Total number of printed pages–7

1 (Sem–2/FYUGP) CHE 21MJ

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CHEMISTRY

(Major)

Paper : CHE4200104MJ

(Chemistry–II)

Full Marks : 45

Time : 2 hours

The figures in the margin indicate full marks for the questions.

1. Answer the following questions : 1×5=5

(a) What are hybrid orbitals ?

(b) Primary and secondary valencies in $[Pt(NH_3)_4]Cl_4$ respectively are— *(choose the correct answer)*

(i) 4 and 6

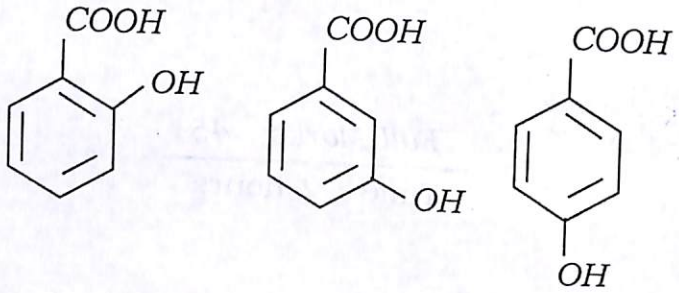
(ii) 6 and 4

(iii) 3 and 4

(iv) 4 and 3

(c) What are nitrenes ?

(d) Arrange the following in increasing order or acid strengths—



(e) Define a reversible process.

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2. Answer ***(any five)*** of the following questions : 2×5=10

(a) What are equivalent and non-equivalent hybrid orbitals ?

(b) Draw the possible resonance structures of phenoxide ion.

(c) Draw the MO diagram of *CO* molecule.

(d) How coordination complexes are different from double salts ?

(e) Both $[Ni(CO)_4]$ and $[NiCl_4]^{2-}$ are tetrahedral. But $[Ni(CO)_4]$ is diamegnatic whereas $[NiCl_4]^{2-}$ is paramagnetic. Explain.

(f) Explain how nitro group at *ortho, meta* and *para* positions of benzyl carbanion influence its stability.

(g) With the help of a suitable example explain the mechanism involving a pentavalent transition state.

(h) Define dissociation constant K_a for a weak acid.

pK_a values of CH_3COOH and $ClCH_2COOH$ are 4.7 and 2.8 respectively. Explain.

(i) Define heat and work.

(j) Calculate C=C bond enthalpy from the following reaction—

$$H_2C = CH_2(g) + H_2(g) \rightarrow H_3C - CH_3(g),$$

$\Delta H = -125.5\ kJ$

Bond enthalpies of $C - C$, $C - H$ and $H - H$ are 347.3, 414.2 and 435.1 $kJ\ mol^{-1}$ respectively.

(k) Give the criterion of spontaneity of a process in terms of Gibbs free energy change. Give its limitations.

3. Answer ***any four*** of the following questions : 5×4=20

(a) (i) Explain the necessity of hybridization of atomic orbitals. Give the conditions of hybridization of atomic orbitals. 1+2=3

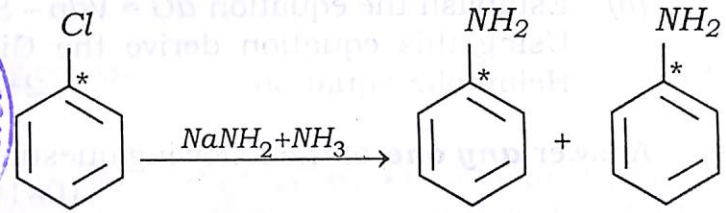
(ii) Write the MO electronic configuration of *HCl* molecule. Draw the energy level diagram of the *HCl* molecule. 1+1=2

(b) Explain the Fajan's rule for polarizability of a bond. Explain the factors with suitable examples that enhances the covalent nature of a bond. 2+3=5

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(c) With the help of suitable example explain Berry pseudorotation.

(d) Chlorobenzene labelled with $^{14}C(*)$ at the position to which the chlorine is attached was treated with sodium amide in liquid ammonia. The aniline produced was analysed to determine the position of the ^{14}C label. The results are indicated below. Show how these data is consistent with the benzyne intermediate.



(e) Give an example of rearrangement reaction. Explain the mechanism of the reaction. 1+4=5

(f) (i) Discuss the protonic and electronic theories of acid and bases. Give examples. Which of the *two* theories is more generalised ? 3+1=4

(ii) Write the conjugate acid and conjugate base of NH_3 molecule. 1

(g) (i) What is a thermochemical equation ?

For combustion of methane gas 890.36 $kJ\ mol^{-1}$ heat is evolved. Write the thermochemical equation for the reaction. 1+1=2

(ii) Calculate q, w, ΔU in SI units when 2 moles of an ideal gas isothermally and reversibly compressed from 1 *atm* to 2 *atm* at 27°C. 3

(h) Establish the equation $dG = Vdp - SdT$. Using this equation derive the Gibbs Helmholtz equation. 2+3=5

4. Answer ***any one*** of the following questions : 10×1=10

(a) (i) Applying the VSEPR theory, discuss about the geometries of AB_4, AB_4L and AB_3L_2 types of molecules, where L represents lone pair of electrons. Give suitable example of each type of molecules. 6

(ii) Give the drawbacks of the VSEPR theory. 4

(b) With the help of suitable example discuss about the different types of weak chemical forces that may exists between molecules.

(c) (i) What are the free radicals ? How free radicals are generated in chemical reaction. Mention the conditions favouring the formation of free radicals. 1+2+2=5

(ii) Identify the product A in the following reaction—

$$H_2C = CHCH_3 + Cl_2 \xrightarrow{500^oC} A + HCl$$

Explain the mechanism of formation of A in the reaction. 1+4=5

(d) (i) For an ideal gas show that $\mu_{JT} = 0$. 3

(ii) What is inversion temperature ? Derive an expression for Joule-Thomson coefficient of a real gas and show that $T_i = \frac{2a}{Rb}$. Symbols signify the usual meanings. 1+4+2=7

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