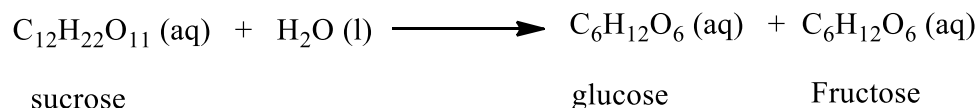## SECTION A (60 Marks)

Answer only **three** questions from this section.

1. Tin and lead are members of group (IV) of the periodic table.
   (a) Write:
      (i) The outer most electronic configuration of the elements
                                                                (1 mark)
      (ii) The formulae of the common oxides of lead   (1 ½ marks)
   (b) Write equations of reactions to show the oxides of lead in (a) (ii) are
       formed   (4 ½ marks)
   (c) Describe the reactions of tin and lead with:
      (i) Sulphuric acid
      (ii) Sodium hydroxide   (8 marks)
   (d) Name one reagent that can be used to distinguish between the following
       pairs ions. In each case state what would be observed and write
       equation(s) for the reaction(s).
      (i) Pb^{2+} and Sn^{2+}
      (ii) Sn^{2+} and Sn^{4+} (5 marks)

2. Chemical Kinetics deduces the order of reaction and its molecularity.

   (a) Explain what is meant by the following terms:

      (i) Order of reaction   (2 marks)

      (ii) Molecularity of a reaction   (2 marks)

   (b) Describe an experiment to show that iodination of propanone follows a

       zero order reaction with respect to iodine.   (7 marks)

   (c) Sucrose is hydrolysed in acidic medium to give a mixture of glucose and
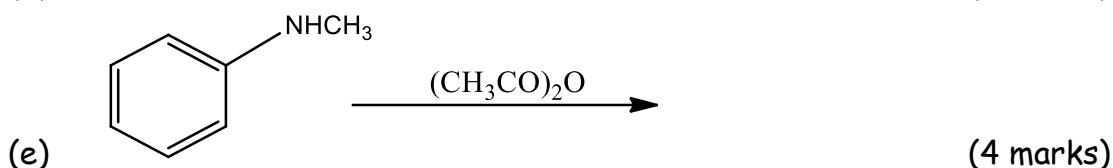
       fructose.

$$C_{12}H_{22}O_{11} \text{ (aq)} + H_2O \text{ (l)} \longrightarrow C_6H_{12}O_6 \text{ (aq)} + C_6H_{12}O_6 \text{ (aq)}$$

   sucrose   glucose   Fructose
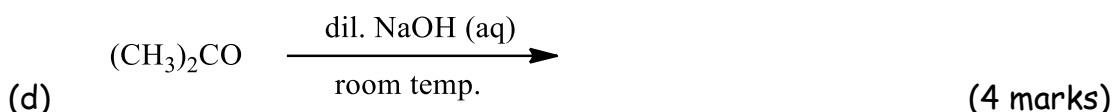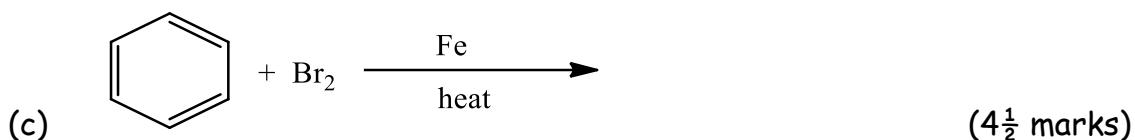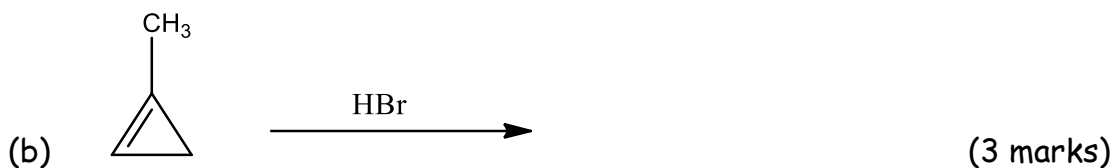
1

The graph below shows a plot of logarithm of the molar concentration of sucrose remaining at intervals of time. Where $In[S] = In[C_{12}H_{22}O_{11}]$
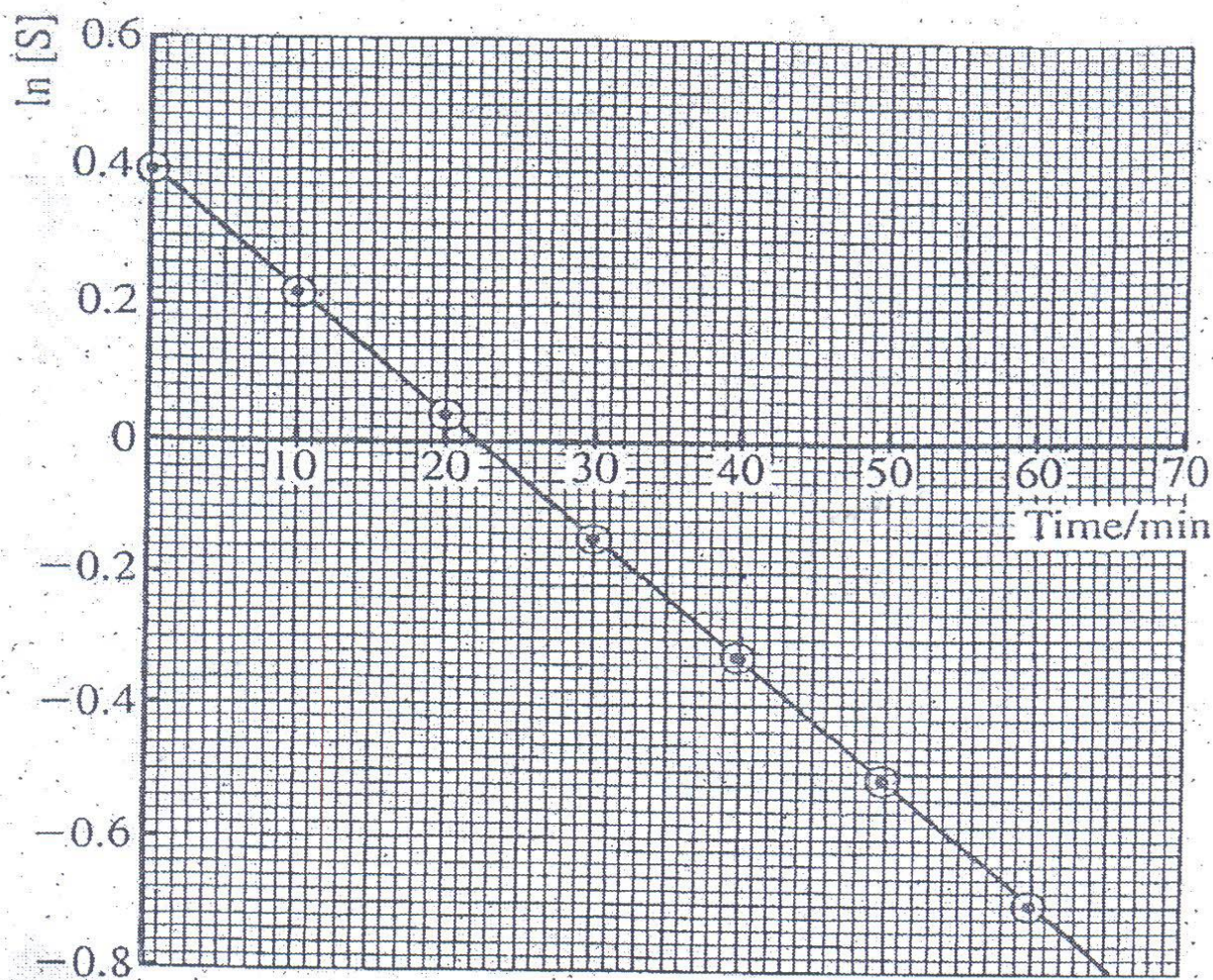
Using the graph, determine the:

      (i)   Original concentration of sucrose   ($1\frac{1}{2}$ marks)

      (ii)   Order of reaction   (2 marks)

      (iii)   Velocity constant for the reaction   ($1\frac{1}{2}$ marks)

      (iv)   Half life for the reaction   (2 marks)

(d)   State the conditions under which the reaction in (c) above is overall first order.   (2 marks)

3. Complete the following equations and in each suggest a mechanism for the reaction.

(a) $CH_3C \equiv CH \xrightarrow[\text{HgSO}_4 \text{, } 60^oc]{\text{H}_2\text{O/H}_2\text{SO}_4}$ (4½ marks)

(b) $\xrightarrow{\text{HBr}}$ (3 marks)

(c) $\bigcirc + Br_2 \xrightarrow[\text{heat}]{\text{Fe}}$ (4½ marks)

(d) $(CH_3)_2CO \xrightarrow[\text{room temp.}]{\text{dil. NaOH (aq)}}$ (4 marks)

(e) $\xrightarrow{(CH_3CO)_2O}$ (4 marks)
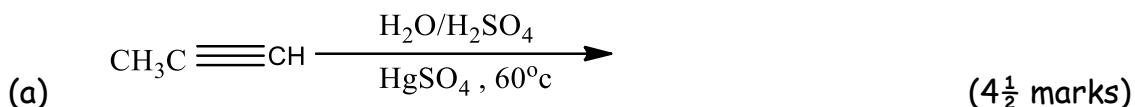
4. (a) Define the terms:
   (i)   Colligative property   (1 mark)
   (ii)   Freezing point depression constant   (1 mark)
   (iii) Osmotic Pressure   (1 mark)

   (b) Describe how the relative molecular mass of camphor can be determined by freezing point depression method using naphthalene as a solvent. (Diagram not required)   (6 marks)

   (c)   State the:

   (i)   Law of osmotic pressure   (1 mark)
   (ii)   Conditions under which the law is invalid.   (1 mark)

   (e) The osmotic pressure of a 2.1% solution of neoprene rubber is 0.45mmHg at 23°C. Determine the number of monomer units in neoprene rubber.   (4 marks)

   (f) Explain why osmotic pressure method was preferred over freezing point depression method for determining the number of monomer units of neoprene rubber.   (2 marks)

3

(g)   250g of water contains 0.1 mole of a non-volatile solute. Calculate the mass of ice deposited when the solution is cooled to -3.72°C. (Kf of water = 1.86°C mole^{-1} Kg^{-1})   (3 marks)

SECTION B (40 Marks)

Answer only **two** questions from this section.

5.   Barium sulphate is a sparingly soluble salt.
   (a)   Define:
      (i)   Solubility product   (2 marks)
      (ii)   Common ion effect.   (1 mark)
   (b)   Describe an experiment that can be carried out to determine the solubility product of barium sulphate.   (6 marks)
   (c)   The molar conductivities of barium sulphate in water at various concentrations are given below.

Concentration ($moldm^{-3}$)	Molar conductivity ($\Omega^{-1}cm^2 mol^{-1}$)
0.0012	421.40
0.0010	421.40
0.0600	421.40
0.0500	415.10
0.0400	412.40
0.0300	407.20
0.0200	402.00
0.0100	395.30

      (i) Plot a graph of molar conductivity against dilution   (4 marks)
      (ii) Determine the percentage of dissociation of barium sulphate in a 0.01M solution.   (2 marks)
   (d)   Calculate the solubility of barium sulphate (grams per litre) in a 0.01M barium chloride solution at 25°C. State all the necessary assumptions made. (The solubility product of barium sulphate at 25°C is $2.0 \times 10^{-5} mol^2 dm^{-6}$)   (5 marks)

4

6. One of the chief ores of iron is siderite (spathic iron)

    (a)   Write the formula of siderite   ($\frac{1}{2}$ mark)

    (b)   Outline how cast iron can be obtained from siderite   (8 marks)

    (c)   Describe briefly how iron reacts with :

        (i) Bromine   (2 marks)

        (ii) Hydrochloric acid   (2 marks)

        (iii)   Concentrated sulphuric acid   ($2\frac{1}{2}$ marks)

    (d)   Describe briefly how the percentage of iron in an ore can be

          determined in the laboratory.   (5 marks)

7. 6.20g of a bromoalkane **W**, C_nH_{2n+1} Br contains 65.04 % by mass bromine.

    (a)   Determine the molecular mass of **W**   ($3\frac{1}{2}$ marks)

    (b)   Write the structural formulae and IUPAC names of all possible

          isomers of **W**   (2 marks)

    (c)   When **W** is refluxed with aqueous potassium hydroxide, compound **Q** is

          formed which forms two layers after five minutes with a mixture of

          concentrated hydrochloric acid and anhydrous zinc chloride. Identify:

        (i) **W**   (1 mark)

        (ii) **Q**   (1 mark)

    (d)   Write equation and suggest a mechanism for the reaction between:

          (i) **W** and hot alcoholic potassium hydroxide solution   (2 marks)

          (ii) **W** and alkaline solution of phenol   (3 marks)

    (e)   Using equations only, show how **W** can be converted to ethylamine

                                                (5 marks)

    (f)   State what would be observed and write equation for the reaction

          between **Q** and acidified chromium (VI) oxide.   ($2\frac{1}{2}$ marks)

8. Nitric acid is industrially prepared by catalytic oxidation of ammonia.

(a)   Describe :

(i) The industrial preparation of nitric acid   (8 marks)

(ii) How copper reacts with nitric acid   (5 marks)

(b)   Nitrous acid and nitric acid are some of the nitrogen containing acids.

(i) Name the reagent(s) that can be used to distinguish between dilute solutions of nitric and nitrous acid.   (1 mark)

(ii) State what would be observed if the dilute acids are separately treated with the reagent(s) named in b(i)   (2 marks)

(iii)   Write equation(s) of any reaction(s) that would take place when dilute solution of each acid is separately treated with the reagent(s) you have named in b(i)   ($1\frac{1}{2}$ marks)

(c)   Describe briefly how nitric acid is used to confirm manganese (II) ions.   (include equation of reaction)   ($2\frac{1}{2}$ marks)

♥ ===END===

WELCOME TO SENIOR SIX, YEAR 2018
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