RAMAKRISHNA MISSION VIDYAMANDIRA
(A Residential Autonomous College under University of Calcutta)
First Year

First-Semester Examination, December 2010

Date : 15-12-2010   **INDUSTRIAL CHEMISTRY (Honours)**   Full Marks : 75

Time : 11am – 2pm   **Paper - I**

(Use separate answer script for each group)

Group – A

Unit - I

Answer <u>any three</u> : [5×3 = 15]

1. a) Strength of a carbon-carbon double bond is less than twice of a carbon-carbon single bond. Explain.
   b) Write down the mechanism of bromine addition in a carbon-carbon double bond. Give the evidences. [2+3 = 5]

2. a) Compare the dipole moment values of ortho-, meta- and para- dinitrobenzene.
   b) Write down the mechanism of the following reaction and draw the energy profile diagram.
   $CH_3CH_2Br + NaOH(aq) \rightarrow CH_3CH_2OH + NaBr$ [2+3 = 5]

3. a) Name the following compounds according to IUPAC system.
   i) $CH_3COCH_2CH_2OH$

   ii) $\underset{\underset{CH_3}{|}}{CH_3\,CH}-CH_2-COOH$

   b) Arrange the following carbanions according to their relative stability and give reason.
   $CH_3\bar{C}H_2, \ (CH_3)_2\bar{C}H, \ (CH_3)_3\bar{C}$

   c) What is necessary and sufficient condition for a molecule to be optically active? [2+2+1 = 5]

4. a) Which of the following alkenes exhibit geometrical isomerism? Write down their stereoisomeric formulas with E/Z nomenclature.

   i) $\underset{\underset{CH_3}{|}}{CH_3-CH_2-C}=\overset{\overset{C_2H_5}{|}}{C}-CH_2-CH_3$

   ii) $H_2C = C(Cl)CH_3$
   iii) $C_2H_5CH = CHCH_2I$
   b) What do you mean by specific rotation for an optically active compound? [3+2 = 5]

5. a) The thermal stability of but-2-ene is greater than but-1-ene. Explain why?
   b) What do you mean by NGP? Illustrate using an example. [2+3 = 5]

Unit - II

Answer <u>any four</u> :   [5×4 = 20]

6. a) The value of m_ℓ lies between $+\ell$ and $-\ell$. Explain.

    b) From de Broglie's concept derive the Bohr's postulate of quantisation of angular momentum for an electron.   [2+3 = 5]

7. a) Predict the structure and bonding of the following molecules in the light of valence bond theory.
        (i) BF_3 (ii) PCl_5

    b) Discuss Sommerfeld's modification in the study of the structure of hydrogen atom.   [2+3 = 5]

8. a) Find out the bond order of peroxide ion using m.o. theory.

    b) Explain the following :
        i) NaCl is a better conductor of electricity in the molten state than in the solid state.
        ii) AlF_3 is more ionic than $AlCl_3$ [2+(1½+1½) = 5]

9. a) What do you mean by differentiating and levelling solvents?

    b) An aqueous solution contains $KHSO_4$ and K_2SO_4 in the ratio 1 : 2. The pH of the solution is 2·30. Calculate pK_a of the $HS\overline{O}_4$ ion.   [2+3 = 5]

10. a) State Pauli's exclusion principle.

    b) Explain the conductivity of p-type semiconductor.   [2+3 = 5]

11. a) Explain the hydrolysis of sodium acetate in the light of Bronsted-Lowry theory.

    b) Explain how will you choose an indicator in an acid-base titration.   [2+3 = 5]

Unit - III

Answer <u>any three</u> :   [5×3 = 15]

12. Discuss the causes of deviation of real gases from ideal behaviour. How are these accounted for in the van der Waals gas equation.   [2+3 = 5]

13. a) Show that $C_m : C_a : C = 1 : 1·128 : 1·224$ where C_m, C_a and C are most probable velocity, average velocity and root mean square velocity respectively for gas molecules.

    b) For a certain gas $T_c = 304·2K$, $P_c = 72·8$ atm. Calculate Van der Waals constants 'a' and 'b' for the gas.   [2+3 = 5]

14. a) Draw P – V diagram to explain the functioning of a Carnot cycle.

    b) Show that the efficiency of a Carnot cycle is given as $\epsilon = \dfrac{T_1 - T_2}{T_1}$ where T_1 and T_2 are the temperatures of the source and sink respectively.   [2+3 = 5]

15. a) Among the following properties mention which are intensive and which are extensive in nature.
        (i) density   (ii) pressure   (iii) Gibb's free energy   (iv) heat capacity

    b) Calculate the heat of formation of benzene at 25°C, if the heats of combustion of benzene, carbon and hydrogen are –780·98, –94·05 and –68·32 Kcal, respectively, at 25°C.   [2+3 = 5]

16. a) The reaction $A \rightarrow B$ has been found to be second order with respect to A. Evaluate the integrated rate expression for this reaction.

    b) Write down the Arrhenius equation for temperature dependence of reaction rate and discuss its significance.   [3+2 = 5]

Unit - IV

Answer <u>any one</u> : [5×1 = 5]

17. a) State Beer's law.
    b) Calculate the solubility of $Mg(OH)_2$, in moles per litre. Given the solubility product of $Mg(OH)_2$ is 5×10^{-12}. [2+3 = 5]

18. a) Explain the graph obtained in the conductometric titration of a strong acid with a strong base.
    b) The UV spectrum of acetone shows two peaks at 280nm $(\varepsilon_{max} 15)$ and 190nm $(\varepsilon_{max} 100)$. Identify the electronic transition for each.
    c) Arrange the following in order of increasing wavenumber of carbonyl absorption in the IR spectrum.
       $PhCOMe$, p-O_2N-C_6H_4-$COMe$, p-H_2N-C_6H_4-$COMe$ [2+1+2 = 5]

Group – B

Answer <u>any four</u> questions : [5×4 = 20]

19. a) State <u>any two</u> of the following laws of forces. [2]
       i) Parallelogram Law
       ii) Equilibrium Law
       iii) Law of Superposition
       iv) Law of action and reaction

    b) A beam AB of length 'l' is supported as shown in the figure and subjected to equal and opposite vertical forces P at its two ends as shown. Find the reactions at the supports C and D. [3]
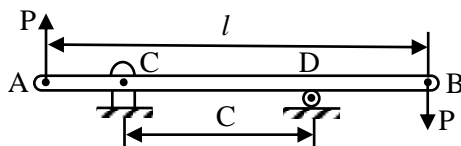
20. Using 'Method of Sections' determine the axial forces in bars 1, 2 & 3 of the tower loaded as shown in the figure. [5]
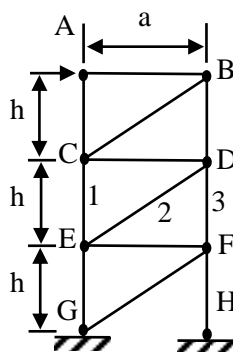
21. a) A vertical load P = 2100Kg is supported by two inclined steel wires AC and BC as shown in the figure. Determine the required cross-sectional area A of each wire if the allowable working stress in tension is $\sigma_w = 700Kg/cm^2$ and the angle $\theta = 30°$. [4]
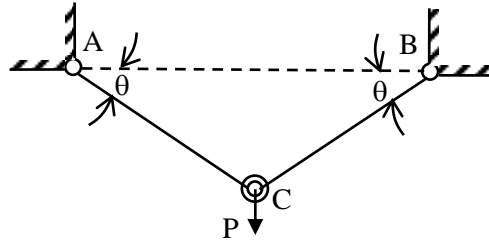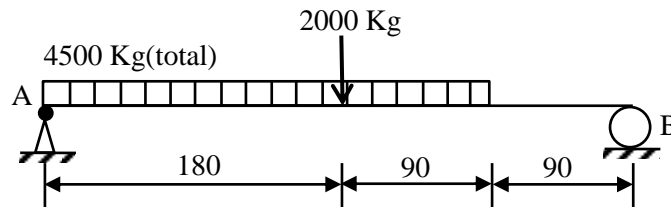
b) Give the relationship expressed by Hooke's Law. [1]

22. Construct to scale, the complete shear force and bending moment diagram for the beam in the figure. [5]

23. How the industrial boilers can be classified? What is the basic difference between a watertube boiler and a fire tube boiler. Name some of the boiler accessories and boiler mountings that are used in modern manufacturing units. [2+1+2]

24. A circular roller of weight Q = 445N and radious r = 152 mm hangs by a tie rod AC = 304 mm and rests against a smooth vertical wall at point B, as shown in the figure. Determine the tension T in the tie rod and the force R_b exerted against the wall at B. [5]