 \times 10^7 \text{ s}$. Find out the cross section for neutron capture (in barns) by B-10.
- 1+4
4. (a) State and explain Neutrino hypothesis.
 - (b) Elucidate the Geiger-Nuttall rule and draw the Sargent's curve.
- 2 x 2.5
5. (a) Draw Segre chart of nuclides and explain its importance in understanding the radioactive decay.
 - (b) Mention the characteristics of nuclear force and explain its origin in the light of pi meson theory.
- 2 x 2.5
6. (a) Draw nuclear shell diagram and write nuclear configuration of As-76.
 - (b) Calculate spin and parity of Fe-57.

2 x 2.5

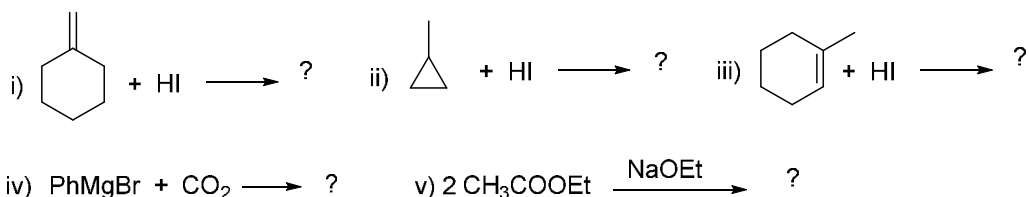
Group-C

(Answer any four Questions)

7. (a) 'On bromination cis-2-butene gives only dl-2,3-dibromobutane'- Explain with proper mechanism.
(b) What will the product if 1,3-butadiene is treated with one molecule of bromine?. Explain your answer.

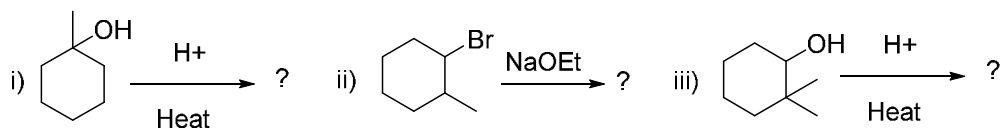
3+2

8. Predict the major products



1+1+1+1+1

9. Predict the major product of the following reactions with proper explanation (any two).



2.5+2.5

10. 'PhCH₂CH₂Br undergoes E1CB mechanism to produce PhCH=CH₂ but CH₃CH₂CH₂Br follows E2 mechanism to give CH₃CH=CH₂'. Explain why?

2.5+2.5

11. Predict the product of the following reaction with proper mechanism.



2.5+2.5

Group-D

(Answer any four Questions)

12. (a) Define the transport number of an electrolyte.
(b) In a moving boundary experiment on KCl the apparatus consisted of a tube of internal diameter 4.146 mm, and it contained aqueous KCl at a concentration of 0.021 mol dm⁻³. A steady current of 18.2 mA was passed and the boundary advanced a distance of 600 mm in 192 seconds. Find the transport number of K⁺ and Cl⁻ ions.
13. (a) Is it possible to measure the equivalent conductance of a weak electrolyte at infinite dilution experimentally? If not then how will you measure it?
(b) The limiting molar conductivities of NaI, NaCH₃CO₂, and Mg(CH₃CO₂)₂ are 12.69 mS m² mol⁻¹, 9.10 mS m² mol⁻¹, and 18.78 mS m² mol⁻¹, respectively (all at 25°C). What is the limiting molar conductivity of MgI₂ at this temperature?

1+4

(1+1)+3

14. (a) Draw a curve of the titration of a strong acid with weak base and explain its feature.
 (b) What is ionic mobility? Write down the relationship between ionic mobility and the ionic conductance. The ionic conductance of the ions, Li^+ , Na^+ , K^+ , Rb^+ and Cs^+ is supposed to be in the order, $\text{Li}^+ > \text{Na}^+ > \text{K}^+ > \text{Rb}^+ > \text{Cs}^+$, but it is observed experimentally that the reverse order is true. Explain why? 2+3
15. (a) The equivalent conductance (λ_{eq}) of a strong electrolyte decreases with increase in concentration, though specific conductance increases. Explain.
 (b) The equivalent conductance of an infinitely dilute solution of NH_4Cl is $150 \text{ ohm}^{-1}\text{cm}^2\text{equiv}^{-1}$ and the conductance of OH^- ion and Cl^- ion are 198 and $76 \text{ ohm}^{-1}\text{cm}^2$, respectively. What is the value of for NH_4OH ? If the equivalent conductance of 0.01N NH_4OH solution be $9.6 \text{ ohm}^{-1}\text{cm}^2\text{equiv}^{-1}$, what is the degree of dissociation? 2+3
16. (a) Explain the idea of ion atmosphere. Draw the pictures of the ionic atmosphere both in presence and absence of external applied field. Discuss about the effects that are responsible for retarding the motion of the central ion under an applied field.
 (b) Define ionic strength. Calculate the mean ionic activity co-efficient of 0.01M KCl solution in presence of 0.01M BaCl_2 solution at 298K . [$A = 0.509$ at 298K]. (1+1+1+1)+1