

Five Year Integrated M.Sc. in Physical Science Examination, 2017

Semester - II

Course: CH-1-02-03 (Old)

(Chemistry)

Time: Four Hours

Full Marks: 80

Questions are of value as indicated in the margin.

Group-A

1. Answer **any ten** of the following: 10x2=20
- Explain Schottky defect with example.
 - Explain with suitable example how proton affinity can be determined by using Born-Haber cycle.
 - He₂ does not exist. - Explain.
 - State Bent's rule of isovalent hybridization.
 - Arrange the following carbanions according to increasing order of stability:
CH₃⁻, CH₃CH₂⁻, (CH₃)₂CH⁻, and (CH₃)₃C⁻
 - What type of bond cleavage generates free radicals?
 - Acetylacetone (CH₃COCH₂COCH₃) forms stable enol. Explain
 - What is the basic difference between singlet and triplet carbenes?
 - Explain with examples, the intensive and extensive variables.
 - What are state functions? Do the state functions have exact differentials?
 - State with suitable example the laws of "Laplace and Lavoisier".
 - Show that pressure is a state function for a gas obeying $(P + a/V^2)(V) = RT$.

Group-B

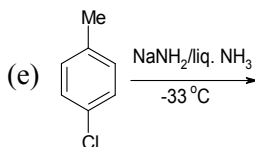
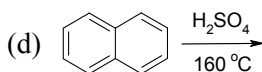
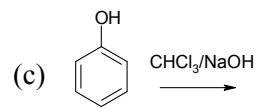
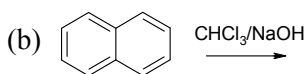
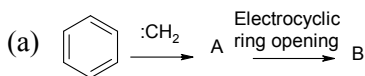
Answer **any two** questions.

2.
 - Define lattice energy. Derive Born Landé equation for lattice energy. 1+3
 - Draw the molecular orbital energy level diagram of a CO molecule. 3
 - What are extrinsic semiconductors? What are the different types of extrinsic semiconductors? Give examples. 1+2
3.
 - Write a note on Valence Bond Theory based on quantum mechanics. What are the drawbacks of this theory? 5+2
 - Find out the limiting value of the radius ratio for tetrahedral coordination. 3
4.
 - Write down the names, symbols and electronic configurations of the inert gases. 2
 - What do you understand by octahedral and tetrahedral holes? Show using figures. 2
 - What are polyhalides? Using VSEPR theory predict the structures of any two type of polyhalides of your choice. 1+2
 - Write a note on non-stoichiometric defect. 3

Group-C

Answer **any two** questions.

5. Write the structure of the products in the following reactions



P.T.O.

(2)

6. a) Write notes on: 3x3
i) Keto-enol tautomerism
ii) Primary Kinetic Isotope Effect
iii) Neopentyl rearrangement
b) Why benzyl cation ($C_6H_5CH_2^+$) is more stable than methyl cation (CH_3^+)? 1
7. a) How benzyne intermediate can be generated? 4
b) How this intermediate can be trapped? 4
c) Write the structure of the self-trapping product of benzyne. 2

Group-D

Answer *any two* questions.

8. a) What are reversible and irreversible processes? What is the work of expansion or compression? Show that the magnitude of the work involved during expansion will be maximum if the process is quasi-static or reversible. 1+1+3
b) If $P = f(V, T)$, derive the cyclic rule, $(dp/dT)_V (dT/dV)_P (dV/dP)_T + 1 = 0$ 2.5
c) The heat of oxidation of magnesium and iron to produce MgO and Fe_2O_3 are $-14.57 \text{ kcal mol}^{-1}$ and $-193.50 \text{ kcal mol}^{-1}$, respectively. Calculate the heat produced in the following reaction: $3Mg + Fe_2O_3 = 3MgO + 2Fe$. 2.5
9. a) Show that in an Isothermal Expansion of an ideal gas $\Delta U=0$ and $\Delta H=0$. 2
b) Derive the thermodynamic relationship, $TV^{\gamma-1} = \text{constant}$ for an adiabatic change in volume of an ideal gas, where symbols have their own meaning. 4
c) Derive the relationship between heat capacities of an ideal gas, $C_p - C_v = R$, the gas constant using thermodynamic relationship. 4
10. a) What are the differences between "Bond Energy" and "Dissociation Energy"? When these two will have the same value? 2+1
b) Define the term "Heat of neutralization". The heat of neutralization of a strong acid by a strong base is 13.70 kcal , whereas the heat of neutralization of acetic acid by a strong base is 12.60 kcal . Calculate the molar heat of dissociation of acetic acid. 1+3
c) A gas initially at $27^\circ C$ is compressed from 40 litres to 4 litres adiabatically and reversibly. Calculate the final temperature of the gas. [Given $C_v = 5 \text{ cal mol}^{-1}$] 3
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