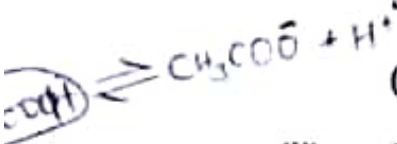# SECTION A

Answer three questions from this section.

1. (a) What is meant by the term **weak acid**?   (01mark)

    (b) State and explain how temperature affects the pH of weak acids.
                                                                                     (03marks)

    (c) (i) 35 cm³ of 0.089M sodium hydroxide solution were added to

             45cm³ of 0.1M benzoic acid .Calculate pH of the resultant solution.
             State any assumptions made in your calculations.

             (Ka for benzoic acid = 6.3×10^{-5} moldm⁻³)   (05marks)

         (ii) State and explain what would happen to the pH of the resultant solution
             in c(i)when a small amount of dilute hydrochloric acid was added to it.
                                                                                     (03marks)

    (d) The table below shows the variation in pH when 30cm³of 0.2M ammonia
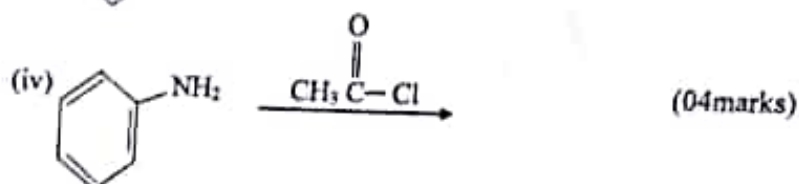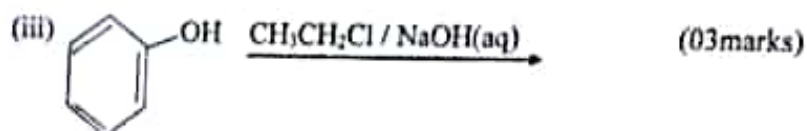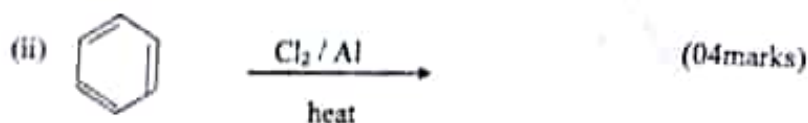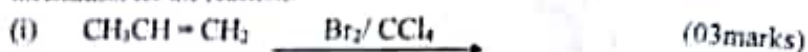
         solution was titrated with hydrochloric acid

Volume of HCl (cm³)	0	4	8	12	16	18	19	19.4	19.8
pH of the solution	10.8	9.9	9.4	9.1	8.7	8.3	8.0	7.8	7.3

Volume of HCl (cm³)	20.2	20.6	21	22	26	28
pH of the solution	3.9	3.5	3.2	2.9	2.5	2.4

    (i)   Plot a graph of pH against volume of hydrochloric acid.   (3½marks)
    (ii) Determine the pH at the end point.   (0½mark)
    (iii) Determine the hydrolysis constant of ammonium chloride formed at the end
          point.   (04marks)

2. (a) (i) Write the formulae of the possible oxides of lead. (1½marks)

    (ii) Write an equation to show how each of the oxides in a(i) is prepared in the laboratory. (03marks)

    (b) Describe how the oxides in (a) react with:

    (i) dilute nitric acid . (03marks)

    (ii) concentrated hydrochloric acid. (05marks)

    (ii) concentrated sodium hydroxide (05marks)

    (c) One of the oxides in (a) is used to confirm manganese(II) ions in solution.

    (i) identify the oxide. (0½mark)

    (ii) describe briefly how the oxide in (i) can be used to confirm manganese (II) ions. Illustrate your answer with an equation. (02marks)

3. (a) What is meant by the term **solubility product**? (01marks)

    (b) Describe an experiment that can be used to determine the solubility product of silver(I) ethanedioate. (06marks)

    (c) The solubility product of silver(I) ethanedioate at 25°C is 2.32×10^{-4} mol^3dm^{-9}.

    Calculate:

    (i) the solubility in $moldm^{-3}$ of silver(I) ethanedioate in pure water. (02marks))

    (ii) the solubility in $moldm^{-3}$ of silver(I) ethanedioate in 0.1M sodium ethanedioate solution. (03marks)

    (d) 25cm^{3}of 0.05M sodium ethanedioate solution were mixed with 25cm^3 of 0.05M silver nitrate solution. State whether there will be precipitation or not. Give a reason for your answer. (03marks)

    (e) Explain how the solubility of silver (I) ethanedioate would be affected if a saturated solution of silver(I) ethanedioate was added:

    (i) silver nitrate solution. (2½marks)

    (ii) aqueous ammonia solution. (2½marks)

    (f) State two applications of solubility product. (01mark)

4. (a) Complete the following equations and in each case outline a
        mechanism for the reaction.

        (i) $CH_3CH = CH_2$ $\xrightarrow{\quad Br_2/ CCl_4 \quad}$ (03marks)

        (ii) $\xrightarrow[heat]{\quad Cl_2 / Al \quad}$ (04marks)

        (iii) —OH $\xrightarrow{\quad CH_3CH_2Cl / NaOH(aq) \quad}$ (03marks)

        (iv)   —NH_2 $\xrightarrow{\quad CH_3\overset{\overset{\displaystyle O}{\|}}{C}-Cl \quad}$ (04marks)

    (b) An organic compound X with a general molecular formula, $C_nH_{2n}O_2$ contains
         40% by mass of carbon.

        (i)   Determine the molecular formula of X   (02marks)

        (ii)   Write the structural formulae and IUPAC names of all the
               possible isomers of X.   (02marks)

        (iii) When X was treated with sodium carbonate solution, there was
               no observable change. Identify X.   (0½mark)

        (iv)   Write an equation to show how X can be converted into an alcohol.
                                                                             (1½marks)

SECTION B

Answer any two questions from this section

5. (a) What is meant by the term **enthalpy of combustion**? (01mark)

   (b) Describe an experiment that can be carried out to determine the

   enthalpy of combustion of hexane. (07marks)

   (c) The standard enthalpies of combustion of the first five straight chain alkanes are shown in the table below.

Number of carbon atoms	1	2	3	4	5
Enthalpy of combustion of alkanes (kJmol^{-1})	-890	-1560	-2220	-2877	-3509

   (i) Plot a graph of the enthalpy of combustion of alkanes against number of carbon atoms. (04marks)

   (ii) Use the graph to determine the enthalpy of combustion of hydrogen and hexane. (02mark)

   (iii) Explain the shape of the graph. (03marks)

   (d) Using the information in (c) (ii), calculate standard enthalpy of formation of hexane. Given that the standard enthalpies of combustion of carbon is – 393kJmol^{-1}. (03marks)

6. Using equations only, show how the following conversions can be effected.

   (a) from phenyl amine (4½marks)
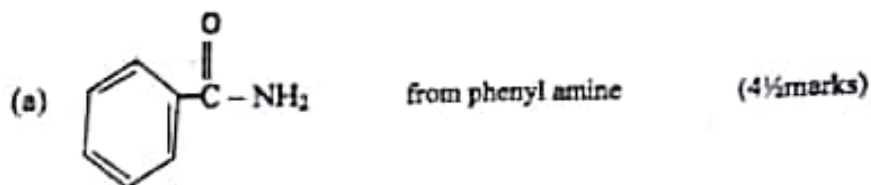
   (b) $CH_3CHBrCH_2Br$ from ethyne (04marks)

   (c) $CH_3CH_2NH_2$ from propanoic acid (3½marks)

   (d) CH_3OCH_3 from ethanol (04marks)

   (e) 2-amino propane from propan- 1- ol (04marks)

Explain the following observations.

(a) Aluminium chloride dissolves in ethanol whereas aluminium fluoride does n̶ (03marks)

(b) An aqueous solution of sodium sulphite turns red litmus paper blue where as an aqueous solution of sodium hydrogen sulphite turns blue litmus paper red. (04marks)

(c) When aqueous ammonia solution was added to nickel (II) sulphate solution a green precipitate was formed which dissolved to form a blue solution. (04marks)

(d) Iodine is insoluble in water but soluble in potassium iodide solution. (03marks)

(e) Ice has a lower density than water. (03marks)

(f) Carbonic acid (H_2CO_3) and sulphurous acid (H_2SO_3) are both dibasic acids but they have different bond angles. (03marks)

8. (a) Describe briefly how concentrated sulphuric acid is manufactured from iron pyrites (FeS_2). (06marks)

(b) Discuss the reactions of sulphuric acid with:
(i) iron
(ii) carbon
(iii) phosphorus (08marks)

(c) Concentrated sulphuric acid is 98%w/w and has a density of $1.84gcm^{-3}$
Calculate
(i) the molarity of concentrated sulphuric acid. (03marks)
(ii) the volume of the concentrated acid required to prepare $500cm^3$ of 2.5M sulphuric acid. (03marks)

END