2025

(May–June)

FYUP : 2nd Semester Examination

CHEMISTRY

(Minor)

[Part—A (Theory)]

(Introductory Chemistry—II)

(CHE–150)

Marks : 56

Time : 3 hours

The figures in the margin indicate full marks for the questions

UNIT—I

(Inorganic Chemistry—II)

(*Marks* : 19)

1. *(a)* Derive the first-order rate equation of a radioactive disintegration. 2

(b) Half-life of radium (molar mass = 226 g mol^{-1}) is 1580 years. Show that 1 g of radium gives $3{\cdot}70\times10^{10}$ disintegration per second. 2

(c) What is nuclear fusion? Give example. 1

(d) Balance the following reaction by ion-electron method : 2

$$MnO_4^- + C_2O_4^{2-} \rightarrow Mn^{2+} + CO_2$$

(Acidic medium)

(e) Assign oxidation number to the underlined elements in each of the following species : 1

(i) $NaBH_4$

(ii) $Na_2S_2O_3$

(f) Identify the oxidant and reductant in the following reaction : 1

$$2Na_2S_2O_3 + I_2 \rightarrow Na_2S_4O_6 + 2NaI$$

OR

2. (a) Calculate the packing fraction of argon isotope $^{40}_{18}Ar$. Mass of the isotope of argon = 39·962384 amu. What does the value of packing fraction imply? 2

(b) Write notes on any *two* of the following : 1½×2=3

(i) Natural radioactivity

(ii) Group displacement law

(iii) Artificial radioactivity

(Continued)

(c) Justify that the following reaction is a redox reaction : 1½

$$2FeSO_4 + H_2SO_4 + H_2O_2 \rightarrow Fe_2(SO_4)_3 + 2H_2O$$

(d) Calculate the equivalent weight of $K_2Cr_2O_7$ in acidic medium. 1½

(e) Define the electronic concept of oxidation reaction. 1

3. (a) How is the concept of solubility product used in the group separation of cations? 3

(b) Distinguish between iodometry and iodimetry. 2

(c) Define acid and base on the basis of Brönsted-Lowry concept. 2

(d) Identify Lewis acids and Lewis bases in the following reactions : 2

(i) $FeCl_3 + Cl^- \rightarrow [FeCl_4]^-$

(ii) $PH_3 + NH_3 \rightarrow [H_3PNH_3]$

(Turn Over)

(e) Given the pK_a values of each, which is a strong acid, H_2SO_4 ($pK_a = -1$) or H_2SO_3 ($pK_a = 1{\cdot}9$)? 1

OR

4. (a) Write the expression for solubility product (K_s) of a sparingly soluble salt A_xB_y. Calculate the solubility product of Ag_2CrO_4, given that its solubility is $2{\cdot}5\times10^{-2}$ per litre and its molar mass is 332 g/mol. 1+2=3

(b) How does molarity differ from molality? An aqueous solution is prepared by dissolving 4 g of NaOH to give 500 ml of it. Calculate the molarity of the solution. 2

(c) On the basis of HSAB principle, predict the stability of the products in the following reactions : 2

(i) $Ag^+ + 2I \rightarrow AgI_2$

(ii) $Ag^+ + 2F^- \rightarrow AgF_2$

(d) How are pK_a and pK_b related to the strength of acids and bases? 1

(e) What are levelling and differentiating solvent? Give example of each. 1+1=2

(Continued)

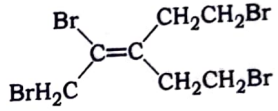
UNIT—II

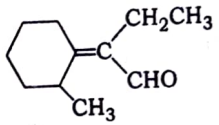
(Organic Chemistry—II)

(Marks : 18)

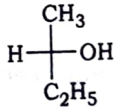
5. (a) Draw the Newman projection formula of the fully eclipsed conformation of 2,3-dibromobutane. 1

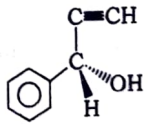
(b) Assign *E*/*Z* configuration to the following molecules : 1×2=2

(i) 

(ii) 

(c) Write the *R*- and *S*-configurations of the following molecules : 1×2=2

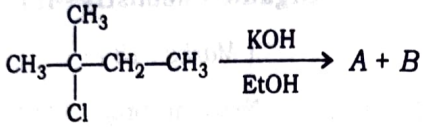
(i) 

(ii) 

(d) Taking suitable example, write the mechanism of E^1cB reaction. 2

(Turn Over)

(e) Write the major and minor products of the following reaction : 1



OR

6. (a) What are *meso*-compounds? Explain using tartaric acid as example. 2

(b) Identify the chiral molecules from the following : 1

(i) $CH_3CHBrCH_3$

(ii) $CH_3CBr_2CH_3$

(iii) $CH_3CHOHC_2H_5$

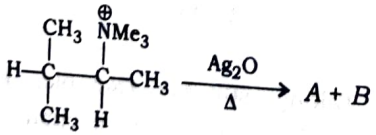
(c) Draw the isomers of the following compounds : 1×2=2

(i) $CH_3(Cl)C{=}C(Cl)CH_3$

(ii) $CH_3CH(OH)CHO$

(d) Illustrate E_2 elimination reaction with the help of an example. 2

(e) Complete the following reaction : 1



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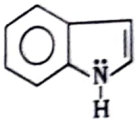
7. (a) Using Hückel's rule, identify the aromatic and non-aromatic compounds from the following : 2

(i) 

(ii) 

(iii) 

(iv) 

(b) Write the products when the following compounds are subjected to nitration : 1×2=2

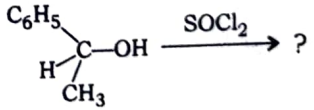
(i) Chlorobenzene

(ii) Benzaldehyde

(c) Write the reaction for the Friedel-Crafts acylation of benzene. 1

(d) Explain how steric factors affect the rate of S_N2 reaction. 2

(e) Complete the following reaction with mechanism : 2



(f) What is an ambident nucleophile? Give example. 1

(Turn Over)

OR

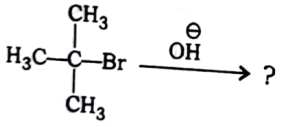
8. *(a)* Write the product and mechanism of the following reaction : 2

$$C_6H_6 + HCN + HCl \xrightarrow[H_2O/H^+]{ZnCl_2} ?$$

(b) Discuss the directive influence of nitro-group on the electrophilic substitution reaction of benzene. 2

(c) Draw the molecular orbital picture of benzene. 1

(d) Complete the following reaction with mechanism : 2



(e) Write the products obtained when halo-alkanes react with the following : 2

(i) KCN

(ii) AgCN

(f) What is neighbouring group participation in nucleophilic substitution? 1

(Continued)

UNIT—III

(Physical Chemistry—II)

(*Marks* : 19)

9. *(a)* State the first law of thermodynamics and write the mathematical expression. 1+1=2

(b) 10 moles of an ideal gas expand reversibly and isothermally from initial pressure of 1 atm to final pressure of 0·1 atm at 0 °C. Calculate the work done. Given, $R = 8{\cdot}314\ JK^{-1}\ mol^{-1}$. 2

(c) Define extensive and intensive variables with example for each. 1½+1½=3

(d) What is heat capacity? Derive thermodynamically $C_P - C_V = R$ for 1 mole of an ideal gas. 1+2=3

OR

10. *(a)* Write notes on the following : 1×2=2

(i) Closed system

(ii) Isochoric process

(b) 3 moles of an ideal gas (C_V = 5 cal $deg^{-1}\ mol^{-1}$) at 10 atm and 0 °C are converted to 2 atm at 50 °C. Calculate ΔE and ΔH for the change. (Given, $R = 1{\cdot}987$ cal $deg^{-1}\ mol^{-1}$) 1+1=2

(Turn Over)

(c) Derive an expression for work done in an isothermal reversible expansion of an ideal gas. 3

(d) What is Joule-Thomson effect? Explain why ideal gases do not show Joule-Thomson effect. 1+2=3

11. (a) What are exothermic and endothermic reactions? Give one example for each. 1+1=2

(b) The heat of combustion of ethyl alcohol (C_2H_5OH) is 1380 kJ mol^{-1}. If the heat of formation of CO_2 and H_2O are 394·5 kJ mol^{-1} and 286·6 kJ mol^{-1} respectively, then calculate the heat of formation of ethyl alcohol. 3

(c) Deduce Langmuir adsorption isotherm. 4

OR

12. (a) State and explain Hess' law of constant heat summation. 2

(b) Calculate ΔH° for the reaction

$$CO_2(g) + H_2(g) \rightarrow CO(g) + H_2O(g)$$

given that ΔH_f° for $CO_2(g)$, $CO(g)$ and $H_2O(g)$ are $-393{\cdot}5$ kJ mol^{-1}, $-111{\cdot}3$ kJ mol^{-1} and $-241{\cdot}8$ kJ mol^{-1} respectively. 3

(Continued)

(c) Give three points of differences between physisorption and chemisorption. 3

(d) What is adsorption isotherm? 1

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