RAMAKRISHNA MISSION VIDYAMANDIRA
(Residential Autonomous College under University of Calcutta)
B.A./B.Sc. FIRST SEMESTER EXAMINATION, JANUARY 2015
FIRST YEAR

Date : 05/01/2015
Time : 11 am – 2 pm

INDUSTRIAL CHEMISTRY (Honours)
Paper : I

Full Marks : 75

[Use a separate Answer Book for each group]

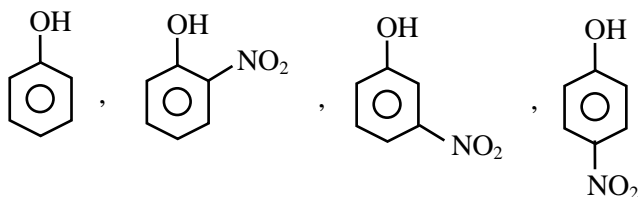## Group – A

Unit – I
#### (*Answer any three questions*) [3×5]

1. a) Give IUPAC name of the compound, HOOC – COOH. [1]

   b) Acetic acid and 1-propanol, both compounds have molecular weight 60. But the boiling point of acetic acid is 118°C whereas 1-propanol has a boiling point 97°C. Explain. [2]
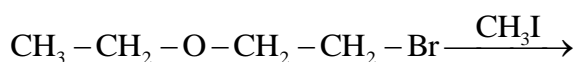

   c) Among the above four compounds which one is the most acidic in nature? Explain properly. [2]

2. a) Base induced dehydrobromination of 1,2-diphenyl-1-chloro ethane results the formation of trans-stilbene over its cis-isomer. Explain with mechanism. [3]

   b) Predict the major product with proper explanation.
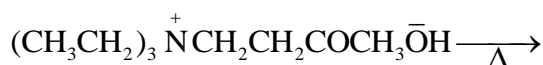
   $$(CH_3CH_2)_3 \overset{+}{N}CH_2CH_2COCH_3 \overline{O}H \xrightarrow{\Delta}$$ [2]

3. a) Alkaline hydrolysis of $Et_2NCH_2CHClCH_2CH_3$ produces $Et_2NCHEtCH_2OH$. Account for the observation. [3]

   b) $CH_3 - CH_2 - S - CH_2 - CH_2 - Br \xrightarrow{CH_3I}$

   $CH_3 - CH_2 - O - CH_2 - CH_2 - Br \xrightarrow{CH_3I}$

   Which one will react faster and why? [2]

4. a) What is specific rotation? Is it a constant value for a particular compound? [2]

   b) Which conformation is the stable from of 1,2-dichloro ethane? [1]

   c) What is the observed rotation of glyceraldehyde if— (i) the concentration is doubled and (ii) the length of the polarimeter tube is doubled? [2]

5. Identify the products in the following reaction sequence: [5]
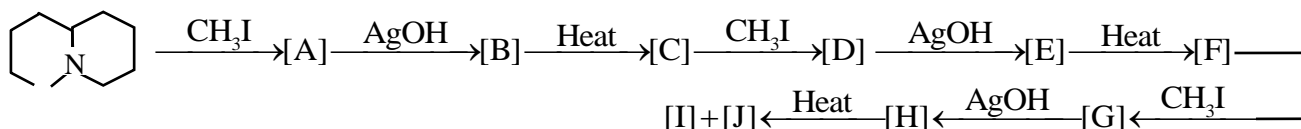
Unit – II
(*Answer any four questions*) [4×5]

6. a) Explain how Sommerfeld overcame the difficulty of fine structure in the atomic spectrum of hydrogen. [3]

   b) What are the radius of He^+ and Li^{2+} systems? Where radius of H is 0·5 Å. [2]

7. a) Show that the maximum capacity of accommadation of electrons in an orbit having principal quantum number 'n' is given by $2n^2$. [2]

b) Explain the structure of $POCl_3$ using V.B Theory. [2]

c) Write down the ground state term symbol for p^4 configuration. [1]

8. a) Arrange the following halogens (F, Cl, Br, I) with their increasing electron affinity order and give proper explanation. [2]

b) Discuss the conductivity of p-type semiconductor. [3]

9. a) Aqueous solution of aluminium chloride is acidic. Explain. [2]

b) Explain the basicity order of H_2O, H_2S, H_2Se and H_2Te. [3]

10. a) Ferric chloride sublimes on heating, Explain. [2]

b) Radius of Be^{2+} = 59 pm and the radius of S^{2-} = 170 pm. Predict the coordination number of Be^{2+} is BeS. [2]

c) What do you mean by hydrogen like system? [1]

11. a) Show that buffer capacity of a buffer is maximum when salt concentration and the concentration of the weak acid or weak base are identical. [2]

b) Arrange the following species with their increasing bond length. O_2, O_2^+, O_2^-. [2]

c) Explain the existence of HeH molecule. [1]

Unit – III
### (*Answer any three questions*) [3×5]

12. a) Comment of the following statements:
    i) Mean free path depends on T and P.
    ii) Absolute zero is unattainable. [3]

b) Joule-Thompson experiment is an iso-enthalpic process. Explain properly. [2]

13. a) Derive the expression for most probable velocity of a gas using Maxwell's velocity distribution. [3·5]

b) Is W (work done) is a path function? Give reasons. [1·5]

14. a) Calculate the number of binary collision per cc per second in He gas at 27°C and 2 atmosphere. The diameter of He is 2Å. [3]

b) Calculate C_P / C_V for HCl molecule. [2]

15. a) Describe Carnot's theorem. [2]

b) An ideal heat engine operating between a source having temperature 0°C and a sink (T_2) produces 1000 cal of work per cycle rejecting 6400 cal. heat. Calculate the efficiency of the engine and temperature of the sink. [3]

16. a) Represent the four operations of Carnot cycle by entropy-temperature (S–T) diagram. [2]

b) Find the condition of mixing of two gases to get the maximum value for entropy of mixing (ΔS_{mix}). [3]
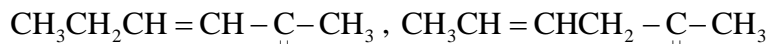
Unit – IV
(*Answer any one question*) [1×5]

17. a) The solubility of AgCl is 0·0015 gm/dm^3. Calculate its solubility product.
    [Given molecular weight of AgCl is 143·5] [2]

b) How can you estimate chloride ion potentiometrically? Discuss the method explaining the principle. [3]

18. a) State Beer's law. [1]

b) Arrange the following compounds with increasing stability along their $\gamma_{C=C}$ stretching frequency. [2]
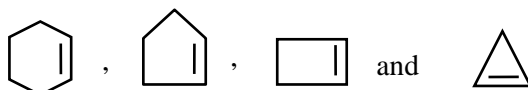
c) How would you differentiate the two by UV spectroscopy?

$$CH_3CH_2CH = CH - \underset{\underset{O}{\|}}{C} - CH_3 \quad , \quad CH_3CH = CHCH_2 - \underset{\underset{O}{\|}}{C} - CH_3$$
　　　　(A)　　　　　　　　　　　　　　　　(B) [2]

Group – B
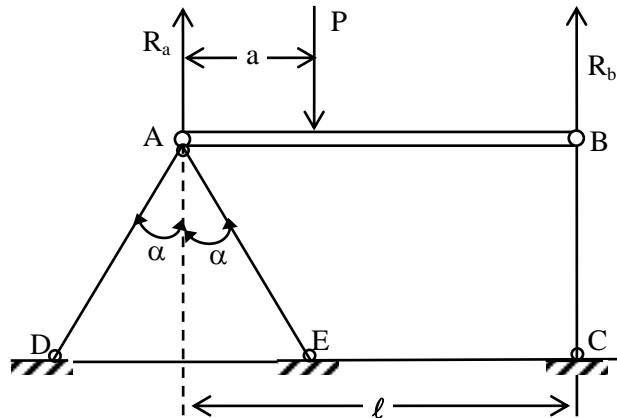
(*Answer <u>any four</u> questions*) [4×5]

19. Name at least five points which a boiler operator has to consider for efficient and safe operation of the boiler. [5]
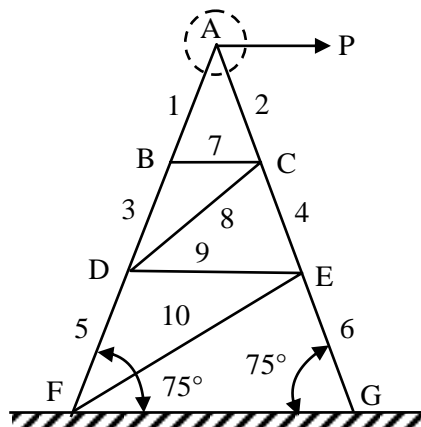
20. Determine the forces in the hinged bars AD, AE and BC supporting the horizontal beam AB on which the vertical load P is acting as show in the figure. Neglect the weight of the beam. [5]

21. Using the method of joints, determine the force produced in each bar of the tower shown in the figure, due to a horizontal force P applied at the top as shown. [5]
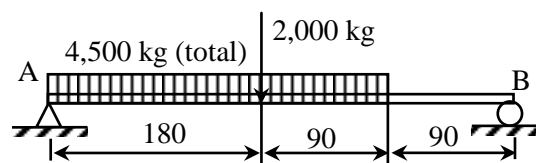

22. Draw a representative stress-strain diagram for structural steel and explain the salient points. [5]

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. Two unequal parallel forces "P" and "Q" are applied at points "A" and "B" on a body acting in the same direction.

Determine the resultant force and its line of action. [5]

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