FYUGP/Sem-2/CH-CE1

2026
(Regular)
Chemistry (Core)
Paper Code : CH-CE-2114
Paper Name : General Chemistry -II

Time : 2 hours ***Full Marks : 45***

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

1. Answer the following questions : 1×4=4

   a) How will you prepare benzene from phenol ?

   b) What are state functions ? Give an example.

   c) Which of the first row transition series elements can exhibit maximum oxidation state ?

   d) Give the Lewis structure of SO_4^{2-}.

2. Answer the following questions : 2×3=6

   a) Using the following Latimer diagram calculate the value of E^0 for the ClO_2^-/Cl_2 couple in basic aqueous solution.

$$ClO_2^- \xrightarrow{+0.68V} ClO^- \xrightarrow{+0.42V} Cl_2$$

   b) Draw Sawhorse projection of eclipsed and staggered ethane.

   c) Show how the edge length (a) of a simple cubic unit cell is related with radius of the atom (r).

3. Answer ***any three*** of the following questions : 5×3=15

a) i) Show that the work done during reversible expansion of a gas is maximum compared to irreversible expansion.

   ii) Calculate q and w for the isothermal irreversible expansion of

Contd...

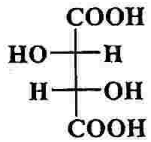
one mole of an ideal gas at 27°C from 20 dm^3 to 30dm^3 against a constant external pressure of 1 atm. 2

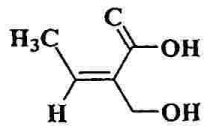
b) Write the mechanistic steps of the chlorination reaction of benzene. Is the $-Cl$ group, an activating or deactivating group in electrophilic aromatic substitutions ? - Give reason.3+2=5

c) Draw the M.O energy level diagram of CO. Comment on the magnetic behaviour and bond order of the molecule. 5

d) i) What is thermodynamic equilibrium ? What conditions are necessary for a system to attain it ? 2

ii) Using CIP rules, designate the following compounds as R/S- or E/Z- configuration :





1+1=2

iii) A part of the Latimer diagram for iron is- 1

$$Fe^{3+} \xrightarrow{+0.77V} Fe^{2+} \xrightarrow{-0.41V} Fe$$

Should we expect Fe^{2+} to disproportionate in aqueous solution?

e) What is linear combination of atomic orbitals (LCAO) ? How LCAO explains the bonding and anti-bonding aspects of A.O.s. 5

f) Show that for a *Carnot cycle* $\oint \frac{\delta q_{rev}}{T} = 0$. 5

4. Answer ***any two*** of the following questions : 10×2=20

a) i) The molar mass of an element is 209g/mol. At room temperature, the element crystallizes in primitive cubic unit

cell with edge length 3.3 Å. Calculate the density of the element.
3

ii) Explain the shape of the following molecules with help of VSEPR theory. **(any two)**

SF_4, XeF_2, ClF_3 2

iii) Explain the followings

A) Calculate the spin only magnetic moment of $[M_n(H_2O)_6]^{2+}$ complex ion. 2

B) Transition metals or their compound acts as good catalyst in many chemical reactions. 1

C) The atomic radii of 2nd row and 3rd row transition, series elements are almost same. 2

b) i) What are the criteria for a molecule to be called aromatic ? Indentify whether the following molecules are aromatic or anti-aromatic :



2+3=5

ii) Define stereogenic centre. 1

iii) Write the mechanism of nitration of benzene. 4

c) i) Define molar heat capacity at constant volume (C_v) and at constant pressure (C_p). 3

ii) Under what condition does $\Delta H = \Delta U$? 2

iii) If $\Delta U = 50\,kJ$ and $\Delta n_g = 1$, calculate

ΔH *at* $300K$ $\left(R = 8.314 J\, mol^{-1} K^{-1}\right)$. 1

iv) Show that the rate of change of enthalpy of reaction with temperature is equal to the difference in heat capacities of the products and reactants. 4

d) i) What is enantiomeric excess ? A sample mixture of mandelic acid has an observed specific rotation of $+8.4^0$, where the pure (*R*)- mandelic acid has a specific rotation of $+12.0^0$. Calculate the enantiomeric excess of (*R*)- mandelic acid. 2+2=4

ii) What is the entropy change for a reversible adiabatic process? Show that for a reversible phase change of an ideal gas-

$$\Delta S = C_v \ln \frac{T_2}{T_1} + nR \ln \frac{V_2}{V1}$$ 1+3=4

iii) A) Arrange the following molecules in the increasing order of their bond angles. 1

H_2O, BrF_3, CH_4, NH_3

B) Calculate the formal charge present on the N atom of NO^{3-} ion. 1

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