Materials required for examination	Item included with question paper
Nil	Nil

Instructions to Candidates

In the boxes above, write your centre number, candidate number, surname and initials, the paper reference and your signature.

Answer ALL the questions in the spaces provided in this question paper.

Calculators may be used.

Show all the steps in any calculations and state the units.

Information for Candidates

The total mark for this paper is 50. The marks for the various parts of questions are shown in round brackets: e.g. (2).

All blank pages are indicated.

A Periodic Table is printed on the back cover of this question paper.

Advice to Candidates

You are reminded of the importance of clear and orderly presentation in your answers.

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Success through qualifications

Answer ALL questions in the spaces provided.

1. The pairs of compounds given in parts (a) to (d) may be distinguished by the test stated.

    For each compound in the pair, describe the observations you would expect to make when the test is carried out. If a gas is evolved, include the name of the gas.

    (a) Solid sodium chloride and solid potassium chloride.

    Test: Flame test.

    Observation with sodium chloride ....

    ....

    Observation with potassium chloride..

    ....

    (2)

    (b) Aqueous potassium sulphate and aqueous potassium sulphite.

    Test: Addition of dilute hydrochloric acid followed by aqueous barium chloride.

    Observation with potassium sulphate ....

    ....

    Observation with potassium sulphite ....

    ....

    (2)

    (c) Solid ammonium sulphate and solid potassium sulphate.

    Test: Warm with aqueous sodium hydroxide, testing any gas with damp red litmus paper.

    Observation with ammonium sulphate ....

    ....

    Observation with potassium sulphate ....

    ....

    (3)

(d) Solid sodium chloride and solid sodium bromide.

Test: **Add concentrated sulphuric acid, testing any gas evolved with damp blue litmus paper.**

Observation with sodium chloride ....

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Observation with sodium bromide ....

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(5)

(Total 12 marks)

2. You are provided with the following apparatus and materials.

- A burette ready to use filled with a solution of aqueous sodium hydroxide.
- An aqueous solution of $0.0500 \ mol \ dm^{-3}$ ethanedioic acid.
- Phenolphthalein indicator.
- Access to the full range of laboratory volumetric apparatus.

(a) Describe how you would carry out titrations to find the volume of sodium hydroxide that reacts with $25.0 \ cm^3$ of the aqueous ethanedioic acid.

In your answer you must include how you would detect the end point and what you would do to obtain a reliable result.

You do **not** need to include any details of calculations you may carry out on your results.

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(6)

(b) The reaction involved in the titration is

$$(COOH)_2(aq) \quad + \quad 2NaOH(aq) \quad \longrightarrow \quad (COONa)_2(aq) \quad + \quad 2H_2O(l)$$
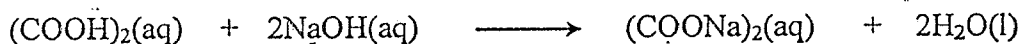
25.0 cm^3 of the aqueous 0.4500 mol dm^{-3} ethanedioic acid required 25.50 cm^3 of the aqueous sodium hydroxide for neutralisation.

(i) Calculate the amount (moles) of ethanedioic acid in 25.0 cm^3 of the solution.

(1)

(ii) Calculate the amount (moles) of sodium hydroxide in 25.50 cm^3 of the solution.

(1)

(iii) Calculate the concentration of the sodium hydroxide solution in mol dm^{-3}.

(1)

(c) Calculate the mass of hydrated ethanedioic acid, $(COOH)_2.2H_2O$, needed to make up 250 cm^3 of aqueous 0.0500 mol dm^{-3} solution. Give your answer to three significant figures.

(3)

(d)   When making up the solution of ethanedioic acid a student, by mistake, uses a 200 cm^3 instead of a 250 cm^3 volumetric flask. The student dissolves the mass of ethanedioic acid crystals calculated to make up 250 cm^3.

Explain what effect this would have on the student's volume of sodium hydroxide solution used in the titration.

[No calculation is required in your answer.]

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(2)

(Total 14 marks)

80

3. In two similar, separate experiments the enthalpy changes for the reactions of sodium hydrogencarbonate and sodium carbonate with excess dilute hydrochloric acid were determined.

(a) The first experiment was to find the enthalpy change, ΔH_1, for the reaction

$$NaHCO_3(s) \ + \ HCl(aq) \longrightarrow NaCl(aq) \ + \ CO_2(g) \ + \ H_2O(l)$$
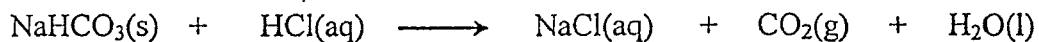
Measurement	Reading
Mass of solid sodium hydrogencarbonate added to hydrochloric acid	5.00 g
Volume of hydrochloric acid	50.0 cm^3
Temperature of hydrochloric acid before addition of solid sodium hydrogencarbonate	22.0 °C
Final temperature of solution	15.5 °C
Molar mass of sodium hydrogencarbonate	84.0 g mol^{-1}
Specific heat capacity of solution	4.18 J g^{-1} °C^{-1}

(i) Calculate the amount (moles) of sodium hydrogencarbonate used.

(1)

(ii) Calculate the heat absorbed in the reaction in kJ mol^{-1}.
[Assume that 1 cm^3 of solution has a mass of 1 g]

(2)

(iii) Calculate the value of ΔH_1 in kJ mol^{-1}. Include a sign in your answer expressing it to a number of significant figures suggested by the data in the table.

(2)

(b) In the second experiment the enthalpy change for the reaction between sodium carbonate and dilute hydrochloric acid was measured.

$$Na_2CO_3(s) + 2HCl(aq) \longrightarrow 2NaCl(aq) + CO_2(g) + H_2O(l)$$
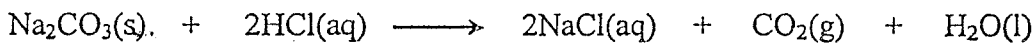
The molar enthalpy change, ΔH_2, was calculated to be -35.6 kJ mol^{-1}.

(i) Give TWO ways in which the temperature change differs when equal molar amounts of sodium hydrogencarbonate and sodium carbonate react separately with the same volume of hydrochloric acid.

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(2)

(ii) Give ONE assumption that has been made in calculating the values of ΔH_1 and ΔH_2 from experimental results.
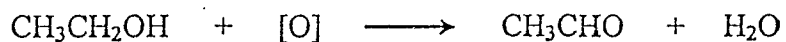
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(1)

(Total 8 marks)

4. Ethanol is oxidised when it reacts with a mixture of reagent A and sulphuric acid. Using the distillation apparatus shown in the diagram, the reaction may be used to prepare an aqueous solution of ethanal. The reaction taking place is shown by the equation below, where [O] represents the oxidising agent.

$$CH_3CH_2OH \quad + \quad [O] \quad \longrightarrow \quad CH_3CHO \quad + \quad H_2O$$

Data

Ethanal CH_3CHO

-   volatile liquid, boiling temperature 21°C
-   miscible with water
-   flammable
-   irritant, harmful vapour
-   molar mass = 44 g mol^{-1}.

Reagent A + water + ethanol

Aqueous sulphuric acid

Heat

To fume cupboard

Ice/water
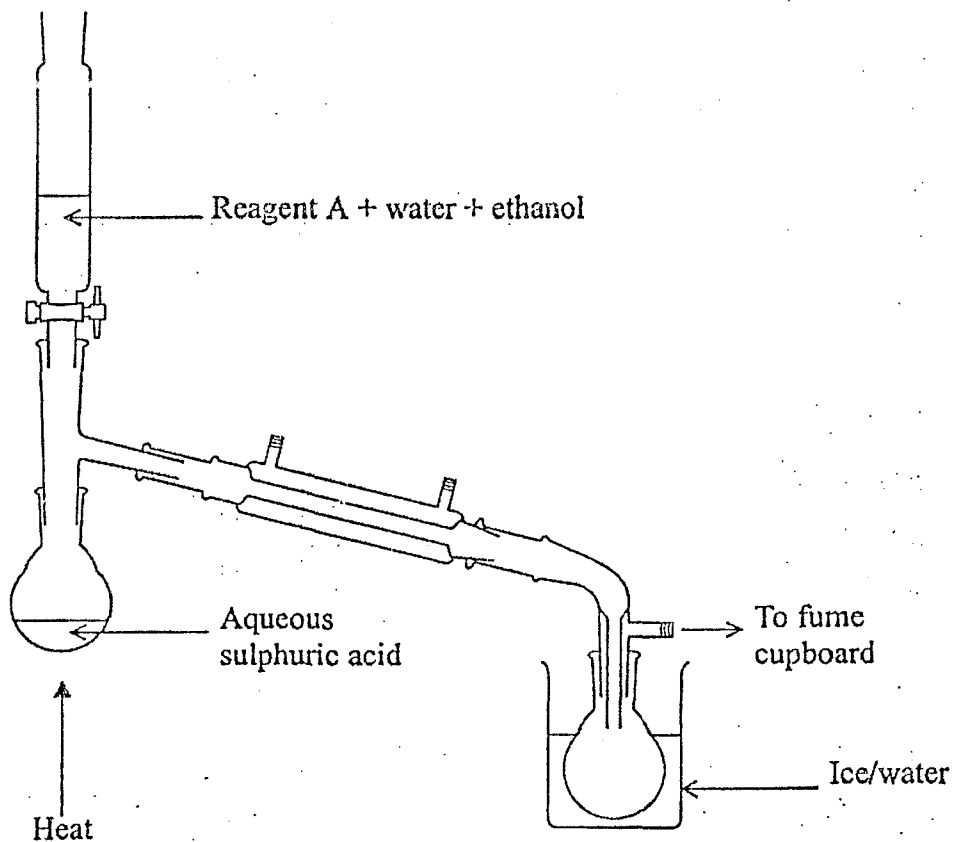
(a) Give the name or formula of reagent A.

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(1)

(b) The preparation is carried out by heating the flask until the aqueous sulphuric acid begins to boil, removing the heat source and then adding the mixture from the separating funnel slowly. The solution in the flask continues to boil.

    (i) What conclusion can you make about the reaction in the flask based on the fact that the solution continues to boil after the heat source is removed?

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(1)

    (ii) Describe how the condenser converts hot vapour into liquid.

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(1)

    (iii) Suggest a reason for surrounding the collection flask with an ice/water mixture

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(1)

    (iv) Suggest a reason for the tube leading to the fume cupboard.

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(1)

(c) Calculate the mass of ethanal that would be formed from 5.0 g of ethanol, assuming a 40% yield.

[Molar mass of ethanol is 46 g mol^{-1}]

(2)

(Total 7 marks)

5. Halogenoalkanes can be hydrolysed on heating with aqueous silver nitrate.

The reaction forms a halide ion, X^-, which immediately reacts with aqueous silver nitrate to form a precipitate.

The rate of hydrolysis of halogenoalkanes can be compared by warming them with aqueous silver nitrate and ethanol in separate test tubes in a water bath as shown in the diagram below.

Halogenoalkane, ethanol and aqueous silver nitrate

Heated water bath
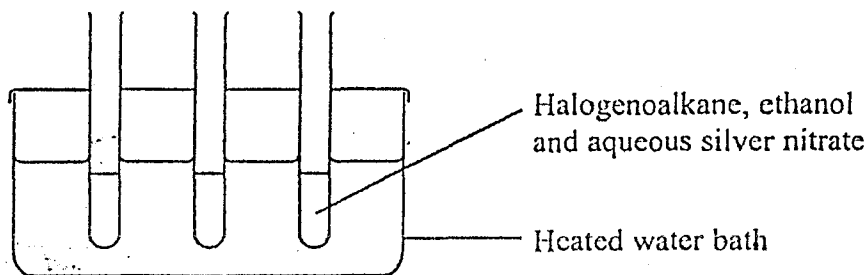
(a) (i) Suggest why ethanol is added to the test tubes.

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(1)

(ii) Write an ionic equation to show the reaction between silver nitrate and a halide ion. Include state symbols in your equation.

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(2)

(iii) Suggest ONE reason why a water bath is used rather than heating the test tubes directly over a Bunsen flame.

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(1)

(b) Describe how you would carry out the experiment in such a way that you can show that the relative rate of hydrolysis of three halogenoalkanes is

2-iodobutane > 2-bromobutane > 2-chlorobutane
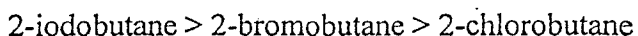
Include in your answer the observation you would make with each halogenoalkane and the relative times for hydrolysis to take place.

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(5)

(Total 9 marks)

TOTAL FOR PAPER: 50 MARKS

END