

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College under University of Calcutta)

B.A./B.SC. FIRST SEMESTER EXAMINATION, DECEMBER 2011

FIRST YEAR

INDUSTRIAL CHEMISTRY (Honours)

Date : 16/12/2011

Time : 11 am – 2 pm

Paper : I

Full Marks : 75

[Use separate Answer Books for each group]

Group – A

Unit – I

Answer **any three** questions :

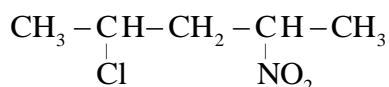
[5×3 = 15]

1. a) Write structures from the following IUPAC names :

i) 3-Carbamoylpentanoic acid

ii) 4-Bromo-5-hydroxyhexan-2-one

b) Give the IUPAC name of the following compound :

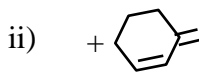
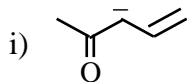


c) Between acetic acid and trichloroacetic acid, which one is more acidic and why?

[2+1+2]

2. a) If the internuclear distance of a heteronuclear diatomic molecule is 1.0\AA and its dipole moment is 1.2D , calculate the percentage of ionic character of the bond.

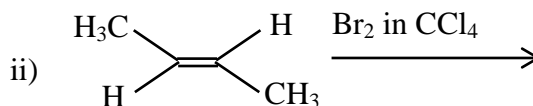
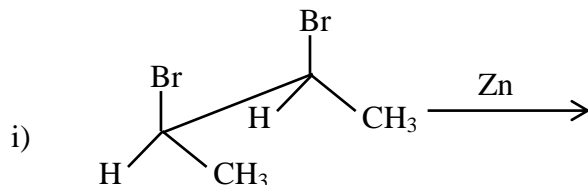
b) Derive major resonance structures for each of the following species and determine which, if any, structure is most important in each case.



c) Orthonitrophenol is more volatile than para-nitrophenol. Explain.

[2+2+1]

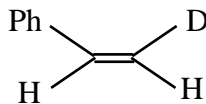
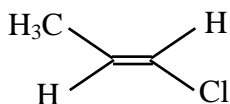
3. a) What happens when—



b) Hydrolysis of H_3CBr with aqueous ethanolic NaOH undergoes bimolecular substitution reaction but Me_3CBr undergoes unimolecular substitution reaction. Explain.

[3+2]

4. a) Predict E or Z nomenclature of the following compounds :



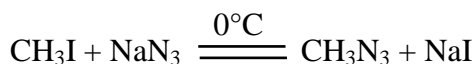
b) What is specific rotation? Write down its mathematical expression. Is it a constant value for a particular compound?

c) What do you mean by a diastereomer? Give an example.

[2+2+1]

5. a) Illustrate the mechanism of $\text{S}_{\text{N}}1$ reaction giving an example with energy profile diagram.

b) What will be the fate of reaction rate if solvent of the following reaction have been changed from methanol to N,N-dimethylformamide?



[2+3]

Unit – II

Answer **any four** questions :

[5×4 = 20]

6. a) Write down the Hund's rules for a polyelectronic system.
b) Find out the term symbol of d^4 electronic configuration in ground state. [3+2]
7. a) What do you mean by hydrogen like system?
b) Write down the expression for ionisation energy for hydrogen atom from Bohr's energy expression.
c) Write down the values for quantum numbers for the electrons present in helium atom in ground state. [1+2+2]
8. a) Deduce Henderson's equation for a buffer made from a weak acid and its salt.
b) What do you mean by buffer capacity of a buffer? [3+2]
9. a) Find out the bond order and magnetic property of B_2
b) Explain the structure of ClF_3 molecule using valence bond theory. [3+2]
10. a) Explain the conductivity of p-type semiconductor using band theory of metals.
b) Ionisation energy of oxygen molecule is less than that of oxygen atom. —Justify [3+2]
11. a) State Ostwald's dilution law.
b) Arrange the following acids in order of their increasing acidity : H_3PO_4 , H_3PO_3 , H_3PO_2 —Give reasons. [2+3]

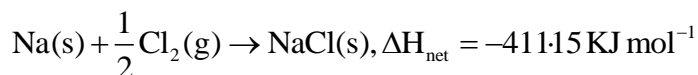
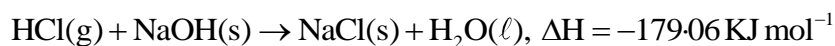
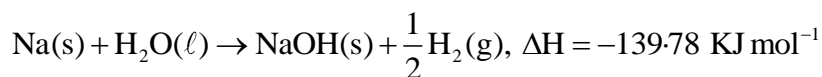
Unit – III

Answer **any three** questions :

[5×3 = 15]

12. a) Show that the enthalpy remains constant during the Joule Thomson experiment.
b) Starting from the mathematical definition of the 1st law of thermodynamics show that the energy of the universe is constant. [3+2]
13. a) Mention which of the following properties are extensive and which are intensive.
(i) entropy (ii) specific heat (iii) Gibb's free energy (iv) volume
b) Starting from Clausius Inequality show for any spontaneous process : $\Delta E_{s,v} < 0$
c) Write down the thermodynamic definition of entropy. [2+2+1]
14. a) Write down the expression for efficiency of a Carnot engine.
b) i) Mention whether you think for efficiency of any other reversible engine working between same two temperatures will be same or different to that of Carnot engine.
ii) What will be the value of efficiency for an irreversible engine also working between same two temperatures?
c) From the expression $\frac{q_1}{T_1} + \frac{q_2}{T_2} = 0$ for a Carnot cycle, show diagrammatically that for any arbitrary cycle $\oint \frac{dq}{T} = 0$. [1+2+2]
15. a) Justify that the real volume of a gas will be related to its ideal volume as $V_{ideal} = V_{real} - b$ where 'b' is a positive constant.
b) i) Write down the Maxwell speed distribution function of a gas free to move in three dimensions.
ii) Also plot this function against speed at two different temperatures and comment. [2+(1+2)]

16. a) Given are the value :



Find out the enthalpy of the reaction $\frac{1}{2}\text{H}_2\text{(g)} + \frac{1}{2}\text{Cl}_2\text{(g)} \rightarrow \text{HCl(g)}$ at the same temperature.

b) From the definition of entropy show that for any change of state, $\Delta S = C_v \ln \frac{T_f}{T_i} + R \ln \frac{V_f}{V_i}$.

(mention any assumption which may be involved)

[3+2]

Unit – III

Answer **any one** question :

[5×1 = 5]

17. a) Give the mathematical expression of the Lambert-Beer's law.

b) $\gamma_{\text{C=O}}$ stretch in saturated acyclic ketone is $1725 - 1705 \text{ cm}^{-1}$; whereas that in an α, β unsaturated acyclic ketone is $1685 - 1665 \text{ cm}^{-1}$. Explain.

c) For acetone, predict the types of transition occurring in UV region. State, among them, which transition will be the weakest one.

[1+2+2]

18. a) The solubility of BaSO_4 is $2.33 \times 10^{-4} \text{ g ml}^{-1}$ at 20°C calculate the solubility product of BaSO_4 .

b) Discuss how chloride ion can be estimated conductometrically.

[2+3]

Group – B

Answer **any four** questions :

[4×5 = 20]

19. State the different advantages of Babcock and Wilcox water tube boilers. What is the main function of Economiser? Why air-pre-heaters are used?

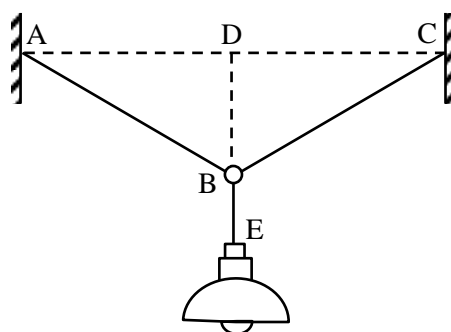
[3+1+1]

20. Draw the typical stress versus strain diagram for structural steel. Explain all the salient features of the diagram.

[2+3]

21. An electric street lamp is suspended from a small ring B supported by two wires AB and CB, the ends A and C of which are on the same level. Assuming these wires to be perfectly flexible and neglecting their weights, find the force produced in each if the weight of the lamp is 15 kg, length of each wire 10m and the sag DB is 4m.

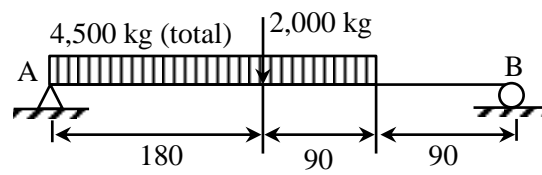
[5]



22. Derive an expression for circumferential strain for a thin circular ring subjected to the action of uniformly distributed radial loading.

[5]

23. For the simple beam in the Figure evaluate the shear force and bending moment at a section just to the left of the point of application of the 2000 kg load. [5]



24. Determine the force produced in each bar of the tower shown in the figure due to a horizontal force P applied to the top as shown. [5]

