RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College under University of Calcutta)

FIRST YEAR [2015-18]

B.A./B.Sc. FIRST SEMESTER (July – December) 2015

Mid-Semester Examination, September 2015

Date : 14/09/2015 **INDUSTRIAL CHEMISTRY (Honours)**

Time : 11 am – 1 pm Paper : I Full Marks : 50

[Use a separate answer book for each group]

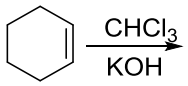
Group – A

Unit - I

Answer **any three** questions : [3×5]

1. Which one of the following pairs will have higher dipole moment? Give reason for your answer. (i) NH_3 and PH_3 (ii) p-dinitrobenzene and p-dihydroxybenzene.
   Arrange the isopropyl, methyl and t-butyl radicals in order of increasing stability and justify your answer. [2+2+1]

2. Which is more stable— phenol or phenoxide ion? Give one reason. Show singlet and triplet states of carbene and state the type of hybridizations involved therein. What will be the product in the following reaction and what is the name of the product?



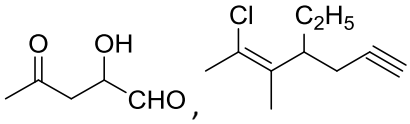
   [1+2+2]

3. What is the characteristic of non-classical carbocation? Cite one example. Draw the orbital picture for acetylene and hence point out the σ-bond and π-bonds. Define inductive effect in organic molecules giving two examples. [2+2+1]

4. Explain why CO_2 has no dipole moment, but SO_2 does. Can a molecule have polar bonds but no dipole moment? Justify your answer citing a suitable example. What is the state of hybridization for the central carbon in the compound: $H_2C=C=CH_2$ [2+2+1]

5. Write the difference between basicity and nucleophilicity? Arrange in order of decreasing nucleophilicity: EtO^-, PhO^-, CH_3COO^-. Write down two examples in each of polar aprotic and non-polar solvents. Ph_3COH, when reacted with diluted sulphuric acid gives yellow solution but in aqueous solution the colour disappears. Explain. [2+2+1]

6. Write the IUPAC name of the compound:



   What is the IUPAC name of isobulyl group and isopropyl group? Draw the structure of carbenium ion and carbonium ion? [2+2+1]

Unit - II

Answer **any two** questions : [2×5]

7. Show that the reversible isothermal work is greater than the irreversible work. State and explain the Hess's law of constant heat summation. [3+2]

8. Explain Joule's experiment and derive each thermodynamic relation from it. [5]

9. Three moles of ideal gas at 1 atm. and 20°C are heated at constant pressure until the final temp. 80°C. For the gas $Cv = 7.5 + 3.2 \times 10^{-3} T$ cal/mol/deg. Calculate w, ΔU, ΔH and q. [5]

Group – B

Answer **any two** questions : [2×5]

10. a) An electron circles a nucleus of charge Ze. Of the two orbits 1 and 2 of radii r_1 and r_2 respectively, its total energy is greater while in orbit 2. Prove that $r_2 > r_1$. Also show which orbit has greater velocity than the other? [3·5]

    b) Though the $(n + \ell)$ rule to determine the order of energy of different subshells is useful in most cases, there are some exception —Justify the statement with an example. [1·5]

11. a) Mention the limitations of Bohr's theory of atomic structure and discuss the Sommerfield's extension on it. [4]

    b) What do you mean by Azimuthal Quantum number? [1]

12. a) State and explain the Heisenberg's Uncertainty Principle. Calculate the uncertainty in the speed of the electron confined in a space of linear dimension of 10Å. [3]

    b) Calculate the first Bohr radius of He^+ ion. Given the first Bohr radius of H atom = 0·529Å. [2]

13. a) Write the electronic configuration of chromium atom in the ground state. [1]

    b) Calculate the kinetic energy of the electron in the first orbit of Bohr Hydrogen atom. [2]

    c) Show that de Broglie's hypothesis applied to an electron moving in a circular orbit leads to Bohr's postulate of Quantisation of angular momentum. [2]

Group – C

14. Answer **any three** questions : [3×5]

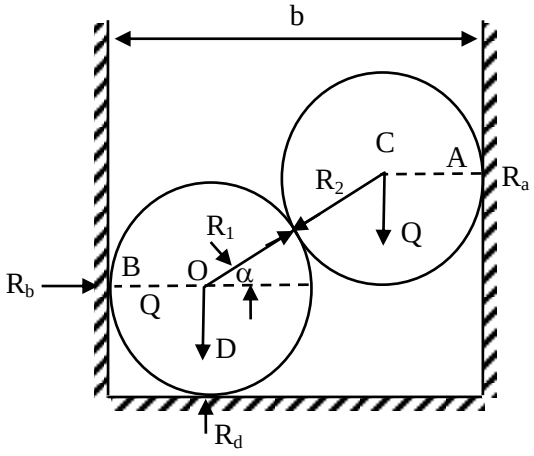
    a) Name five main causes of energy loss in a Boiler. Explain any two in detail.

    b) Draw a neat sketch of a Babcox Wilcox watertube boiler and lable the parts.

    c) Draw a schematic drawing of a typical Boiler house and lable the parts.

    d) What is free body diagram? Explain with examples.

    e) Two smooth spheres each of radius 'r' and weight Q rest in horizontal channel having vertical walls, the distance between them is b. Find the pressure exerted on the walls and floor at the points of contact A, B and D. The following numerical data are given, r = 254 mm, b = 914 mm, Q = 445 N



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