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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)* What is solubility product of a substance? Calculate the solubility product of AgCl at 25 °C when the solubility of AgCl in water at 25 °C is 0·00179 g/L. 2½

(b) How would you prepare 250 ml of 0·1 N solution of hypo ($Na_2S_2O_3 \cdot 5H_2O$, molecular weight 248)? 1

(c) What are redox titrations? Give example. 2

(d) Explain Bronsted-Lowry concept of acids and bases. Give an example for each. 1+1=2

(e) What do you understand by levelling effect of solvents? 2

OR

2. *(a)* What is meant by the term pK_a? Given the pK_a values for each, which is a stronger acid. Justify $HClO_4$ (pK_a 7·4), $HBrO_4$ (pK_a 8·7) and HIO_4 (pK_a 11). 3

(b) Classify the following as Lewis acids and Lewis bases giving suitable reasons : 2

(i) $AlCl_3$

(ii) H_2O

(c) Cations of group II and group III B are both precipitated as their sulphides in systematic group separation. Explain how you would separate the cations of group II from those of group III B. 2

(d) Why is $KMnO_4$ not used as a primary standard solution? 1

(3)

(e) Give one example of acid-base indicator and mention its colour in acidic and alkaline medium. 1½

3. (a) Identify (i) oxidation, (ii) reduction, (iii) oxidant and (iv) reductant in the following reaction : 2

$$2FeCl_3 + SnCl_2 \longrightarrow 2FeCl_2 + SnCl_4$$

(b) Complete and balance the following reaction by ion-electron method : 1½

$$Na_2S_2O_3 + I_2 \longrightarrow ?$$

(c) Briefly discuss the process of extraction of iron from its haematite ore. Write relevant chemical equations involved. 3

(d) Describe how urea is manufactured and write relevant equations involved. 2

(e) Give one example each of a white pigment and a red pigment. 1

OR

4. (a) What is an electrochemical series? Predict whether the following redox reaction is feasible or not under standard conditions :

$$Zn + Cu^2 \longrightarrow Zn^2 + Cu$$

(4)

Given that—

$$E^{\circ}_{Zn/Zn^2} = 0·763 \text{ V and}$$

$$E^{\circ}_{Cu^2/Cu} = 0·337 \text{ V}$$
1+2=3

(b) Briefly describe froth-floatation process with a suitable example. 1½

(c) Differentiate between calcination and roasting. 2

(d) What is cement clinker? Write the composition of cement clinker. 2

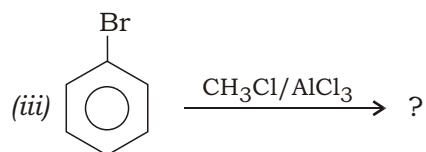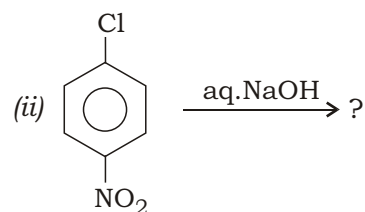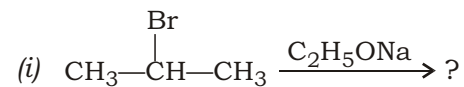(e) What are phosphatic fertilizers? Give example. 1

SECTION—II

(Organic)

(Marks : 19)

5. (a) The hydrolysis of t-butyl bromide is a typical example of S_N1 reaction.

$$H_2O + (CH_3)_3C\,Br \longrightarrow (CH_3)_3COH + HBr$$

Discuss the mechanism of the reaction. Why is the mechanism designated as S_N1 reaction? 2

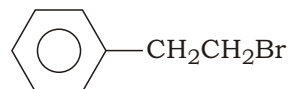(b) Compare the nucleophilicities and basicities of t-BuO$^{\ominus}$ and EtO$^{\ominus}$. 1½

(5)

(c) How would you synthesize ethyl acetate from ethyl bromide? Give reaction. 1

(d) Complete the following reactions : 1×3=3

(i)
$$CH_3-\overset{\overset{\displaystyle Br}{|}}{CH}-CH_3 \xrightarrow{C_2H_5ONa} ?$$

(ii)

$$\xrightarrow{aq.NaOH} ?$$

(iii)

$$\xrightarrow{CH_3Cl/AlCl_3} ?$$

(e) Explain why

is not formed during the radical bromination of
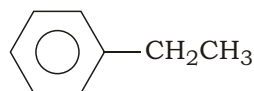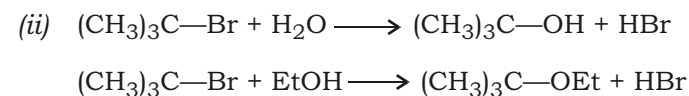

2

(6)

OR

6. (a) Which S_N1 reaction of each pair is expected to take place at a faster rate and why? 2

(i) $(CH_3)_3C-Br + H_2O \longrightarrow (CH_3)_3COH + HBr$

$(CH_3)_2CH-Br + H_2O \longrightarrow (CH_3)_2CHOH + HBr$

(ii) $(CH_3)_3C-Br + H_2O \longrightarrow (CH_3)_3C-OH + HBr$

$(CH_3)_3C-Br + EtOH \longrightarrow (CH_3)_3C-OEt + HBr$
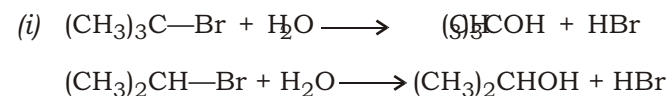
(b) Account for the failure of the following S_N2 reaction : 1

$$\overset{\ominus}{Br} + CH_3-OH \longrightarrow CH_3-Br + \overset{\ominus}{OH}$$
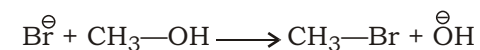
(c) R—Br reacts with AgCN to give R—NC, whereas it reacts with NaCN to give R—CN. Explain. 2
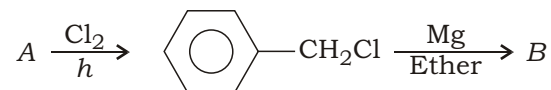
(d) What is Hofmann elimination rule? Explain giving a suitable example. 1½
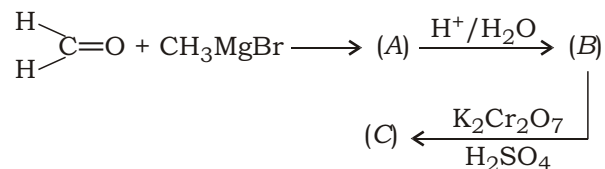
(e) Complete the following reactions : 1×2=2

$$CH_3-\overset{\overset{\displaystyle CH_3}{|}}{CH}-CH_2Br \begin{cases} \xrightarrow[\text{Ethanol/}]{\text{KOH}} ? \\ \xrightarrow[\text{Wurtz reaction}]{\text{Na}} ? \end{cases}$$
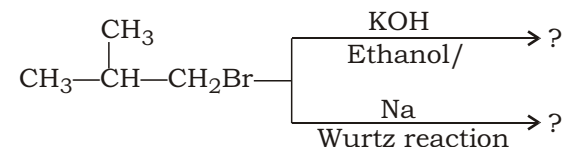
(7)

(f) Identify *A* and *B* in the following reaction : ½+½=1

$$A \xrightarrow{\underset{h}{Cl_2}} \bigcirc - CH_2Cl \xrightarrow{\underset{Ether}{Mg}} B$$

7. (a) Out of benzaldehyde and acetaldehyde, which is more reactive and why? 1½

(b) Identify *A*, *B* and *C* in the following transformations : 1½

$$\underset{H}{\overset{H}{>}} C=O + CH_3MgBr \longrightarrow (A) \xrightarrow{H^+/H_2O} (B)$$

$$(C) \xleftarrow{\underset{H_2SO_4}{K_2Cr_2O_7}}$$

(c) What is Reimer-Tiemann reaction? Give its mechanism. 2½

(d) "Phenols are acidic and they are considerably stronger acids than alcohols." Explain. 2

(e) How will you distinguish between *n*-propyl alcohol and isopropyl alcohol by Lucas test? Give relevant equations. 2

OR

8. (a) How will you synthesize ethylene glycol from ethylene? Give reaction. 2

(b) What happens when glycerol is heated with potassium hydrogen sulphate? Give reaction. 1

(8)

(c) Give the mechanism of base-catalyzed self-condensation of acetaldehyde. 2½

(d) What happens when acetophenone is treated with zinc amalgam and HCl? Write mechanism. 2½

(e) Arrange the following in decreasing order of acidity : 1½

p-nitrophenol, *m*-nitrophenol and 2,4-dinitrophenol

Section—III

(Physical)

(*Marks* : 18)

9. (a) What are path functions and inexact differentials? 2

(b) Derive the expression for maximum work done when *n* moles of an ideal gas are expanded isothermally and reversibly from V_1 to V_2 volume. 4

(c) Calculate the heat of formation of benzene at 25 °C, if the heats of combustion of benzene, carbon and hydrogen are -780.98 kcal mol^{-1}, -94.05 kcal mol^{-1} and -68.32 kcal mol^{-1} respectively at 25 °C. 3

OR

10. *(a)* Define extensive and intensive properties. Give one example of each. 2

(b) Explain the following terms : 1½+1½=3
  (i) Joule-Thomson effect
  (ii) Inversion temperature

(c) Describe osmometric method for the determination of molecular mass of macromolecule. 4

11. *(a)* State and explain Hess's law of constant heat summation. 1+2=3

(b) The heat of reaction N_2 $3H_2$ $2NH_3$ at 27 °C was found to be –21·976 kcal. What will be the heat of reaction at 50 °C? Given that the molar heat capacities at constant pressure and at 27 °C for nitrogen, hydrogen and ammonia are 6·8 cal mol^1 degree^1, 6·77 cal mol^1 degree^1 and 8·86 cal mol^1 degree^1. 4

(c) Distinguish between physisorption and chemisorption. 2

OR

12. *(a)* What is the zeroth law of thermodynamics? How does the idea of temperature come from it? 2

(b) Discuss Freundlich adsorption isotherm of a gas on a solid surface. How are the constants in this isotherm equation determined graphically? 1+2=3

(c) A polymer is composed of equal number of molecules of molecular weights 50000 and 90000. Calculate the number average and weight average molecular weight and also calculate the polydispersity of the polymer sample. 3½+½=4

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