

Odd Semester, 2020

(Held in March, 2021)

CHEMISTRY

(Elective/Honours)

(Chem-EH-301)

(General Chemistry—III)

Marks : 56

Time : 3 hours

*The figures in the margin indicate full marks for the questions***SECTION—I****(Inorganic)**

(Marks : 18)

1. (a) Discuss the variation of atomic and ionic radii of an element across the period and down the group. 3
- (b) Electron gain enthalpy of chlorine is higher than that of fluorine. Explain. 1½
- (c) What is catenation? Explain the uniqueness of carbon to catenate. 2½

- (d) Give one preparation and one use of lithium aluminum hydride. 2

OR

2. (a) The oxidising character of elements increases and reducing character decreases as we move from left to right in a period. How would you explain this observation? 2
- (b) Arrange in decreasing order the acid strength of oxyacid of halogen of the type HOX (X = Cl, Br, I). Give reason to your answer and also indicate the Na salt of the above oxyacid used mainly as a disinfectant in the recent Covid-19 pandemic. 2+1=3
- (c) Ionisation energies of C, N and O follow the order C < N > O. Explain. 2
- (d) Give one method of preparation and one use of sodium thiosulphate. 2
3. (a) Explain why most of the compound of transition metals are generally coloured. 1½
- (b) Lanthanides exhibit +3 most common oxidation state whereas certain lanthanides also show +2 and +4 oxidation state. Explain. 3

(3)

- (c) Actinides have greater tendency to form complexes than lanthanides. Explain. $1\frac{1}{2}$
- (d) What happens when—
- (i) $\text{Ni}(\text{CO})_4$ is heated above 150°C ;
- (ii) ferric salt reacts with potassium ferrocyanide?
- (Write down the balance chemical reaction wherever necessary.) $1\frac{1}{2}+1\frac{1}{2}=3$

OR

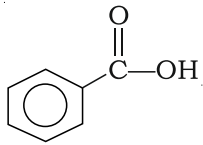
4. (a) What is lanthanide contraction and what are its consequences? $1+2=3$
- (b) In the 1st transition series, oxidation state increases from Sc^{+3} to Mn^{+7} and then decreases back from Mn^{+7} to Zn^{2+} . Give reason to your answer. 2
- (c) What are transuranic elements? Give one example. 1
- (d) What happens when—
- (i) KMnO_4 is treated with KI solution in acidic medium;
- (ii) UF_4 is treated with F_2 ?
- (Write down the balance chemical reaction wherever necessary.) $1\frac{1}{2}+1\frac{1}{2}=3$

(4)

SECTION—II

(Organic)

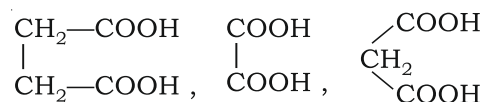
(Marks : 19)

5. (a) How is acetic acid (CH_3COOH) prepared from acetonitrile (CH_3CN)? Write chemical equation and its mechanism. $1+1=2$
- (b) Complete the following reactions : $1\times 3=3$
- (i) $\text{CH}_3\text{COOH} + \text{CH}_2\text{N}_2 \rightarrow ?$
- (ii) $\text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{R} + \text{NH}_3 \rightarrow ?$
- (iii)  + $\text{PCl}_5 \rightarrow ?$
- (c) What are organometallic compounds? Give a method for the preparation of Grignard reagent. Write chemical equation. $\frac{1}{2}+1+\frac{1}{2}=2$
- (d) Starting from ethyl acetoacetate, how will you synthesize succinic acid? $2\frac{1}{2}$

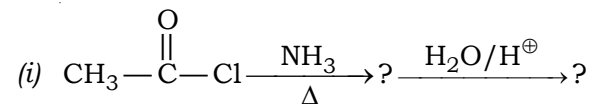
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OR

6. (a) Arrange the following acids in order of increasing acidity. Explain with appropriate reasons : 1½

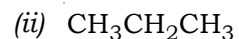
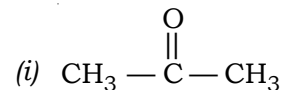


- (b) Identify the products in the following reactions : 1+1=2



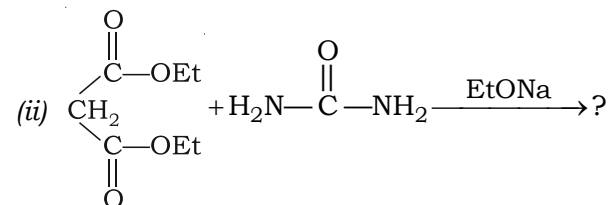
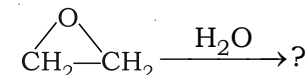
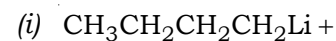
- (c) Differentiate between resonance and tautomerism. 2

- (d) Using a suitable Grignard reagent, prepare the following compounds : 1+1=2



(6)

- (e) Complete the following reactions : 1+1=2

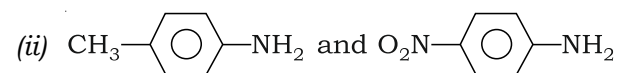
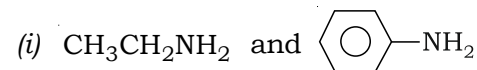


7. (a) Give the synthesis of propylamine by Gabriel phthalimide reaction with mechanism. 1½

- (b) Explain, giving examples, why the α-H atom of nitro-alkanes is acidic. 1½

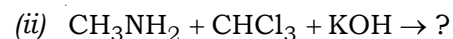
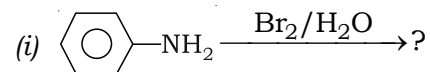
- (c) How can you separate a mixture of 1°, 2° and 3° amines? Give chemical equations. 1½

- (d) Which of the following pairs of compounds is more basic? Give reasons : 1½×2=3



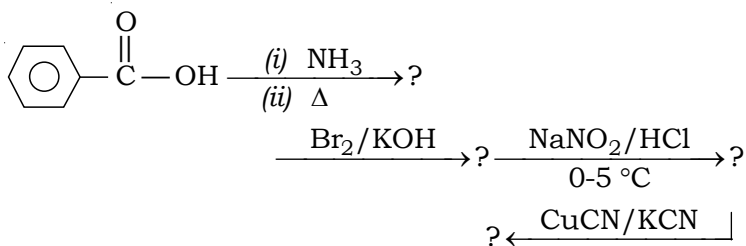
(7)

- (e) Complete the following reactions : 2



OR

8. (a) Nitration of aniline produces *m*-nitro-aniline as major product even though the amino group is *o*- and *p*-directing. Explain giving equations. 1½
- (b) How will you prepare ethanamine from propanamide? Write its mechanism. 2
- (c) Identify the products in the following reactions : 2



- (d) How will you carry out the following conversions? 1½×2=3
- (i) Nitrobenzene to benzene
- (ii) Aniline to *p*-hydroxyazobenzene

(8)

- (e) Amines have higher boiling points than the hydrocarbons of corresponding molecular mass. Explain. 1

SECTION—III

(Physical)

(Marks : 19)

9. (a) State Carnot's theorem and write an expression for the efficiency of the Carnot's engine. 1+1=2
- (b) Derive an expression for variation of free energy with temperature and pressure. 3
- (c) Derive the relation between K_p and K_c . 2½
- (d) The value of K_p for the reaction
- $$\text{CO} + \text{H}_2\text{O} \rightleftharpoons \text{CO}_2 + \text{H}_2$$
- is 1.06×10^5 at 25°C . Calculate the standard state free energy change (ΔG°) of the reaction at 25°C . ($R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$) 2½

(9)

OR

10. (a) Derive Gibbs-Helmholtz equation. 3
- (b) State Le Chatelier's principle and discuss the effects of temperature and pressure on the following reaction : $1+2=3$
$$\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$$
$$\Delta H = -92.38 \text{ kJ}$$
- (c) State and explain the law of mass action. 2
- (d) Calculate the entropy change when 1 mole of ethanol is evaporated at 351 K. The molar heat of vaporisation of ethanol is $39.84 \text{ kJ mol}^{-1}$. 2
11. (a) Explain the phenomenon of osmosis. 2
- (b) What is van't Hoff factor? What is the cause of abnormal molecular weights of solutes in solution? $1+2=3$
- (c) Explain Brownian movement. 2
- (d) A solution of 12.5 g of non-volatile solute in 170 g of water gave boiling point elevation of 0.63 K. Calculate the molar mass of the solute. ($K_b = 0.52$) 2

(10)

OR

12. (a) What are colloids? What are the differences between lyophilic and lyophobic colloids? $1+2=3$
- (b) Explain the phenomenon of Tyndall effect in colloids. 2
- (c) State Henry's law. What are its limitations? 2
- (d) At 298 K, the vapour pressure of ether is 442 mm of Hg. When 6.1 g of a substance was dissolved in 50 g of ether, the vapour pressure fell to 410 mm. Calculate the molecular weight of the substance. (Molecular weight of ether = 74) 2

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