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( February )

CHEMISTRY

( Elective/Honours )

[ Part—A (Theory) ]

( Inorganic—III, Organic—III, Physical—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 elements of group-1 are soft, electrically conducting, good reducing agents and form univalent ions. 2

- (b) Give three main points of differences between beryllium and the rest of the alkaline earth elements. 1½
- (c) Using suitable examples, explain inert pair effect. 1½
- (d) Differentiate between electron gain enthalpy and ionization enthalpy. 1½
- (e) Write down one method of preparation, one use and draw the structure of lead tetraacetate. 1½
- (f) Write down the complete electronic configuration of arsenic. 1

**OR**

2. (a) Define catenation. 1
- (b) Explain why the alkaline earth metal oxides are less basic than those of group-1 metals. 1
- (c) Give one method of preparation of hydrazine. What happens when hydrazine is exposed to air? Draw the structure of hydrazine indicating the bond length and bond angles. 1+1+1=3
- (d) Write all the possible oxidation states of group-16 (oxygen family) elements. 1

( 3 )

- (e) How do the atomic radii vary—  
(i) across the period;  
(ii) down the group?  
Explain the observation.  $1\frac{1}{2}+1\frac{1}{2}=3$

3. (a) Even though Zn, Cd and Hg are *d*-block elements, explain why they are not classified as transition elements. 2

(b) Write and explain the abnormal electronic configuration of Cr and Cu. 2

- (c) What happens when KI solution is added to—  
(i) alkaline  $\text{KMnO}_4$  solution;  
(ii) acidified  $\text{KMnO}_4$  solution?

Write down the balanced chemical reaction.  $1\frac{1}{2}+1\frac{1}{2}=3$

(d) Explain why most compounds of transition elements are coloured. 2

OR

4. (a) Mention the similarities between lanthanides and actinides. 2

(b) Write down the general electronic configuration of *d*-block elements. 1

( 4 )

(c) What are synthetic elements? Discuss the synthesis of plutonium.  $1+1=2$

(d) Why do transition elements act as good catalyst? 2

(e) Draw the structure and mention the uses of  $\text{Ni}(\text{CO})_4$ . 2

SECTION—II

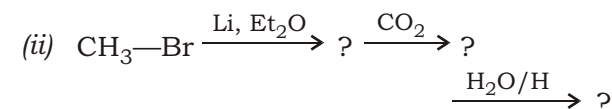
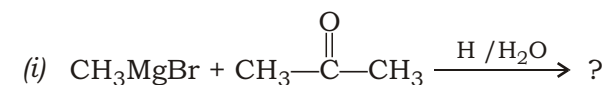
( Organic )

( Marks : 19 )

5. (a) The  $\text{pK}_a$  values of  $\text{CH}_3\text{COOH}$ ,  $\text{HCOOH}$  and  $\text{CH}_2\text{Cl}-\text{COOH}$  are 4.75, 3.75 and 2.87 respectively. Explain the variation in the  $\text{pK}_a$  values. 2

(b) How will you prepare  $\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{NH}_2$  from  $\text{CH}_3-\text{COOH}$ ? 1

(c) Complete the following reactions with mechanism :  $1\frac{1}{2}+2=3\frac{1}{2}$



( 5 )

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

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

**OR**

6. (a) Arrange the following in decreasing order of  $pK_a$ . Give reasons :  $1 + 2 = 3$

Benzoic acid, 4-nitrobenzoic acid,  
4-methoxybenzoic acid

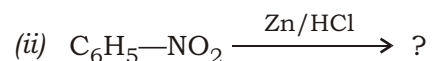
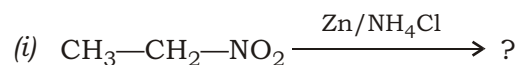
- (b) Why is Grignard reagent prepared under anhydrous conditions? 1

- (c) Starting from  $\text{CH}_3\text{CH}_2\text{Br}$ , how would you synthesize  $\text{CH}_3-\text{CH}_2-\text{CH}_2\text{OH}$ ? Give mechanism.  $2\frac{1}{2}$

- (d) Starting from diethyl malonate, how will you synthesize the following?  $1\frac{1}{2} \times 2 = 3$

- (i) Barbituric acid  
(ii) Succinic acid

7. (a) Complete the following reactions :  $1 \times 2 = 2$



( 6 )

- (b) How will you prepare nitroalkanes from alkanes? Give equations.  $1\frac{1}{2}$

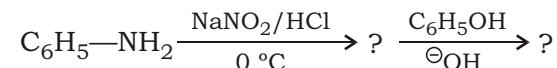
- (c) The  $pK_a$  of the conjugate acids of ethylamine and aniline are 10.7 and 4.6 respectively. Explain. 2

- (d) Give reasons for the following :  $1 \times 2 = 2$

- (i) Boiling point of  $(\text{CH}_3)_2\text{NH}$  is higher than that of  $(\text{CH}_3)_3\text{N}$ .

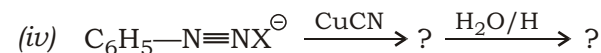
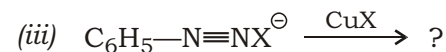
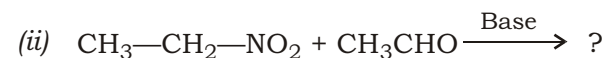
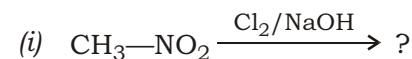
- (ii) Aryl diazonium ions are more stable than alkyl diazonium ions.

- (e) Complete the following reaction with mechanism : 2



**OR**

8. (a) Complete the following reactions with mechanism :  $1\frac{1}{2} + 1\frac{1}{2} + 1\frac{1}{2} + 2 = 6\frac{1}{2}$



- (b) How will you distinguish between primary, secondary and tertiary amines using Hofmann method? 3

( 7 )

SECTION—III

( Physical )

( Marks : 19 )

9. (a) Derive the Clausius-Clapeyron equation for the equilibrium of the type
- Liquid  $\rightleftharpoons$  Vapour 3
- (b) Write the expression for the equilibrium constant of the following reaction, in terms of  $K_c$  :
- $N_2 + 3H_2 \rightleftharpoons 2NH_3$  2
- (c) Explain the following terms with examples :  $1\frac{1}{2} \times 2 = 3$
- (i) Homogeneous equilibrium
- (ii) Heterogeneous equilibrium
- (d) Calculate the efficiency of a Carnot's engine working between the temperatures 27 °C and 127 °C. 2

OR

10. (a) Obtain an expression for entropy change of an ideal gas in terms of temperature and volume change. 3
- (b) Derive van't Hoff equation for the temperature dependence of equilibrium constant. 3

( 8 )

- (c) State Trouton's rule. 2
- (d) Calculate  $K_c$  for the reaction
- $2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$
- at 27 °C.  $K_p$  for the reaction is  $3.5 \times 10^{-23}$  atm at 27 °C. 2

11. (a) What are colligative properties? Give examples. 2
- (b) Define boiling point of a liquid. Why is boiling point of a solvent less than that of its solution?  $1+1=2$
- (c) Discuss briefly the peptization and Bredig's method of preparation of colloids.  $1\frac{1}{2}+1\frac{1}{2}=3$
- (d) Define 'Gold number'. Gold numbers for gelatin, haemoglobin and sodium oleate are 0.005, 0.05 and 0.07 respectively. Which has the greatest protective action?  $1+1=2$

OR

12. (a) State and explain Raoult's law. Mention its limitations.  $2+1=3$

( 9 )

- (b) What are the different ways of purifying colloids? Discuss them briefly.  $1+2=3$
- (c) Write notes on the following :  $1\frac{1}{2}\times 2=3$
- (i) Reverse osmosis
  - (ii) Electrophoresis

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