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(July)

CHEMISTRY

(Elective/Honours)

(General Chemistry—II)

(Inorganic, Organic and Physical)

(Chem-EH-201)

Marks : 56

Time : 3 hours

The figures in the margin indicate full marks
for the questions

SECTION—I

(Inorganic)

(Marks : 19)

1. (a) Write the expression for solubility product (K_{sp}) of a sparingly soluble salt CaF_2 and calculate its K_{sp} . Given that solubility of CaF_2 is $2.2 \times 10^{-2} \text{ L}^{-1}$. 1+2=3
- (b) Complete the following chemical reactions :
- (i) $\text{Na}_2\text{S}_2\text{O}_3 + \text{I}_2 \rightarrow ?$
- (ii) $\text{CuSO}_4 + \text{KI} \rightarrow ?$
- And identify which one is iodimetric and iodometric titration. 2+1=3

- (c) Discuss the function of phenolphthalein as an acid-base indicator. 2
- (d) In liquid NH_3 , NH_4Cl acts as an acid whereas KNH_2 acts as a base. Explain. 1½

OR

2. (a) Give the Lewis definition of acid and base with suitable examples. 1½+1½=3
- (b) Calculate the equivalent mass of KMnO_4 in acidic medium (mass of KMnO_4 158) and also calculate the amount required to prepare 0.1 N of KMnO_4 in 250 cc volumetric flask. 1+1½=2½
- (c) How are $\text{p}K_a$ and $\text{p}K_b$ values related to strength of acids and bases? Among H_3PO_4 , H_2PO_4^- and HPO_4^{2-} , which one is expected to have highest value of $\text{p}K_a$ and which one the least? 1+2=3
- (d) What are primary standard solutions? Give example. 1
3. (a) Explain why Zn rod and CuSO_4 solution will react, but Cu rod and ZnSO_4 will not. Giving $E^\circ_{\text{Zn}^{2+}/\text{Zn}}$ 0.76 V and $E^\circ_{\text{Cu}^{2+}/\text{Cu}}$ 0.34 V. 2

(3)

- (b) Describe briefly the principle of each of the following : $2 \times 2 = 4$
- (i) Zone refining
- (ii) Electrolytic refining
- (c) Complete and balance the given equation by ion-electron method : 2
- $$\text{Fe}^{2+} \quad \text{Cr}_2\text{O}_7^{2-} \quad \text{H}^+ \quad ?$$
- (d) Give one example each of N-fertilizer, P-fertilizer and K-fertilizer. $1\frac{1}{2}$

OR

4. (a) What is standard electrode potential? Mention two applications of electro-chemical series. $1+2=3$
- (b) Giving examples, differentiate the process of calcination from roasting. 2
- (c) What is cement? What are the raw materials required for the manufacture of cement? $1+1\frac{1}{2}=2\frac{1}{2}$
- (d) Write down the industrial method for the preparation of urea. 2

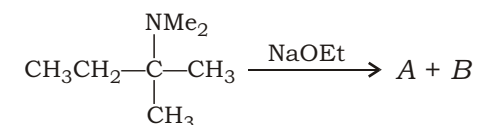
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SECTION—II

(Organic)

(Marks : 19)

5. (a) Predict the major and minor products in the following reaction : 2

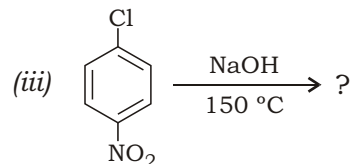
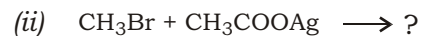
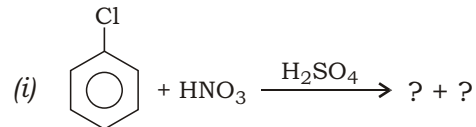


- (b) What type of a reaction occurs between *t*-butyl bromide and hot alcoholic KOH solution? Write its reaction and mechanism. $2\frac{1}{2}$
- (c) Explain why the reaction of R-X with AgCN yields alkyl isocyanides. $1\frac{1}{2}$
- (d) Write the products of the following reactions : $1+1+1\frac{1}{2}=3\frac{1}{2}$
- (i) Benzene + $\text{Cl}_2 \xrightarrow{\text{anh. AlCl}_3} ?$
- (ii) $\text{C}_6\text{H}_5\text{Br} \xrightarrow[\text{dry ether}]{\text{Mg}} ?$
- (iii) $\text{C}_6\text{H}_5\text{Cl} \xrightarrow[\text{liq. NH}_3]{\text{KNH}_2} ?$

(5)

OR

6. (a) Discuss the role of a solvent in S_N1 reaction. 1
- (b) Why are alkyl fluorides bad choices as substrates for nucleophilic substitution reaction? 1
- (c) \ominus OH can act as a base as well as a nucleophile. Explain with suitable examples. 2
- (d) Complete the following reactions by writing suitable mechanism : $2+1\frac{1}{2}+2=5\frac{1}{2}$



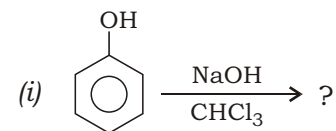
7. (a) What type of carbonyl compounds undergo aldol condensation? Write the reaction and mechanism of the condensation of propanone with dilute NaOH. $2\frac{1}{2}$

(6)

- (b) How will you distinguish propan-1-ol and propan-2-ol by Lucas reagent? Write suitable reactions. 2
- (c) Complete the following reactions : $1 \times 2 = 2$
- (i) $2 \text{HCHO} \xrightarrow{50\% \text{ KOH}} ? ?$
- (ii) Ethylene glycol + $\text{PCl}_5 \longrightarrow ?$
- (d) Explain by resonance that phenol is more acidic than ethanol. 2
- (e) Write the product obtained when ethanal is treated with Zn-Hg and conc. HCl . 1

OR

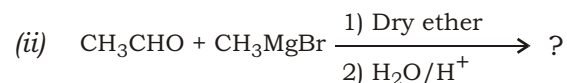
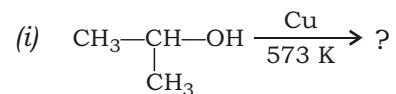
8. (a) What is Benzoin condensation? Write its reaction and mechanism. 2
- (b) Write the products of the following reactions with proper mechanism : $2 \times 2 = 4$



- (c) Write the preparation of *cis*-1,2-di-ol from *cis*-butene. $1\frac{1}{2}$

(7)

- (d) Identify the products in the following reactions : 1×2=2



SECTION—III

(Physical)

(Marks : 18)

9. (a) Describe the osmometric method for the determination of the molecular mass of macromolecules. 3½
- (b) Define the following : 3
- (i) Adiabatic process
- (ii) Inversion temperature
- (iii) Isolated system
- (c) 10 moles of an ideal gas expand reversibly and isothermally from 102 litres to 1020 litres at 27 °C. How much heat would be absorbed in the process? (Given $R = 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$.) 2½

(8)

OR

10. (a) Derive an expression for work done in an isothermal reversible expansion of an ideal gas. 3
- (b) Deduce the relation between C_p and C_v . 2
- (c) State the second law of thermodynamics and write its mathematical equation. 1+1=2
- (d) In a polymer sample, 100 molecules have molecular weight 10^4 each and 200 molecules have molecular weight 10^5 each. Calculate the number average and weight average molecular weights. 1+1=2
11. (a) Give the main points of Langmuir theory of adsorption and deduce the Langmuir adsorption isotherm. 2+3=5
- (b) State and explain Hess's law of constant heat summation. 2
- (c) Calculate H° for the reaction
- $$\text{CO}_2(\text{g}) + \text{H}_2(\text{g}) \rightarrow \text{CO}(\text{g}) + \text{H}_2\text{O}(\text{g})$$
- given that H_f° for $\text{CO}_2(\text{g})$, $\text{CO}(\text{g})$ and $\text{H}_2\text{O}(\text{g})$ are -393.5 , -111.3 and $-241.8 \text{ kJ mol}^{-1}$ respectively. 2

OR

12. (a) Derive Kirchhoff's equations for temperature dependence of heats of reaction. 4
- (b) Define the following : 3
- (i) Enthalpy of solution
 - (ii) Standard state of a substance
 - (iii) Chemisorption
- (c) Calculate the heat change accompanying the transformation of C (graphite) to C (diamond) if the heats of combustion of graphite and diamond are 393.5 and $395.4 \text{ kJ mol}^{-1}$ respectively. 2

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