FOR OFFICIAL USE

Section B Total Marks

X012/201

NATIONAL QUALIFICATIONS 2002

TUESDAY, 4 JUNE 9.00 AM – 11.00 AM

CHEMISTRY INTERMEDIATE 2

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Date of birth
Day Month Year

Scottish candidate number

Number of seat

Necessary data will be found in the Chemistry Data Booklet for Standard Grade and Intermediate 2 (1999 Edition).

Section A —Part 1 Questions 1 to 25 and Part 2 Questions 26 and 27

Instructions for completion of **Part 1** and **Part 2** are given on pages two and seven respectively.

Section B (Questions 1 to 14)

All questions should be attempted.

The questions may be answered in any order but all answers are to be written in the spaces provided in this answer book, and must be written clearly and legibly in ink.

Rough work, if any should be necessary, as well as the fair copy, is to be written in this book.

Rough work should be scored through when the fair copy has been written.

Additional space for answers and rough work will be found at the end of the book. If further space is required, supplementary sheets may be obtained from the invigilator and should be inserted inside the **front** cover of this book.

Before leaving the examination room you must give this book to the invigilator. If you do not, you may lose all the marks for this paper.

SECTION A

PART 1

Read carefully

1. Check that the answer sheet provided is for Chemistry Intermediate 2 (Section A).
2. Fill in the details required on the answer sheet.
3. **In questions 1 to 25 of this part of the paper, an answer is given by indicating the choice A, B or D by a stroke made in INK in the appropriate place in Part 1 of the answer sheet—see sample question below.**
4. **For each question there is only ONE correct answer.**
5. Rough working, if required, should be done only on this question paper, or on the rough working sh provided—**not** on the answer sheet.
6. At the end of the examination the answer sheet for Section A **must** be placed **inside** the front cove this answer book.

This part of the paper is worth 25 marks.

SAMPLE QUESTION

To show that the ink in a ball-pen consists of a mixture of dyes, the method of separation would be

A fractional distillation

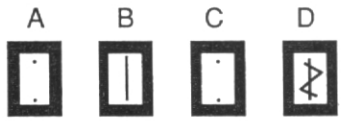
B chromatography

C fractional crystallisation

D filtration.

The correct answer is B—chromatography. A **heavy** vertical line should be drawn joining the two dot the appropriate box in the column headed **B** as shown **in the example on the answer sheet**.

If, after you have recorded your answer, you decide that you have made an error and wish to make a cha you should cancel the original answer and put a vertical stroke in the box you now consider to be corr Thus, if you want to change an answer **D** to an answer **B**, your answer sheet would look like this:



If you want to change back to an answer which has already been scored out, you should **enter a tick (✓** the RIGHT of the box of your choice, thus:

SECTION A

PART 1

1. Which of the following elements is the most recently discovered?

   (You may wish to use page 8 of the data booklet to help you.)

   A Aluminium

   B Hydrogen

   C Iodine

   D Magnesium

2. Which of the following gases does **not** exist as diatomic molecules?

   A Nitrogen

   B Oxygen

   C Fluorine

   D Neon

3. An atom has atomic number 17 and mass number 35.

   The number of neutrons in the atom is

   A 17

   B 18

   C 35

   D 52.

4. The formula for magnesium sulphite is

   A MgS

   B $MgSO_3$

   C $MgSO_4$

   D MgS_2O_3.

5. What is the charge on the chromium ion in $CrCl_3$?

   A 1+

   B 1–

   C 3+

   D 3–

6. Which of the following particles contains a different number of electrons from the others?

   (You may wish to use page 1 of the data booklet to help you.)

   A Cl^-

   B S^{2-}

   C Ar

   D Na^+

7. What is the relative formula mass of ammonium sulphate, $(NH_4)_2SO_4$?

   A 70

   B 118

   C 132

   D 228

8. During the electrolysis of copper(II) chloride solution, the reaction taking place at the positive electrode is

   A $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$

   B $Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$

   C $2Cl^-(aq) \rightarrow Cl_2(g) + 2e^-$

   D $Cl_2(g) + 2e^- \rightarrow 2Cl^-(aq)$.

9. The fractional distillation of crude oil depends on the fact that different hydrocarbons have different

   A densities

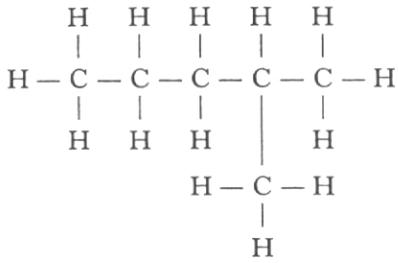
   B solubilities

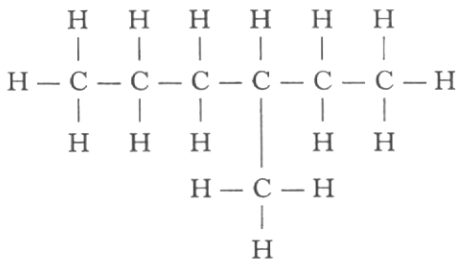
   C boiling points

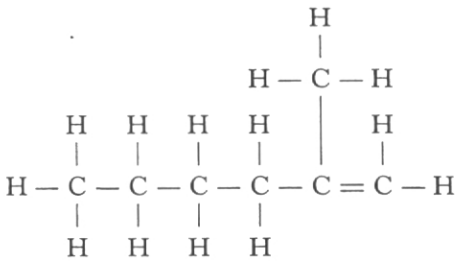
   D ignition temperatures.

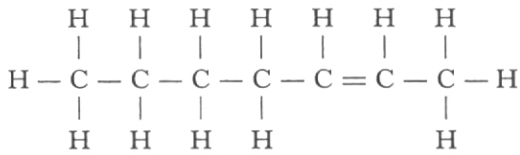
[Turn over

10. Which of the following molecules is an isomer of heptane?

A 

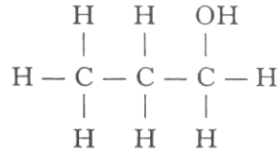
B 

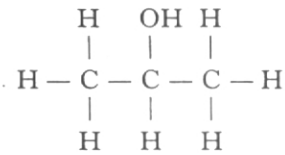
C 

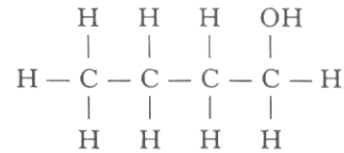
D 

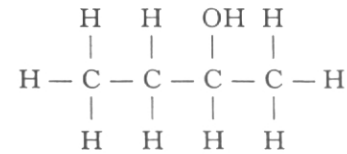
11. Which of the following alcohols has highest boiling point?

(You may wish to use page 6 of the c booklet to help you.)

A 

B 

C 

D 

12. Catalytic converters speed up the conver of harmful gases to less harmful gases. Wh of the following reactions is most likely occur in a catalytic converter?

A Carbon dioxide reacting to form car monoxide

B Carbon monoxide reacting to f carbon dioxide

C Nitrogen reacting to form nitro dioxide

D Oxygen reacting to form hydrogen ox

13. Which of the following are polymers?

A Plant sugars

B Animal fats

C Marine oils

D Vegetable proteins

14. What type of substance is formed when starch is hydrolysed?

A A sugar

B A carboxylic acid

C An amino acid

D An ester

15. What is the ratio of glycerol molecules to fatty acid molecules produced on the hydrolysis of a fat or oil?

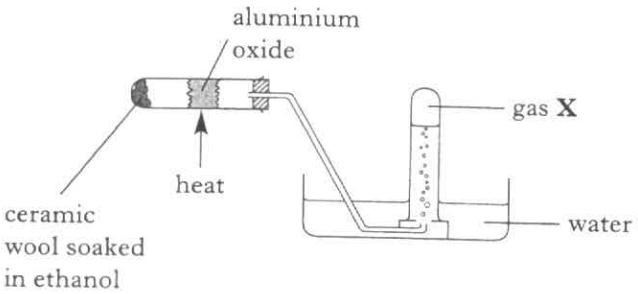
A 1 : 1

B 1 : 2

C 1 : 3

D 1 : 4

16. The apparatus below can be used to dehydrate ethanol.



Gas **X** will

A burn with a pop

B relight a glowing splint

C turn limewater cloudy

D rapidly decolourise bromine solution.

17. Which line in the table correctly describes what happens to a dilute solution of hydrochloric acid when water is added to it?

	pH	**$H^+(aq)$ concentration**
A	increases	increases
B	increases	decreases
C	decreases	increases
D	decreases	decreases

18. Which of the following acid solutions would have the lowest conductivity?

A 0·1 mol l^{-1} ethanoic acid

B 0·1 mol l^{-1} hydrochloric acid

C 0·1 mol l^{-1} nitric acid

D 0·1 mol l^{-1} sulphuric acid

19. The pH of the solution formed when ammonia is bubbled into water is most likely to be

A 3

B 5

C 7

D 9.

20. Which of the following statements describes the concentrations of $H^+(aq)$ and $OH^-(aq)$ ions in pure water?

A The concentrations of $H^+(aq)$ and $OH^-(aq)$ ions are equal.

B The concentrations of $H^+(aq)$ and $OH^-(aq)$ ions are zero.

C The concentration of $H^+(aq)$ ions is greater than the concentration of $OH^-(aq)$ ions.

D The concentration of $OH^-(aq)$ ions is greater than the concentration of $H^+(aq)$ ions.

21. Which of the following compounds is a base?

A Potassium carbonate

B Potassium chloride

C Potassium nitrate

D Potassium sulphate

22. Which of the following sodium chloride solutions would contain most dissolved solute?

A 100 cm^3 of 4 mol l^{-1} solution

B 200 cm^3 of 3 mol l^{-1} solution

C 300 cm^3 of 1 mol l^{-1} solution

D 400 cm^3 of 0·5 mol l^{-1} solution

[Turn over

23. Some metals can be obtained from their metal oxides by heat alone.

Which of the following oxides would produce a metal when heated?

A Calcium oxide

B Copper oxide

C Zinc oxide

D Silver oxide

24. Which of the following substances will **not** produce a gas when added to dilute hydrochloric acid?

A Copper

B Zinc

C Copper(II) carbonate

D Zinc carbonate

25. Which of the following solutions when ad to copper(II) chloride solution will produc precipitate?

(You may wish to use page 5 of the c booklet to help you.)

A Sodium hydroxide solution

B Calcium bromide solution

C Magnesium nitrate solution

D Lithium sulphate solution

SECTION A

PART 2

In Questions 26 and 27 of this part of the paper, an answer is given by circling the appropriate letter (or letters) in the answer grid provided.

In some questions, two letters are required for full marks.

If more than the correct number of answers is given, marks will be deducted.

In some cases, the number of correct responses may NOT be identified in the question.

A total of 5 marks is available in this part of the paper.

SAMPLE QUESTION

A CH_4	B H_2	C CO_2
D CO	E C_2H_5OH	F C

(*a*) Identify the hydrocarbon.

(A)	B	C
D	E	F

The one correct answer to part (*a*) is A. This should be circled.

(*b*) Identify the **two** elements.

A	(B)	C
D	E	(F)

As indicated in this question, there are **two** correct answers to part (*b*). These are B and F. Both answers are circled.

(*c*) Identify the substance(s) which can burn to produce **both** carbon dioxide and water.

(A)	B	C
D	(E)	F

There are **two** correct answers to part (*c*). These are A and E.

Both answers are circled.

If, after you have recorded your answer, you decide that you have made an error and wish to make a change, you should cancel the original answer and circle the answer you now consider to be correct. Thus, in part (*a*), if you want to change an answer A to an answer D, your answer sheet would look like this:

(A)	B	C
(D)	E	F

If you want to change back to an answer which has already been scored out, you should enter a tick (✓) in the box of the answer of your choice, thus:

✓ (A)	B	C
(D)	E	F

26. The grid shows six oxides.

A H_2O	B NO_2	C K_2O
D CaO	E CO	F SO_2

(*a*) Identify the oxide produced by the sparking of air in car engines.

(*b*) Identify the **two** oxides which dissolve in water to produce alkaline solutions.

(*c*) Identify **two** oxides produced by burning hydrocarbons.

27. Naturally occurring silver (atomic number 47, relative atomic mass 108) consists of a mixture of two isotopes with mass numbers 107 (^{107}Ag) and 109 (^{109}Ag).

Identify the true statement(s).

A	Isotopes of silver have the same number of neutrons.
B	Isotopes of silver have the same number of protons.
C	All silver atoms have a relative atomic mass of 108.
D	Atoms of ^{107}Ag are more abundant than those of ^{109}Ag.
E	All silver atoms have 47 electrons.

Candidates are reminded that the answer sheet for Section A MUST be placed INSIDE the front cover of this answer book.

[Turn over for SECTION B on *Page ten*]

Marks

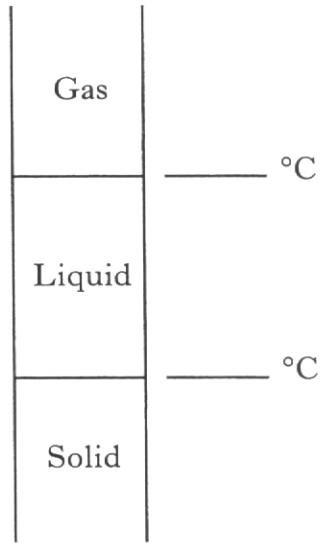
SECTION B

50 marks are available in this section of the paper.

1. (*a*) Write the formula for barium chloride.

_____ **1**

(*b*)



(i) Using information from the data booklet, mark on the diagram the melting point and boiling point of barium chloride. **1**

(ii) In what state is barium chloride at 900 °C?

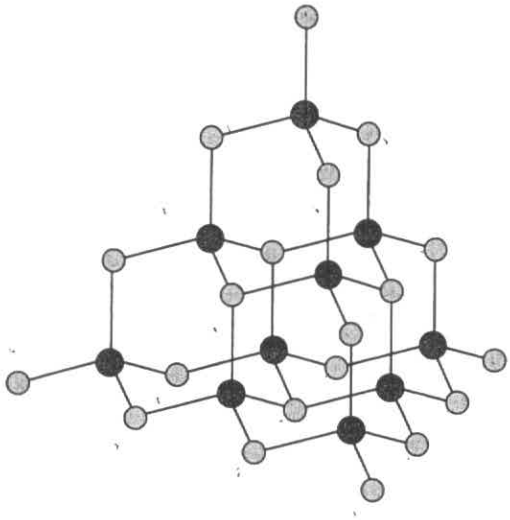
_____ **1**

(3)

Marks

2. Carborundum and silica are examples of covalent network compounds.

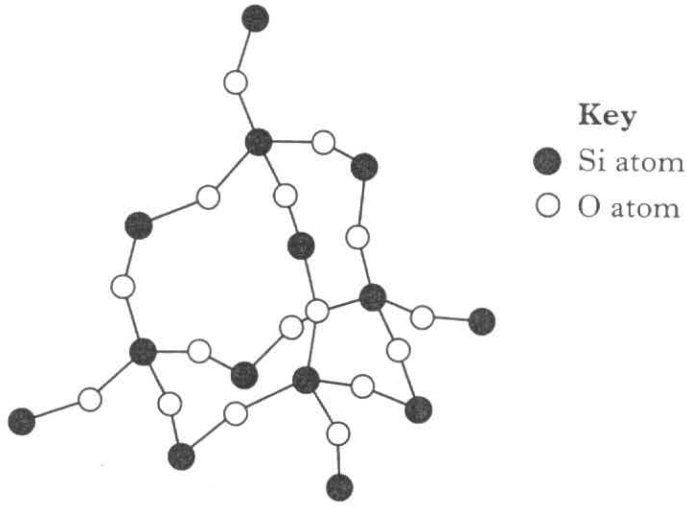
(*a*) In carborundum, the lattice contains **equal** numbers of silicon and carbon atoms.



Write the formula for carborundum.

_____ **1**

(*b*) Part of the silica lattice is shown below.



(i) Why does silica **not** conduct electricity?

_____

_____ **1**

(ii) Why does silica have a high melting point?

_____

_____ **1**

(3)

Marks

3. (*a*) When iron rusts, iron(II) ions are formed.
Write the ion-electron equation for the formation of iron(II) ions from iron atoms.

_____ **1**

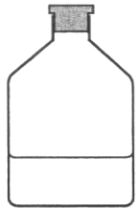
(*b*) Name the solution used to test for iron(II) ions.

_____ **1**

(*c*) The apparatus and chemicals shown below can be used to show that both oxygen and water are required for rusting.

oil

drying agent

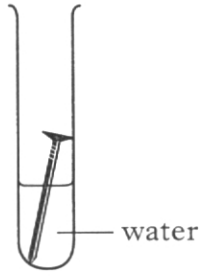


water boiled to remove oxygen

unboiled water

stoppers

The following test tubes were set up.

Experimental conditions		
water and oxygen present	only oxygen present	only water present
		
test tube **1**	test tube **2**	test tube **3**

Complete and label the diagram of test tube **3**. **1**

(3)

Marks

4. A new air bag is being developed for use in cars.
In the reaction, butane reacts with an oxide of nitrogen.

$$C_4H_{10} + N_2O \rightarrow CO_2 + H_2O + N_2$$

(*a*) Balance this equation. **1**

(*b*) Nitrogen is formed in the reaction. Draw a diagram to show how the outer electrons are shared in a molecule of nitrogen. **1**

(2)

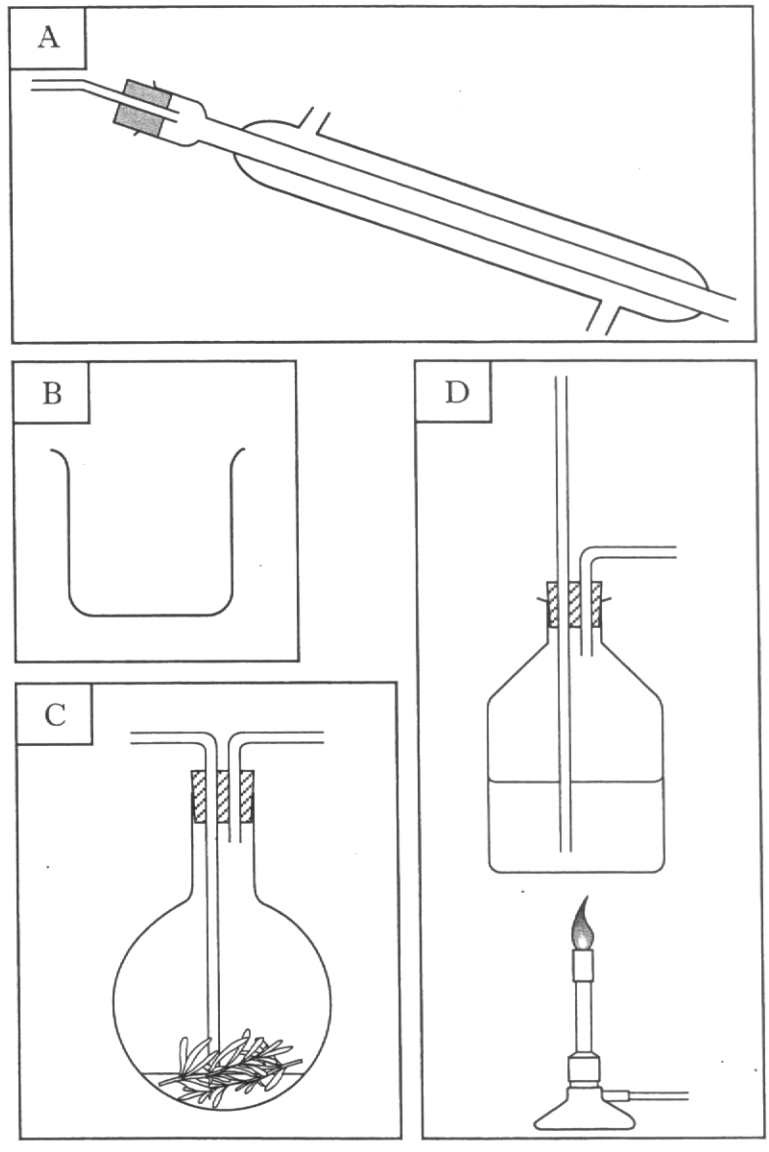
[Turn over

Marks

5. Lavender flowers contain an oil.

(*a*) Lavender oil is produced from the flowers by steam distillation. The flowers are put into a flask with a little water. Steam from a steam generator is blown through them to extract the oil. The mixture of lavender oil and steam distils over. It is condensed and collected.

The pieces of apparatus which are used to carry out this steam distillation are shown below.



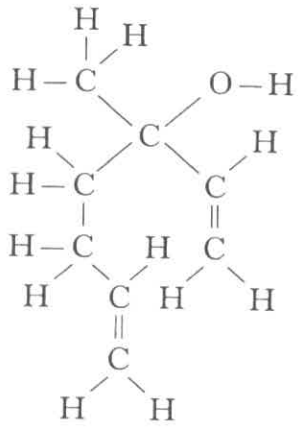
Put a letter in each box to show the order in which the pieces of apparatus should be arranged to obtain the mixture.

1

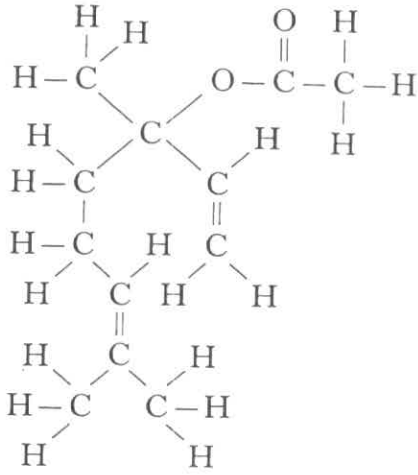
5. (continued)

Marks

(*b*) The structural formulae for two of the compounds in lavender oil are shown below.



linalool



linalyl ethanoate

(i) To show that lavender oil contains unsaturated compounds it can be tested by shaking a sample with bromine solution.

Bromine solution is corrosive. Apart from wearing safety goggles, give another safety precaution which should be taken when shaking the sample with bromine solution.

_____

_____ **1**

(ii) Linalool is an alcohol. Circle the alcohol group in the linalool molecule shown above. **1**

(iii) Linalyl ethanoate is made from an alcohol and ethanoic acid.

To which group of compounds does linalyl ethanoate belong?

_____ **1**

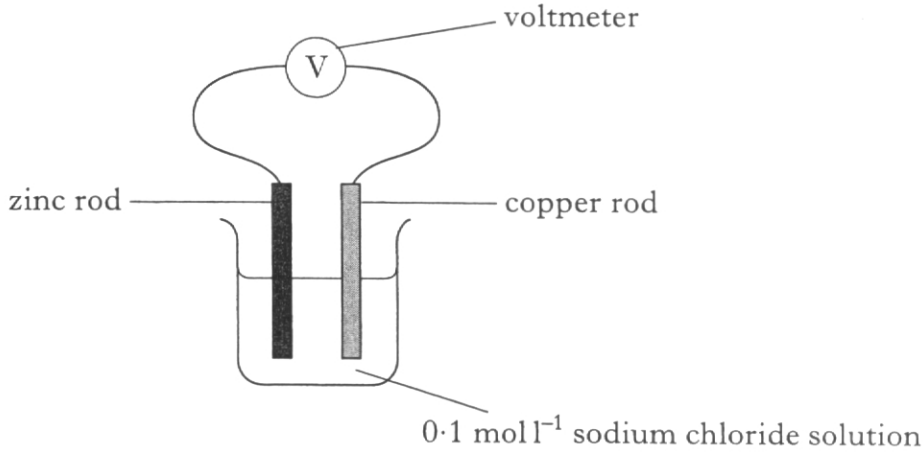
(iv) Draw the full structural formula for ethanoic acid.

1

(5)

Marks

6. In a **PPA**, students were asked to investigate how different metals affect the size of the voltage generated by a simple cell.



Results:

Metals used	Average voltage (V)
iron and copper	0·5
zinc and copper	
zinc and iron	0·2

(*a*) What should be done to the metal rods **before** connecting them in the cell?

_____

_____ **1**

(*b*) State **two** factors which the students would have kept the same during this experiment.

_____

_____

_____ **1**

(*c*) Complete the results table above by predicting the average voltage reading which could have been obtained using zinc and copper rods. **1**

(3)

Marks

7. Millions of tonnes of fossil fuels can be saved by burning household rubbish in furnaces to produce energy.

The emissions from these furnaces are carefully controlled to prevent harmful substances being released into the atmosphere.

(*a*) Nitrogen dioxide gas is produced in the furnaces.

What would form if this gas dissolved in water in the atmosphere?

_____

_____ 1

(*b*) Acidic hydrogen chloride is removed from the emissions using calcium hydroxide.

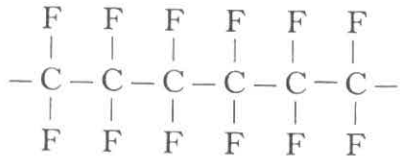
$$2HCl + Ca(OH)_2 \longrightarrow CaCl_2 + 2H_2O$$

Name this type of chemical reaction.

_____ 1

(*c*) To remove small ash and soot particles, the emissions are passed through cloth filters coated with the polymer, poly(tetrafluoroethene).

A section of the polymer is shown.



Draw the full structural formula for the monomer from which poly(tetrafluoroethene) is made.

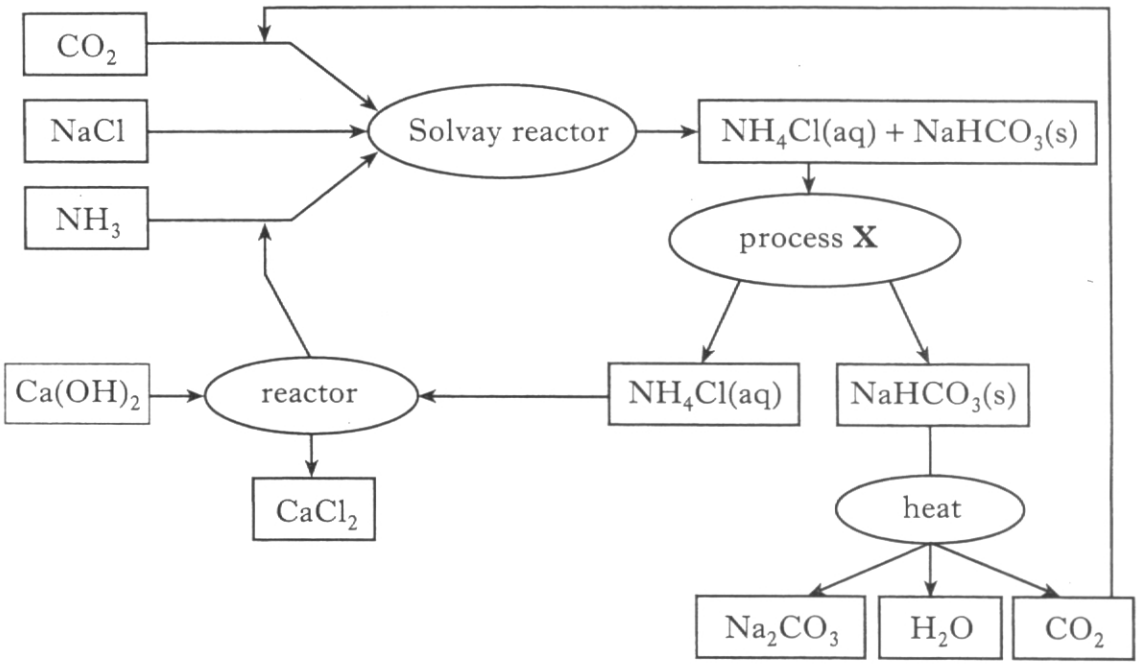
1

(3)

[Turn over

Marks

8. Sodium carbonate is an important industrial chemical which is made from sodium chloride by the Solvay Process.



(*a*) Name process **X**.

_____ **1**

(*b*) Identify a substance which is recycled.

_____ **1**

(*c*) The salt sodium carbonate Na_2CO_3 is the main product of the Solvay process.

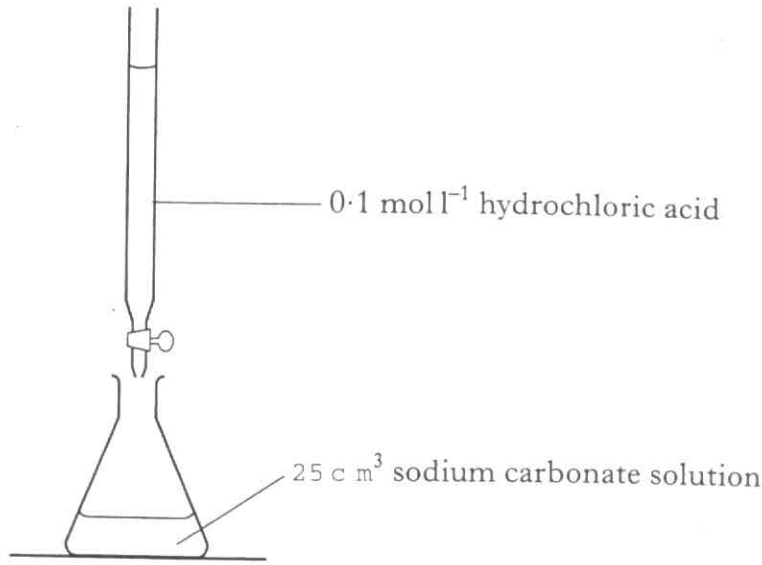
Name another **salt** produced.

_____ **1**

8. (continued) *Marks*

(*d*) The main use for sodium carbonate is glassmaking, for which a high purity is required. The purity of a sample of sodium carbonate can be checked by titration with acid.

$$Na_2CO_3(aq) + 2HCl(aq) \longrightarrow 2NaCl(aq) + CO_2(g) + H_2O(\ell)$$



22·4 cm^3 acid was required in the titration of this sodium carbonate solution.

Calculate the concentration, in mol l^{-1}, of the sodium carbonate solution.

_____ mol l^{-1} **2**

(5)

[Turn over

Marks

9. Sodium thiosulphate ($Na_2S_2O_3$) reacts with hydrochloric acid as shown.

$$(Na^+)_2S_2O_3^{2-}(aq) + 2H^+Cl^-(aq) \longrightarrow 2Na^+Cl^-(aq) + S(s) + SO_2(g) + H_2O(\ell)$$

(*a*) By omitting spectator ions, write the ionic equation for the reaction.

_____ **1**

(*b*) This reaction is used in a **PPA** to study the effect of temperature on reaction rate. The rate is determined from the time taken to produce a certain amount of sulphur.

(i) How would you decide when to stop timing?

_____

_____

_____ **1**

(ii) The experiment must be carried out in a well ventilated area. Give a reason for this.

_____

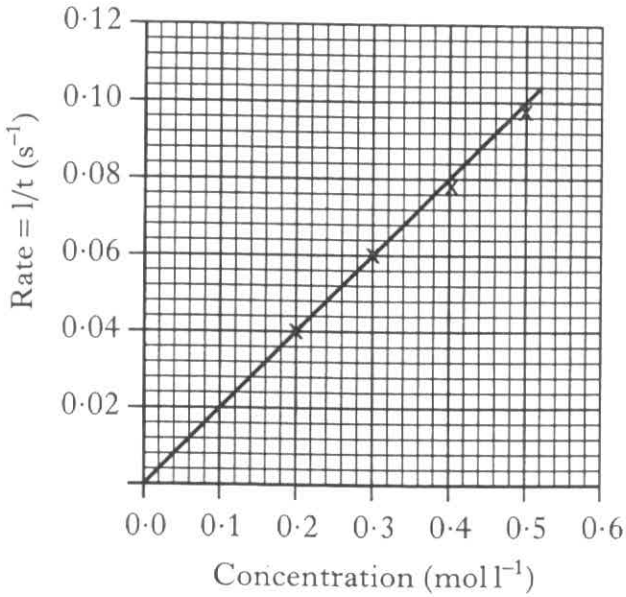
_____ **1**

Marks

9. (continued)

(*c*) A student investigated the effect of changing the **concentration** of the sodium thiosulphate solution on the reaction rate.

The results obtained are shown.



(i) Use the graph to find the time taken, in seconds, when the experiment was carried out using 0·1 mol l^{-1} sodium thiosulphate solution.

_____ s **1**

(ii) The graph shows that the reaction rate increases as concentration increases. Use the collision theory to explain why the reaction rate increases.

_____

_____

_____

_____ **1**

(5)

[Turn over

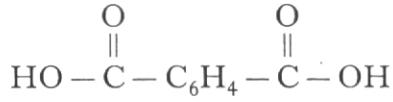
Marks

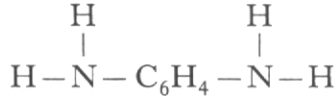
10. Kevlar is a recently developed polymer.

(*a*) State a useful property of Kevlar.

_____ **1**

(*b*) The monomers used to make Kevlar have the following structural formulae.





Why are these molecules able to take part in condensation polymerisation?

_____

_____ **1**

(*c*) Kevlar is an example of a polyamide.
Draw the structure of an amide link.

1

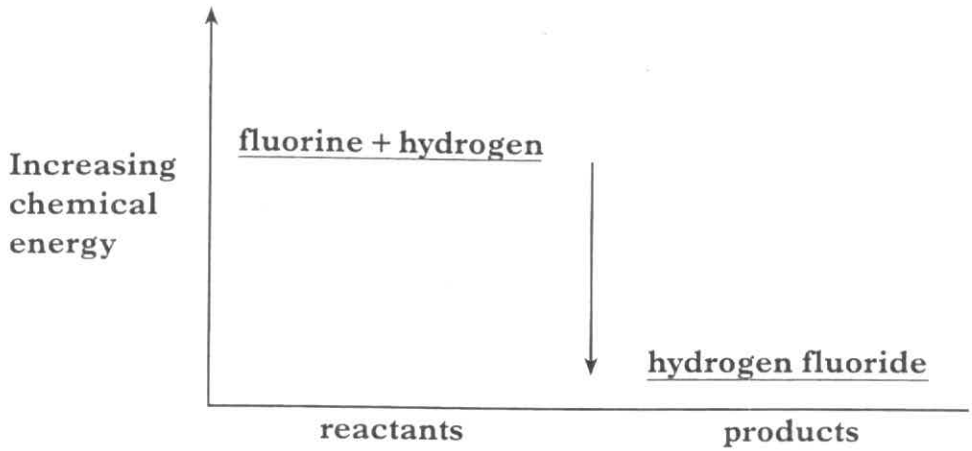
(3)

Marks

11. (*a*) What is the name given to the group 7 elements?

_____ **1**

(*b*) The diagram shows the chemical energies of the reactants and products when fluorine reacts with hydrogen.



(i) What does the diagram indicate about the chemical reaction?

_____

_____ **1**

(ii) Hydrogen fluoride forms a very weak acid when it is dissolved in water. What is meant by a **weak** acid?

_____

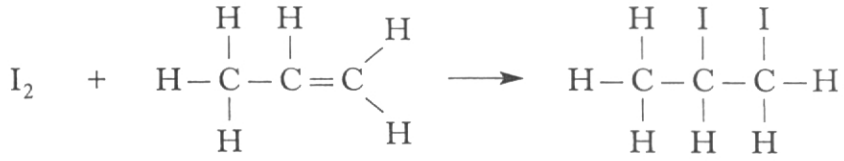
_____ **1**

(3)

[Turn over

Marks

12. Iodine can react with propene in the following way.



(*a*) (i) Name the homologous series to which propene belongs.

_____ **1**

(ii) Name the type of chemical reaction which takes place when iodine reacts with propene.

_____ **1**

(*b*) Calculate the mass of iodine, in grams, that will react with 100 g of propene.

Space for working

_____ g **2**

(*c*) The mass of iodine that reacts with 100 g of a substance is known as the iodine number.

Explain why oils are likely to have higher iodine numbers than fats.

_____

_____ **1**

(*d*) Liquid oils can be converted into hardened fats using a solid catalyst. The catalyst used is the transition metal, nickel. What type of catalyst is the nickel?

_____ **1**

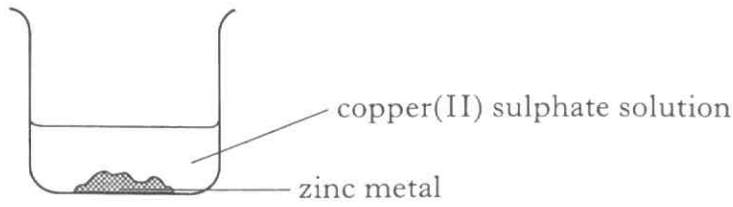
(6)

Marks

13. (*a*) What mass of copper(II) sulphate (gram formula mass = 159·5 g) is required to make 400 cm^3 of 0·50 mol l^{-1} copper(II) sulphate solution?

2

(*b*) When zinc is added to 0·50 mol l^{-1} copper(II) sulphate solution, the blue colour fades and brown copper metal forms.



(i) The ion-electron equations for the oxidation and reduction reactions are

$$Zn(s) \longrightarrow Zn^{2+}(aq) + 2e^-$$
$$Cu^{2+}(aq) + 2e^- \longrightarrow Cu(s)$$

Combine the two ion-electron equations to give the redox equation for the reaction.

1

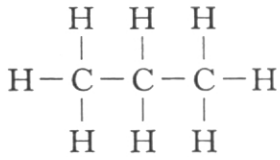
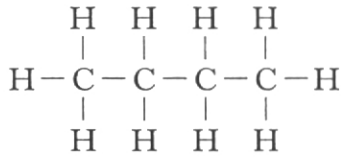
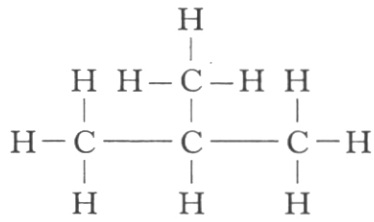
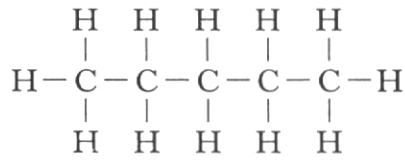
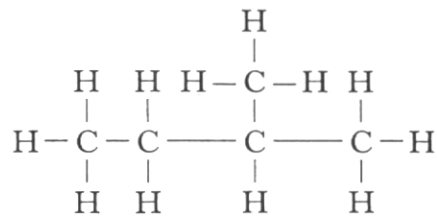
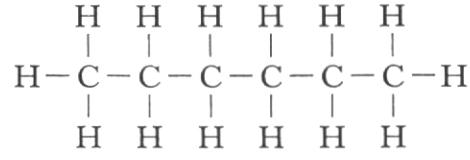
(ii) During the first 60 seconds of the reaction, the concentration of the copper ions drops from 0·50 mol l^{-1} to 0·41 mol l^{-1}.

What is the average rate of the reaction, in mol l^{-1} s^{-1}, during the first 60 seconds?

_____ mol l^{-1} s^{-1} **1**

(4)

14. Gases can be liquefied by increasing the pressure, but above a certain temperature it is not possible to do this. This temperature is known as the critical temperature. The critical temperatures of some alkanes are shown below.

Alkane	Critical temperature (°C)
	97
	152
	135
	197
	187
	234

Marks

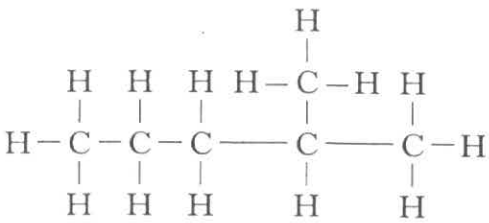
14. (continued)

(*a*) Describe the trend in critical temperatures for the straight-chain alkanes.

_____

_____ **1**

(*b*) Predict the critical temperature of the alkane



_____ °C **1**

(2)

[END OF QUESTION PAPER]