

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College under University of Calcutta)

B.A./B.Sc. SECOND SEMESTER EXAMINATION, MAY 2015

FIRST YEAR

CHEMISTRY (General)

Paper : II

Date : 29/05/2015

Time : 11 am – 2 pm

Full Marks : 75

[Use a separate Answer book for each group]

Group – A

Unit - I

[Answer any one question]

1. a) What are the limitations of Valence Bond Theory? [3]
b) What is semiconductor? What happens when small amount of 'B' is doped with Si? [3]
c) Define Lewis theory of acids and bases. Pick out Lewis acids and Lewis bases from the following compounds / ions— SO_2 , AlCl_3 , Co^{3+} and F^- . [2+2]
d) What are standard and formal potentials of a system? Write down Nernst equation for a redox system : $\text{OX} + ne \rightleftharpoons \text{Red}$ stating the meaning of each term. [2+1]
2. a) Draw a labelled MO diagram for N_2 molecule. Calculate the bond order of N_2^+ , N_2 and N_2^- species and discuss their magnetic behaviour. [2+3]
b) Arrange the following halides in increasing order of their Lewis acidity : BF_3 , BCl_3 , BBr_3 , BI_3 give reason. [3]
c) Standard potential of $\text{H}_2\text{O}_2/2\text{H}_2\text{O}$ and $\text{O}_2/\text{H}_2\text{O}_2$ couples are 1.77 volts and a 6.8 volt respectively. Using these data, comment on the feasibility of the reaction. $\text{H}_2\text{O}_2 + \text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$ and give a characteristic name to this reaction indicating the changes in oxidation numbers. [3]
d) What is disproportionation reaction? Give example. [2]

Unit - II

[Answer any one question]

3. a) What are first order and second order reactions? Give one example of each. [3]
b) Deduce the relation between the rate constant and half life period for a first order reaction. [2]
c) Explain the reaction rate by collision theory and transition state theory. [3]
d) Show the variation of equivalent conductance with concentration. What is equivalent conductance at infinite dilution? [3+1]
4. a) What is zero order reaction? Give an example. [3]
b) Draw a comparative study between 1st and 2nd order reaction with respect to (i) rate expression (ii) unit of k and (iii) half life period. [3]
c) Deduce the unit of k_n from its rate expression. [1]
d) Show the variation of conductance of a given KCl solution with volume of AgNO_3 solution added. [3]
e) What is the law of independent migration of ions? [2]

Group – B

Unit - I

[Answer any three questions]

5. What is carbocation? Arrange the following carbocations according to their increasing stability with explanation.



[1+1+3]

6. a) What are enantiomers and diastereomers? Give examples. [3]
 b) Write down the E and Z isomers of 2-pentene. [2]
7. a) Mention the products with mechanism $\text{CH}_3 - \text{CH} = \text{CH}_2 + \text{HBr} \rightarrow ?$
 What will happen if the reaction is carried out in presence of benzoyl peroxide under light? [2+1]
 b) How can you distinguish between 1-butyne and 2-butyne by chemical test? [2]
8. a) What is Friedel-Crafts reaction? [2]
 b) How will you convert benzene to phenol? [3]
9. a) Carry out the following conversions :
 i) $\text{CH}_3 - \text{CH} = \text{CH}_2 \rightarrow \text{CH}_3 - \underset{\text{OH}}{\text{CH}} - \text{CH}_3$
 ii) $\text{CH}_3 - \text{CH} = \text{CH}_2 \rightarrow \text{CH}_3 - \text{CH}_2 - \text{CH}_2\text{OH}$ [2+2]
 b) Write down the product of the following reaction $\text{CH} \equiv \text{CH} \xrightarrow[\text{(1mole)}]{\text{HBr (2mole)}} ?$ [1]

Unit - II

[Answer any two questions]

10. a) "Acetaldehyde does not respond to Cannizzaro reaction but trimethyl acetaldehyde does." Explain [3]
 b) Predict the products of the following reactions [1+1]
 i) $\text{PhCHO} + \text{HCHO} \xrightarrow{50\% \text{ NaOH}} ?$
 ii) $\text{PhCHO} \xrightarrow[\text{C}_2\text{H}_5\text{OH} - \text{H}_2\text{O}]{\text{KCN}} ?$
11. a) Write down the product with mechanism. $\text{CH}_3\text{CHO} \xrightarrow{\text{dilute NaOH}} ?$ [3]
 b) How would you distinguish chemically between acetaldehyde and acetophenone? [2]
12. a) Discuss $\text{S}_{\text{N}}1$ reaction of alkyl halides with suitable example. [3]
 b) Write a note on Saytzeff reaction. [2]

Group – C

Unit - I

[Answer any one question]

13. a) State the postulates of kinetic theory of gases and deduce $PV = \frac{1}{3} mnc^2$. [3]
 b) i) Write down the expression for the probability of gas molecules to be moving with a speed in the range c to $c+dc$ at a given temperature in accordance with Maxwell's distribution law.
 ii) Depict the same graphically at two different temperatures.
 iii) Find out the value of speed at which the above probability is maximum. [3×2]
 c) Write down the van-der-Waals' equation for n moles of a real gas. What are the units of 'a' and 'b'? [3]
14. a) Calculate kinetic energy of two moles of CO_2 at 300°C . [3]
 b) What is root mean square velocity? Calculate root mean square velocity of oxygen at 27°C . [3]
 c) What do you mean by mean free path and collision frequencies? [3]
 d) i) Define viscosity coefficient.
 ii) How it changes with temperature for a liquid. [2×1.5]

Unit - II

[Answer any one question]

15. a) Classify the following variables as extensive or intensive— specific heat, internal energy, density, heat capacity. [2]
b) A system is enclosed on all sides by fixed adiabatic, non-permeable walls. What is the nature of the system? — Open, closed, isolated. [2]
c) Derive $C_p - C_v = R$ for an ideal gas. [3]
d) Deduce the relation $TV^{\gamma-1} = k$ (const.) for an adiabatic reversible change of an ideal gas. [3]
e) In the isothermal expansion of He gas at 27°C , pressure is reduced from 10 atmospheric pressure to 1 atmospheric pressure irreversibly. Calculate the work done. [3]
16. a) Starting with the mathematical definition of 1st law of thermodynamics prove that
i) Work done in an adiabatic process is independent of path.
ii) Total internal energy of the universe is constant. [2×2]
b) Calculate the work done in SI unit when one mole of an ideal monoatomic gas at 27°C expands adiabatically and reversibly from 1 litre to 10 litre. [3]
c) Deduce $PV^\gamma = \text{constant}$ for adiabatic reversible change of an ideal gas. [3]
d) Derive Kirchoff's equation showing the variation of heat of reaction with temperature. [3]

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