RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. SECOND SEMESTER EXAMINATION, MAY 2016

FIRST YEAR [BATCH 2015-18]

Date : 28/05/2016   **CHEMISTRY (General)**

Time : 11 am – 2 pm   **Paper : II**   Full Marks : 75

[Use a separate Answer Book for each group]

Group – A

[*Attempt one question from each Unit*]

Unit – I

1. a) Draw molecular orbital energy level diagram for O_2 molecule. Explain the paramagnetism of the molecule.   [3+2]

    b) Explain the reaction in terms of Lux Flood definition :   [2+2]

       i) $PbO + SO_3 \rightarrow PbSO_4$

       ii) $3CaO + P_2O_5 \rightarrow Ca_3(PO_4)_2$

    c) What is disproportionation reaction? Explain with one example.   [2]

    d) What is redox indicator? Give example.   [2]

2. a) Give a brief introduction on Lewis acid/base concept. Arrange the following in increasing order of their Lewis acidity.   [2+2+2]

       i) BF_3, BCl_3, BBr_3, BI_3

       ii) SiF_4, $SiCl_4$, $SiBr_4$, SiI_4

    b) What happens if small amount of As is doped with Si?   [2]

    c) Define with example Disproportionation and comproportionation reactions.   [2]

    d) Discuss the drawbacks of Valence Bond Theory.   [3]
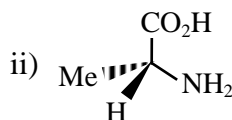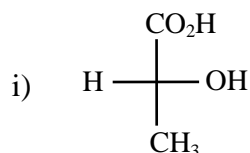
Unit – II

3. a) For a reaction, $N_2 + 3H_2 = 2NH_3$, show that rate of consumption of N_2 and that of consumption of H_2 are not same. Also show the difference in the same graphical plot.   [3]

    b) In a 1st order reaction, the time needed for decomposition of $\frac{1}{3}$ is constant at constant temp. and is independent of initial concentration. Explain using equations.   [3]

    c) i)   How does the conductivity of a solution depend on speed of ions and total no. of charge carriers?   [2]

       ii)   What is equivalent conductance and what is its unit?   [1]

    d) What is autocatalytic reaction? Explain with an example.   [1·5]

    e) What is enzyme catalysis? Give example.   [1·5]

4. a) Differentiate between order and molecularity of a reaction.   [2]

    b) How does a catalyst accelerate the rate of a chemical reaction? What do you mean by catalyst poison?   [3]

    c) The equivalent conductivity at infinite dilution λ_0 for CH_3COONa, HCl and NaCl are 78,384 and 109 units, respectively. Calculate λ_0 for CH_3COOH.   [2]

    d) Show that for a 2nd order reaction $A \rightarrow P$, $kt = \dfrac{x}{a(a-x)}$ where, k is the rate constant, a being the initial concentration of A and x is the degree of dissociation.   [3]

    e) Explain, normally the rate of reaction increases with increase in temperature.   [2]
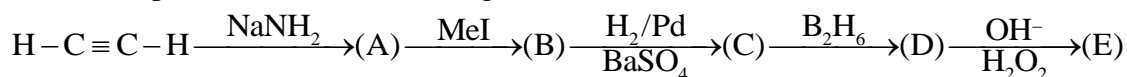
Group - B

[*Attempt <u>one question</u> from <u>each Unit</u>*]
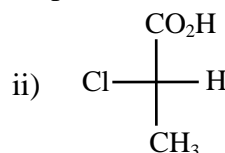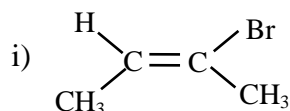
Unit – III

5. a) Write down Fischer projections of all the stereoisomers of tartaric acid
$HO_2C-CH(OH)-CH(OH)-CO_2H$. [3]

b) Why meso-tartaric acid is not optically active. [1]

c) Write down the E– and Z– isomeric structures of 2–pentene. [2]

d) Assign R/S configurational designation at the chiral centres of the following molecules. [2]

i)
$$\begin{array}{c} CO_2H \\ | \\ H-\!\!\!-OH \\ | \\ CH_3 \end{array}$$

ii)
$$Me\cdots\!\!\!\!\overset{\displaystyle CO_2H}{\underset{\displaystyle H}{\diagup}}NH_2$$

e) Show the mechanism of nitration of nitrobenzene. [4]

f) Write short note on Friedel-Craft's reaction. [3]

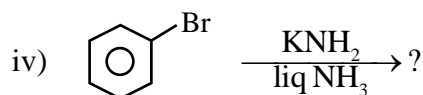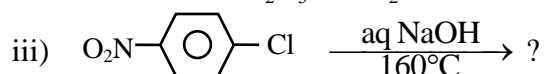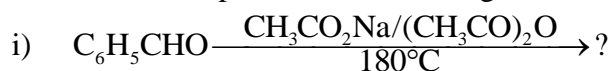6. a) Predict the product(s) in the following reactions : [5]

$$H-C\equiv C-H \xrightarrow{NaNH_2} (A) \xrightarrow{MeI} (B) \xrightarrow[BaSO_4]{H_2/Pd} (C) \xrightarrow{B_2H_6} (D) \xrightarrow[H_2O_2]{OH^-} (E)$$

b) Show the mechanism of the following reaction : $R-CH=CH_2+HBr \rightarrow R-CHBr-CH_3$. [3]

c) Write E/Z and D/L nomenclature of the following compounds. [2]

i)
$$\underset{CH_3}{\overset{H}{\diagdown}}C=C\underset{CH_3}{\overset{Br}{\diagup}}$$

ii)
$$\begin{array}{c} CO_2H \\ | \\ Cl-\!\!\!-H \\ | \\ CH_3 \end{array}$$

d) Write short notes on— [2×2·5]

   i) Polymerisation Reaction

   ii) Hydroboration Reaction

Unit – IV

7. a) Write down the products of following reactions : [4×1]

   i) $C_6H_5CHO \xrightarrow[180°C]{CH_3CO_2Na/(CH_3CO)_2O}$?

   ii) $C_6H_5CHO \xrightarrow[C_2H_5OH/H_2O]{KCN}$?

   iii) $O_2N-\!\!\langle O \rangle\!\!-Cl \xrightarrow[160°C]{aq\ NaOH}$?

   iv) $\langle O \rangle^{Br} \xrightarrow[liq\ NH_3]{KNH_2}$?

b) Write down the product with mechanism. $CH_3CHO \xrightarrow{dil\ NaOH}$? [3]

c) Discuss S_N1 reaction of alkyl halides with suitable example. [3]

8. a) Discuss E2 reaction with suitable example. [3]

b) Write down the products of the following reactions. [2×1]

   i) $CH_3-CH_2-\underset{\underset{Br}{|}}{CH}-CH_3 \xrightarrow[EtOH]{NaOEt}$?

   ii) $CH_3-CH_2-\underset{\underset{H\bar{O}N^+Me_3}{|}}{CH}-CH_3 \xrightarrow{\Delta}$?
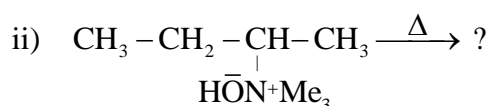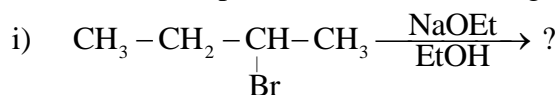
c) Write a note on Benzoin Condensation.   [3]

d) Formaldehyde undergoes Cannizzaro reaction, but acetaldehyde cannot. Why?   [2]

Group – C

[*Attempt <u>one question</u> from <u>each Unit</u>*]

Unit – V

9. a) Define average and root mean square speed of gas molecules.   [3]

b) State the principle of equipartition of energy. Calculate the vibrational K.E of an NH_3 molecule.   [2+2]

c) From $PV = \dfrac{1}{3} mN\bar{C}^2$, derive Avogadro's law and Dalton's law of partial pressure. [Terms are having usual meaning]   [5]

10. a) The critical point of a gas described by P_C, V_C and T_C have finite values for a definite gas, are dependent on van der Waals' constants 'a' and 'b'. Deduce the values of P_C, V_C and T_C for a van der Waals gas.   [4]

b) Define viscosity coefficient of liquid. What are its units? Explain the effect of change of temperature on viscosity coefficient.   [3+1+2]

c) Write down the expression for Maxwell's distribution of speed of gas molecules and discuss its characteristics.   [2]

Unit – VI

11. a) Deduce the relation PV^{γ} = constant for an ideal gas stating the necessary assumptions.   [3]

b) At 27°C, one mole of an ideal gas expands from 5 lit to 10 lit. The change is isothermal and reversible. Calculate ΔE and ΔH. Apply 1st law equation to find out the value of q.   [4]

c) Explain— "Joule-Thomson coefficient of an ideal gas is zero".   [3]

d) "Adiabatic curve is steeper than isothermal one"— Justify or Criticize the statement.   [3]

12. a) Deduce thermodynamically that $C_P - C_V = R$ for one mole of an ideal gas.   [3]

b) "The heat of neutralization of all strong acids with strong alkalis is always same" —Justify the statement.   [3]

c) Define Hess' law of constant heat with example.   [3]

d) i) Derive the temperature dependence of heat of reaction as $\dfrac{d(\Delta H)}{dT} = \Delta C_P$.

ii) Also find out the integrated form.   [4]

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