RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College under University of Calcutta)

B.A./B.SC. SECOND SEMESTER EXAMINATION, MAY-JUNE 2013

FIRST YEAR

Date : 22/05/2013 **Chemistry (General)**

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

Group-A

Unit-I

(Answer **any one** question)

1. a) Draw the molecular orbital diagram of oxygen and nitrogen molecules and comment on the bond order, magnetic properties of oxygen and nitrogen molecules. 1½+1½+1+1
   b) Can ammonia act both as a lewis base and as a Bronsted –Lowry base? Explain 2
   c) What do you mean by electrode potential and standard red ox potential? Explain with example. 3
   d) Write briefly about n-type and p-type semiconductors. 3

2. a) Define acids and bases in terms of Lux-Flood concept with suitable examples. 3
   b) From the below mentioned compounds pick out the Lewis base, Lewis acid or both and explain
   $$PCl_3,\ SO_3,\ SnCl_4$$ 4
   c) What is formal potential? Write the significance of formal potential. 3
   d) Explain the property of electrical conductivity of metals by band theory with pictorial representation. 3

Unit-II

(Answer **any one** question)

3. a) Define order and molecularity of chemical reaction with examples. 3
   b) Deduce the equation for the rate constant and half life period of a 1st order reaction. 3
   c) Write down the effect of (i) temperature and (ii) dilution on equivalent and specific conductance for a weak electrolyte. 3
   d) A 1st order reaction requires 52 minute for 75% completion. Calculate its half-life. 2
   e) What are the units of specific conductance and equivalent conductance? 1

4. a) What do you mean by energy of activation? Draw the energy level diagrams for an exothermic and an endo thermic reaction. How does such a diagram for an uncalaysed reaction get changed when a catalyst is added. 1+2+1
   b) Show that for a second order reaction the half life is inversely proportional to the initial concentration of the reactant .
   c) How does the rate of an elementary chemical reaction vary with temperature? 3+1
   d) (i) Write the statement for the Law of independent migration of ions in context to an electrolytic solution. 2
   (ii) Given the equivalent conductances of sodium butyrate, sodium chloride and hydrochloric acid as 83, 127 and 426 ohm^{-1} cm^2 at 25^0 respectively. Calculate the equivalent conductance of butyric acid at infinite dilution. 2

Group-B

(Answer **any three** questions)

Unit - I

5. a) Write resonance structures of (i) $CH_2 = C - \bar{C}H_2$ and (ii) nitro benzene. 2
   b) Using inductive effect explain the acidity of the following compounds (according to increasing order)
   $CH_3COOH,\ FCH_2COOH,\ ClCH_2COOH$ 2
   c) Between $CH_3CH_2\overset{+}{C}H_2$ and $CH_2{=}C{-}\overset{+}{C}H_2$ which one is more stable carbocation? 1

6. a) Classify which one is chiral and which one is achiral (i) A hand and (ii) the letter A 1

   b) Draw and specify as R and S the enantiomers (in Fischer projection formula) if any of all the three monochloro pentanes. 1+3

7. a) Synthesize $Me_2CH\ CH_2\ CH_2\ CH_3$ from two 2-carbon compounds. 3

   b) Write mechanism of the flowing reactions.

   Methane $+Cl_2 \xrightarrow[\text{or heat}]{\text{uv}} CH_3Cl+HCl$. 2

8. a) Give the structural formulae for the alkenes formed on dehydrobromination of (i) 1-bromobutane and (ii) 2-bromobutane. 2

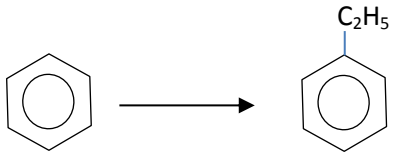
   b) Give the products with stereochemistry (if any) of the following reactions.

   (i) Trans-2-butene+$Br_2 \rightarrow$

   (ii) $Me_2C{=}CH_2 \xrightarrow{Hg(OAc)_2,\ water} \xrightarrow{NaBH_4, OH^-}$ 3

9. a) Write the mechanism of nitration of toluene with the energy profile diagram. 2.5+1

   b) 1.5



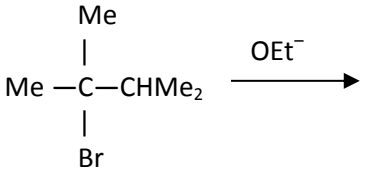
The above conversion can be done by two ways which one is preferred? Justify.

Unit-II

(Answer **any two** questions)

10. a) Discuss SN^2 reaction on the following aspects. 4
    (i) Example
    (ii) Rate equation
    (iii) Energy profile diagram
    (iv) Mechanism

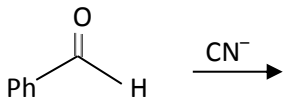
    b) Predict the major product of the following reaction 1



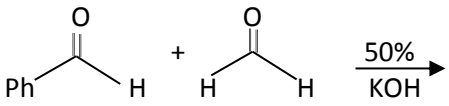
11. a) Write short notes on (i) Perkin reaction and (ii) Cannizzaro reaction. 2.5x2

12. a) Predict the product (s) 1.5x2

    (i)



    (ii)



    b) Write the mechanism of base catalysed aldol condensation reaction of acetone. Comment on the yield of the product. 2

Group-C

(Answer **any three** questions)

Unit - I

13. a) Write down the distribution function for molecular speeds in case of ideal gas at a particular temperature, allowed to move in the all three directions. 2

    b) Draw a qualitative plot to show how no. of gas molecules in a given speed range C to C+ dC varies with the speed C, at two different temperatures. 3

14. a) Define the following quantities (for gas molecules)
    (i) mean speed, (ii) mean square speed (iii) Collision frequency (iv) mean free path 4

    b) Write down the relationship that exists between collision frequency and mean free path. 1

15. a) Write down the van-der-Waals equation of state for 'n' mole of gas. 1

    b) What are the dimensions of the van-der-Walls constants 'a' and 'b'. 2

    c) Consider that the value of the volume correction term 'a' for an ideal gas is almost zero. Ascertain whether the value of pressure for this gas is less than or higher than the ideal value at the same volume and temperature. 2

16. a) Draw the P-V isotherms at two different temperatures (i) below the critical temperature (T<Tc) (ii) above the critical temperature (T>Tc) for a van-der-Wall gas and a real gas. 3

    b) Calculate the $\bar{C}_v$ for NH_3 molecule applying the law of equipartition of energy. 2

17. a) i) What is the origin of surface tension in a liquid. 1
    ii) How does the surface tension value for liquid-vapor surface change with temperature. Explain the observation. 1+1

    b) Define the term viscosity coefficient for a fluid. 2

Unit-II

(Answer **any two** questions)

18. a) A system 'x' can be devided into N number of subsystems x_1, x_2, x_3……. x_n. Value of a certain property is measured for the entire system and also for the smaller subsystems. The values that were obtained are Y when the measurement is done on the entire system and y_1, y_2, y_3…… y_n when the measurement are carried out on the subsystems x_1, x_2, x_3……. x_n. What will be the relation between 'Y' and 'y_1', 'y_2', 'y_3'…….'y_n'. if (i) The property is intensive in nature
    (ii) The property is extensive in nature. 1.5+1.5

    b) Give one example each of a closed system and an isolated system. 1

    c) 'X' is state function. What will be the value of the integral $\oint dx$? 1

19. a) Show thermodynamically that for an ideal gas $C_p - C_v = nR$. 3

    b) An ideal gas expands against vacuum under adiabatic condition (sum P_1, V_1 to P_2, V_2). Find out the value of the following quantities
    q, w, ΔE, ΔT (temperature change) 2

20. a) The heats of formation of CO_2 diamond and graphite are -94500 and -94050 cal. respectively. Find out the enthalpy change in the transformation of diamond to graphite with proper statement. 3

    b) Derive the relationship $\Delta H(T_2) - \Delta H(T_1) = \int_{T_1}^{T_2} \Delta C_p dT$ where $\Delta H(T_i)$ is the enthalpy change and ΔC_p is the change of C_p for the reaction. 2

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