

3/EH-23 (iii) (Syllabus-2015)

2016

( October )

CHEMISTRY

( Elective/Honours )

( General Chemistry-III )

( Chem-EH-301 )

Marks : 56

Time : 3 hours

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

SECTION—I

( Inorganic )

( Marks : 18 )

1. (a) Explain why the atomic and ionic radii of the alkaline-earth metals are lower as compared to alkali metals. How do they differ from alkali metals based on the above observation? 1½+1½=3
- (b) How do the acidic and basic characters of oxides of the s- and p-block elements change on moving across a period and down the group? 3

( 2 )

OR

2. (a) What is inert-pair effect? Give a reason why on moving down the group the lower oxidation state of group 13 elements becomes more stable. 2
- (b) Give one method of preparation and one use of the following compounds :  $1\frac{1}{2} \times 2 = 3$
- (i) Potassium iodide
- (ii) Lead tetraacetate
- (c) Explain why phosphorus forms pentahalides but nitrogen does not form pentahalides. 1
3. (a) Give reasons for the following :  $1\frac{1}{2} \times 2 = 3$
- (i) Cations of transition elements have a higher tendency to form complexes.
- (ii) The second and the third rows of transition elements resemble each other more closely than they resemble the first row transition elements.
- (b) What is lanthanide contraction? Explain the cause of lanthanide contraction. 3

( 3 )

OR

4. (a) What are transuranic elements? Write down the preparation of the first transuranic element. 2
- (b) Explain the separation of lanthanides by ion-exchange method. 3
- (c) What is the number of ions per mole of the complex  $\text{CoCl}_3 \cdot 5\text{NH}_3$  in aqueous solution? 1
5. (a) What is meant by effective atomic number? Calculate the effective atomic number of cobalt in  $[\text{Co}(\text{NH}_3)_6]^{3+}$ .  
(Atomic number of cobalt = 27)  $1+1=2$
- (b) Give the IUPAC nomenclature of the following :  $\frac{1}{2} \times 3 = 1\frac{1}{2}$
- (i)  $[\text{Ag}(\text{NH}_3)_2]\text{Cl}$
- (ii)  $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$
- (iii)  $(\text{NH}_4)_3[\text{Cr}(\text{NCS})_6]$
- (c) What is chelating ligand? Write down the applications of chelate formation.  $2\frac{1}{2}$

OR

6. (a) Give an example and draw the structure of an octahedral complex of the type  $[\text{M}(\text{aa})_3]$ . What type of isomerism will it exhibit?  $1\frac{1}{2}$

( 4 )

(b) Using valence-bond theory, predict the structure and magnetic behaviour of  $[\text{Mn}(\text{CN})_6]^{4-}$  and also mention whether it is an outer or inner orbital complex and high-spin or low-spin complex.  $2\frac{1}{2}$

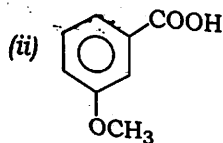
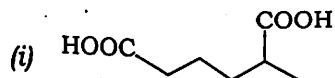
(c) What relationship exists between the crystal-field splitting energy ( $\Delta_0$ ) and pairing energy ( $P$ ) in determining whether a given complex will be high spin or low spin? 2

## SECTION—II

( Organic )

( Marks : 19 )

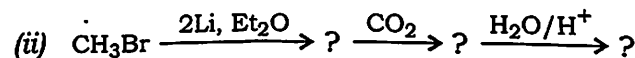
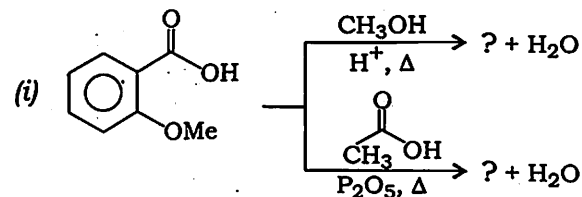
7. (a) Name the following compounds according to IUPAC nomenclature :  $\frac{1}{2} \times 2 = 1$



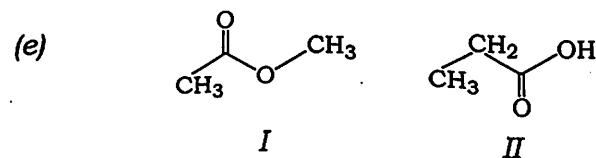
(b) Arrange the following in decreasing order of  $\text{pK}_a$  :  $1\frac{1}{2}$   
Benzoic acid, 4-nitrobenzoic acid, 4-methoxybenzoic acid

( 5 )

(c) Complete the following reactions with mechanisms :  $2 \times 2 = 4$



(d) Why is Grignard reagent prepared under anhydrous conditions?  $1\frac{1}{2}$



Although I and II are isomers, the boiling point of I is lower than II. Explain.  $1\frac{1}{2}$

OR

8. (a) Discuss with an example the difference between tautomerism and resonance.  $1\frac{1}{2}$

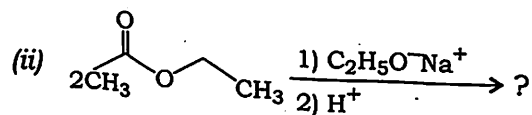
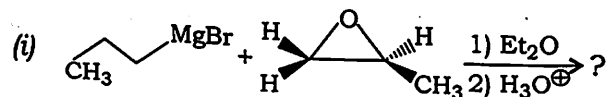
(b) "Acid chlorides give a pungent smell in air." Explain. 1

( 6 )

- (c) Starting from ethylacetoacetate, how would you synthesize the following compounds?  $1\frac{1}{2} \times 2 = 3$

- (i) Cinnamic acid  
(ii) Ethyl methyl ketone

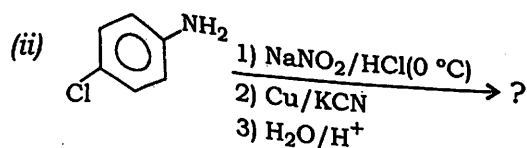
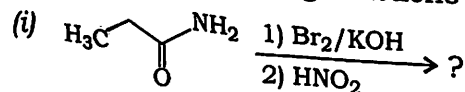
- (d) Complete the following reactions with mechanisms :  $2 \times 2 = 4$



9. (a) "Ethylamine is soluble in water whereas aniline is not." Explain.  $1\frac{1}{2}$

- (b) Why is it necessary to use concentrated  $\text{H}_2\text{SO}_4$  in nitration of benzene?  $1\frac{1}{2}$

- (c) Complete the following reactions :  $2 \times 2 = 4$



( 7 )

- (d) Why is diazotization of aniline always carried out in ice-cold solution?  $1$

- (e) "The basic strength of amines in aqueous solution is different from gaseous phase." Explain.  $1\frac{1}{2}$

OR

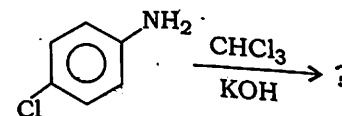
10. (a) Why is it difficult to prepare pure amines by ammonolysis of alkyl halides?  $1\frac{1}{2}$

- (b) Why does  $-\text{NO}_2$  group increase the electrophilic character at *ortho*- and *para*-positions and not at *meta*-position? Explain with structures.  $1\frac{1}{2}$

- (c) How will you make the following conversions?  $1\frac{1}{2} \times 2 = 3$

- (i) Benzene to aniline  
(ii) Aniline to *p*-hydroxyazobenzene

- (d) Complete the following reaction :  $2$



- (e) Give reason why aryl diazonium ions are more stable than alkyl diazonium ions.  $1\frac{1}{2}$

( 8 )

SECTION—III

( Physical )

( Marks : 19 )

11. (a) Derive the expression for entropy change of an ideal gas in terms of temperature and volume change. 3
- (b) Calculate the efficiency of a Carnot's engine working between the temperatures 110 °C and 25 °C. 2
- (c) State Le Chatelier's principle and discuss the effect of pressure on the reaction
- $$\text{PCl}_5 \rightleftharpoons \text{PCl}_3 + \text{Cl}_2 \quad 2$$
- (d) State and explain the 'law of mass action'. 2½

OR

12. (a) Derive the Gibbs-Helmholtz equation. 3
- (b) State Trouton's rule. 1½
- (c) The value of  $K_p$  for the equilibrium
- $$2\text{H}_2\text{O}(\text{g}) + 2\text{Cl}_2(\text{g}) \rightleftharpoons 4\text{HCl}(\text{g}) + \text{O}_2(\text{g})$$
- is 0.035 atm at 400 °C when the partial pressure is expressed in atmosphere. Calculate the value of  $K_c$  for the same reaction. 2

D7/108

( Continued )

( 9 )

- (d) Derive van't Hoff equation for temperature dependence of equilibrium constant in terms of  $K_c$ . 3
13. (a) Distinguish between order and molecularity of a reaction. 2
- (b) Derive an expression for the rate constant of a first-order reaction. Show that the half-life of a first-order reaction is independent of the initial concentration of the reactant. 2+1=3
- (c) What do you understand by lowering and relative lowering of vapour pressure? 1+1=2
- (d) A solution containing 4 g of a non-volatile organic solute per 100 ml solution was found to have an osmotic pressure equal to 500 cm of mercury at 27 °C. Calculate the molecular weight of the solute. 2½

OR

14. (a) For a particular reaction, the rate constant  $k$  is  $2.8 \times 10^{-5} \text{ lit mol}^{-1} \text{sec}^{-1}$  at 300 K and  $7.0 \times 10^{-1} \text{ lit mol}^{-1} \text{sec}^{-1}$  at 400 K. Calculate the energy of activation for the reaction. (Given  $R = 1.98 \text{ cal mol}^{-1} \text{deg}^{-1}$ ) 2½

D7/108

( Turn Over )

( 10 )

- (b) The differential form of the rate of a reaction is

$$\frac{dx}{dt} = k(a-x)^2$$

Obtain the integrated form of the rate equation.

3

- (c) Define boiling point of a liquid. Why is boiling point of a solvent less than that of its solution?

1+1=2

- (d) Explain reverse osmosis.

2

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1st copy  
3/EH-62 (iii) (Syllabus-2015)

2016

( October )

BOTANY

( Elective/Honours )

( Angiosperm Taxonomy, Economic Botany,  
Ethnobotany and Phytogeography )

( BOT-ELH-301 )

Marks : 56

Time : 3 hours

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

Answer Question No. 1 which is compulsory  
and **four** questions, selecting  
**one** from each Section

1. Write short notes on the following : 4×4=16

- (a) Barriers to plant migration
- (b) Spikelets of Poaceae
- (c) Processing of rubber
- (d) Rules of priority