FOR OFFICIAL USE

Section B | Total Marks | |

X012/201

NATIONAL QUALIFICATIONS 2005

TUESDAY, 31 MAY
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 – Questions 1–30 (30 marks)

Instructions for completion of **Section A** are given on page two.

Section B (50 marks)

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, should be written in this book, and then scored through when the fair copy has been written. If further space is required, a supplementary sheet for rough work may be obtained from the invigilator.

Additional space for answers 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 booklet.

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.

SCOTTISH QUALIFICATIONS AUTHORITY

Read carefully

1 Check that the answer sheet provided is for **Chemistry Intermediate 2 (Section A)**.

2 Check that the answer sheet you have been given has **your name**, **date of birth**, **SCN** (Scottish Candidate Number) and **Centre Name** printed on it.

Do not change any of these details.

3 If any of this information is wrong, tell the Invigilator immediately.

4 If this information is correct, **print** your name and seat number in the boxes provided.

5 Use **black** or **blue ink** for your answers. **Do not use red ink**.

6 The answer to each question is **either** A, B, C or D. Decide what your answer is, then put a horizontal line in the space provided (see sample question below).

7 There is **only one correct** answer to each question.

8 Any rough working should be done on the question paper or the rough working sheet, **not** on your answer sheet.

9 At the end of the exam, put the **answer sheet for Section A inside the front cover of this answer book**.

Sample Question

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

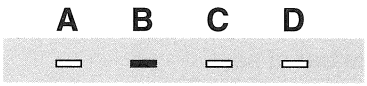
A fractional distillation

B chromatography

C fractional crystallisation

D filtration.

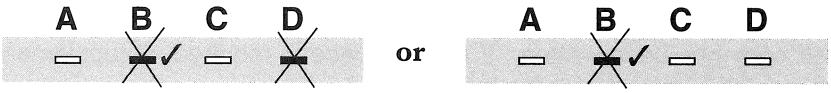
The correct answer is **B**—chromatography. The answer **B** has been clearly marked with a horizontal line (see below).



Changing an answer

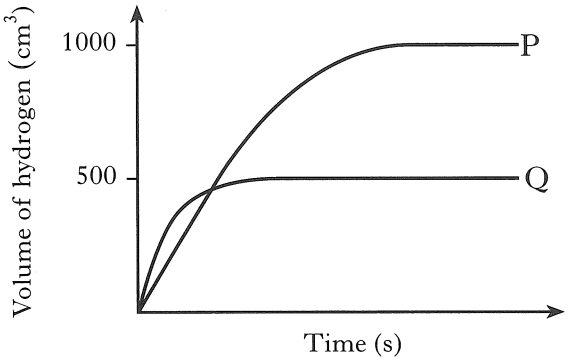
If you decide to change your answer, cancel your first answer by putting a cross through it (see below) and fill in the answer you want. The answer below has been changed to **B**.

If you then decide to change back to an answer you have already scored out, put a tick (✓) to the **right** of the answer you want, as shown below:



SECTION A

1. Graph P shows the volume of hydrogen gas collected when 1·0 g of magnesium ribbon reacts with excess 2 mol l^{-1} hydrochloric acid.



Which of the following samples of magnesium, when reacted with excess 2 mol l^{-1} hydrochloric acid would produce graph Q.

A 0·5 g of magnesium ribbon

B 0·5 g of magnesium powder

C 1·0 g of magnesium powder

D 2·0 g of magnesium ribbon

2. Which of the following compounds contains only two elements?

A Magnesium hydroxide

B Magnesium phosphate

C Magnesium sulphite

D Magnesium nitride

3. Which of the following gases is unchanged when it passes through the catalytic converter in a car?

A Carbon dioxide

B Carbon monoxide

C Nitrogen dioxide

D Nitrogen monoxide

4. 2, 8, 8 is the electron arrangement for an atom of an element belonging to the

A halogens

B noble gases

C alkali metals

D transition metals.

5. Different atoms of the same element have identical

A nuclei

B mass numbers

C numbers of neutrons

D numbers of protons.

6. Which of the following compounds exists as diatomic molecules?

A Carbon monoxide

B Carbon tetrachloride

C Nitrogen trihydride

D Sulphur dioxide

7. A substance, **X**, has a melting point of 996 °C and a boiling point of 1704 °C. It only conducts electricity when molten or when dissolved in water.

The structure of **X** is likely to be

A ionic

B metallic

C covalent network

D covalent molecular.

[Turn over

8. In a reaction, calcium silicate is decomposed to calcium oxide and silicon dioxide.

$$CaSiO_3(s) \rightarrow CaO(s) + SiO_2(s)$$

Which of the following statements about the reaction is correct?

A The number of moles of products is less than the number of moles of reactant.

B The number of moles of products equals the number of moles of reactant.

C The mass of the products is greater than the mass of the reactant.

D The mass of the products equals the mass of the reactant.

9. What name is given to the reaction shown by the following equation?

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$$

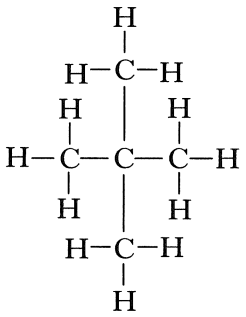
A Combustion

B Condensation

C Dehydration

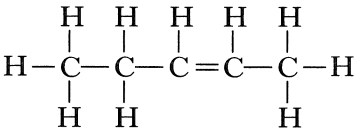
D Hydrolysis

10.



Which of the following compounds is an isomer of the one shown above?

A



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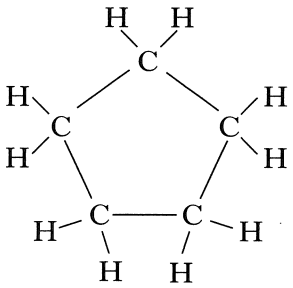
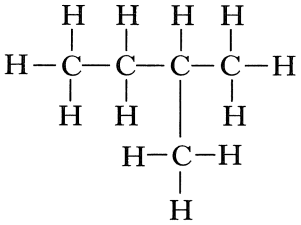


C



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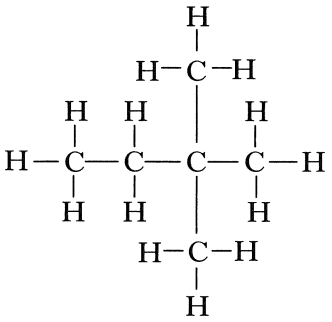
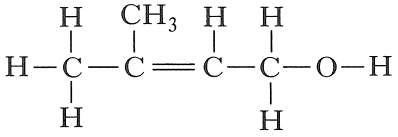


11.



The above molecule is an example of

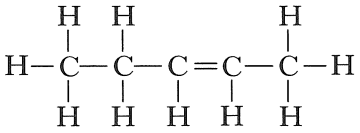
A a saturated alcohol

B an unsaturated alcohol

C a saturated carboxylic acid

D an unsaturated carboxylic acid.

12.



The name of the above compound is

A but-2-ene

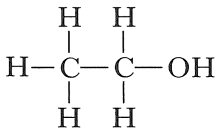
B pent-2-ene

C but-3-ene

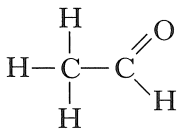
D pent-3-ene.

13. Which of the following structural formulae is that of an ester?

A



B



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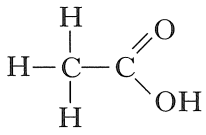

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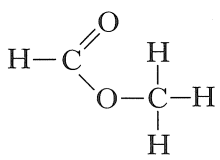
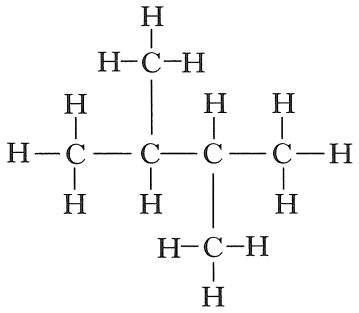


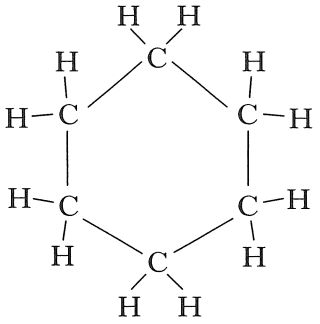
14. A hydrocarbon **Y** has molecular formula C_6H_{12} and does not react with bromine solution.

A possible full structural formula for hydrocarbon **Y** is

A



B



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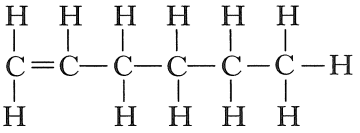

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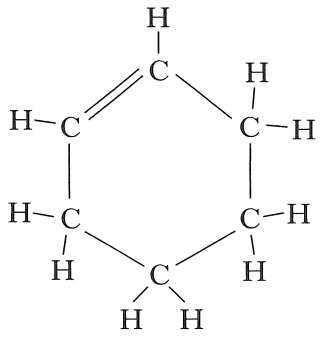


[Turn over

15. Which of the following is a renewable source of energy?

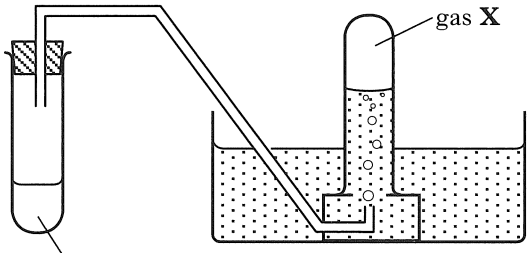
A Coal

B Petrol

C Ethanol

D Natural gas

16.



Gas **X** will

A burn with a pop

B turn limewater cloudy

C relight a glowing splint

D rapidly decolourise bromine solution.

17. Which of the following is the molecular formula for a carbohydrate?

A $C_6H_{14}O$

B $C_6H_{12}O_2$

C $C_6H_{10}O_4$

D $C_6H_{12}O_6$

18. What type of substance is formed when a protein is hydrolysed?

A A sugar

B An alkanol

C An amino acid

D An ester

19. What happens to a dilute solution of hydrochloric acid when water is added to it?

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

20. Which of the following solutions has the highest pH?

A 0·1 $mol\,l^{-1}$ ammonia solution

B 0·1 $mol\,l^{-1}$ sodium hydroxide

C 0·1 $mol\,l^{-1}$ ethanoic acid

D 0·1 $mol\,l^{-1}$ hydrochloric acid

21. 100 cm^3 of a solution contains 0·2 moles of solute.

The concentration of the solution, in $mol\,l^{-1}$, is

A 0·002

B 0·5

C 2

D 5.

22. $2KOH(aq) + H_2SO_4(aq) \rightarrow K_2SO_4(aq) + 2H_2O(\ell)$

How many moles of potassium hydroxide are needed to neutralise 20 cm^3 of sulphuric acid, concentration 1 $mol\,l^{-1}$?

A 0·01

B 0·02

C 0·03

D 0·04

Questions 23 and 24 refer to the following equation

$$Ba^{2+}(aq) + 2NO_3^-(aq) + 2Na^+(aq) + SO_4^{2-}(aq)$$
$$\downarrow$$
$$Ba^{2+}SO_4^{2-}(s) + 2Na^+(aq) + 2NO_3^-(aq)$$

23. The type of reaction represented by the equation above is

A addition

B displacement

C neutralisation

D precipitation.

24. The spectator ions present in the reaction above are

A $Na^+(aq)$ and $NO_3^-(aq)$

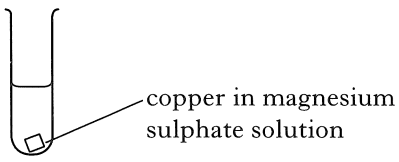
B $Na^+(aq)$ and $SO_4^{2-}(aq)$

C $Ba^{2+}(aq)$ and $NO_3^-(aq)$

D $Ba^{2+}(aq)$ and $SO_4^{2-}(aq)$.

25. In which of the following test tubes will a reaction occur?

A



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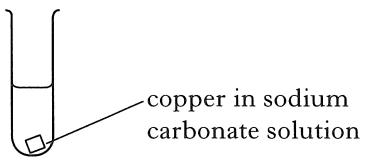
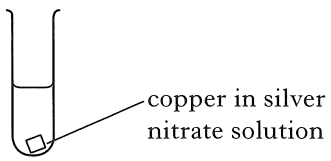


C



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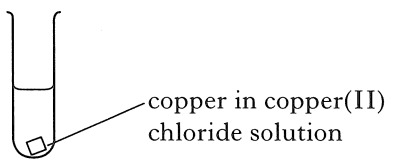
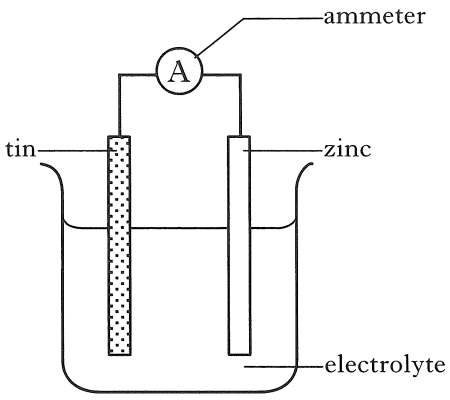


26. A cell produces a flow of electrons.



In the above cell, electrons flow from

A zinc to tin through the ammeter

B tin to zinc through the ammeter

C zinc to tin through the electrolyte

D tin to zinc through the electrolyte.

27. An acidic solution contains

A only hydrogen ions

B equal numbers of hydrogen and hydroxide ions

C more hydrogen ions than hydroxide ions

D more hydroxide ions than hydrogen ions.

28. Which of the following equations shows iron(II) ions being oxidised?

A $Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$

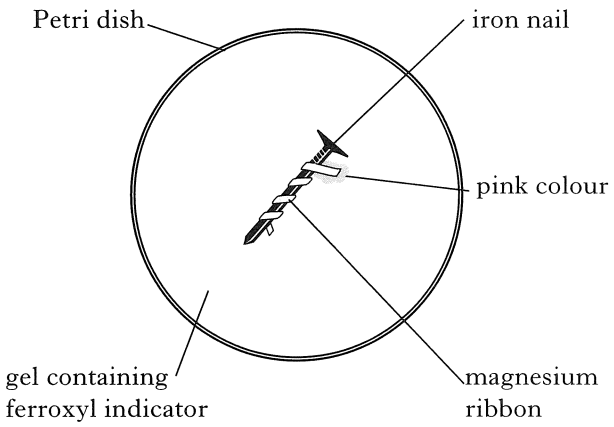
B $Fe^{2+}(aq) \rightarrow Fe^{3+}(aq) + e^-$

C $Fe(s) \rightarrow Fe^{2+}(aq) + 2e^-$

D $Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$

[Turn over

29.



Which ion gives a pink colour with ferroxyl indicator?

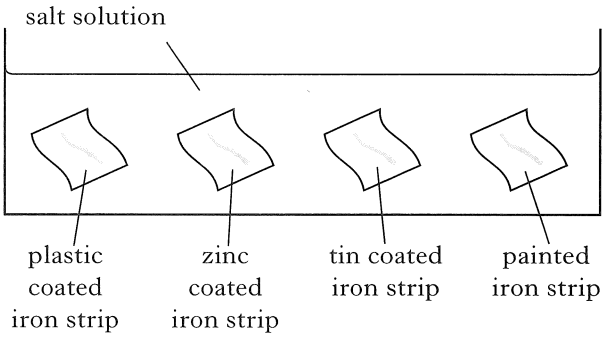
A $OH^-(aq)$

B $Fe^{2+}(aq)$

C $Fe^{3+}(aq)$

D $Mg^{2+}(aq)$

30. The coatings on four strips of iron were scratched to expose the iron. The strips were placed in salt solution.



The iron strip which would have rusted most quickly was the one which was

A plastic coated

B zinc coated

C tin coated

D painted.

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*) The alkali metals, the halogens and the noble gases are the names of groups of elements in the Periodic Table.

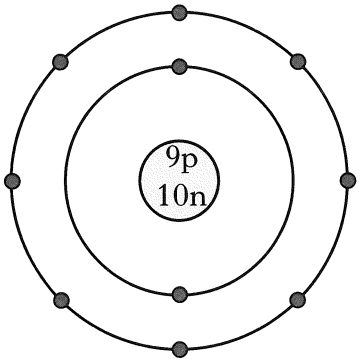
Complete the table by circling a word in each box to give correct information about each group.

(Two pieces of correct information have already been circled.)

Group		
alkali metals	(metals) / non-metals	reactive / non-reactive
halogens	metals / non-metals	reactive / non-reactive
noble gases	metals / non-metals	reactive / (non-reactive)

2

(*b*) Complete the table for the particle shown below.



Key:

p = proton
n = neutron
● = electron

Atomic number	Symbol for the element	Mass number	Overall charge of the particle

2

(4)

Marks

2. (*a*) Sodium carbonate reacts with dilute hydrochloric acid.

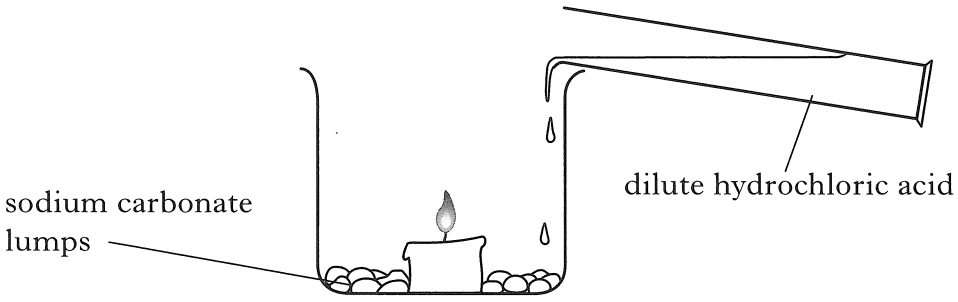
(i) Write the formula for sodium carbonate.

_____ **1**

(ii) Name the salt formed when sodium carbonate reacts with hydrochloric acid.

_____ **1**

(*b*) A teacher used this reaction in an experiment to show that carbon dioxide puts out a flame.



Why would the candle burn for longer if an equal volume and concentration of ethanoic acid was used instead of the dilute hydrochloric acid?

_____

_____ **1**

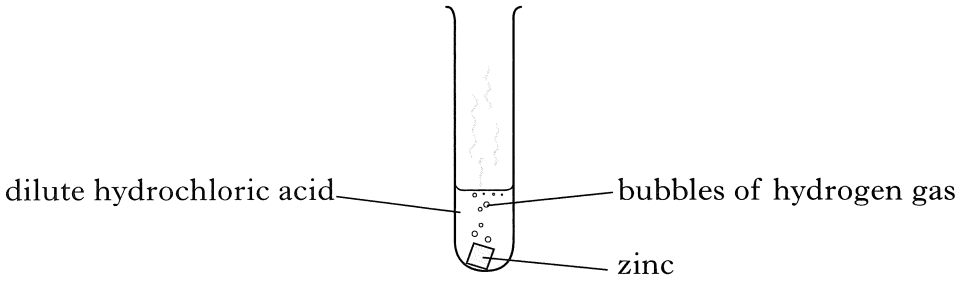
(3)

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

3. (*a*) Zinc reacts with dilute hydrochloric acid producing hydrogen gas.



(i) State the test for hydrogen gas.

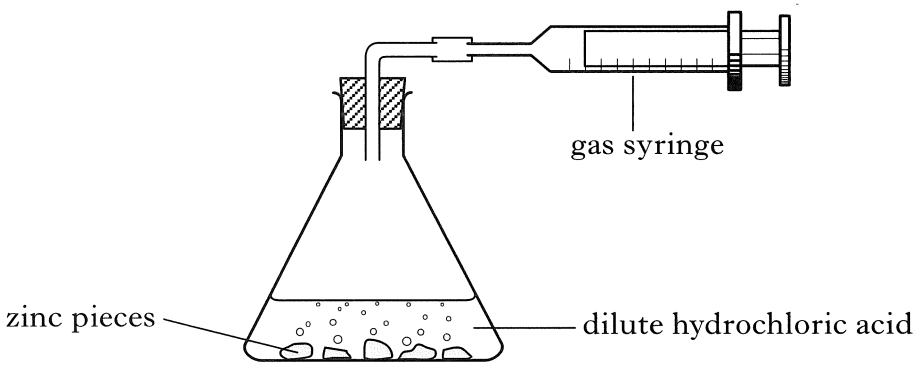
_____

_____ **1**

(ii) During the experiment, the test tube becomes warm. What term is used to describe a reaction which gives out heat?

_____ **1**

(*b*) The rate of reaction between zinc and dilute hydrochloric acid can be followed by measuring the volume of gas given off during the reaction.



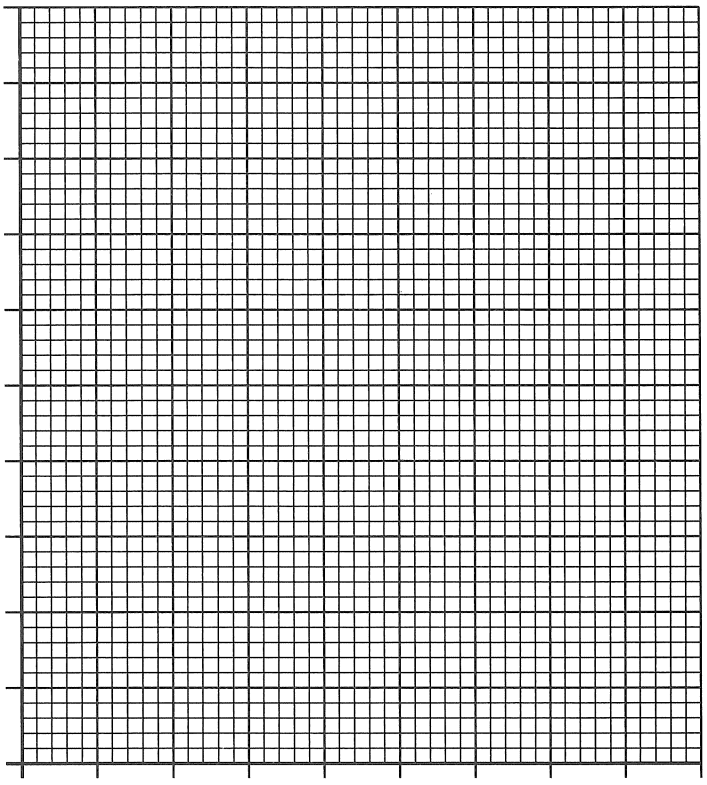
Results	
Time (seconds)	**Volume of gas (cm^3)**
0	0
10	20
20	40
30	58
40	72
50	80
60	

Marks

3. (*b*) (continued)

(i) Plot a line graph of the results of the reaction.

(Additional graph paper, if required, can be found on page 26.)



2

(ii) Predict the volume of gas which would have been given off after 60 seconds.

_____ cm^3 **1**

(*c*) Calculate the average rate at which gas is given off during the first 40 seconds of the reaction.

_____ $cm^3 s^{-1}$ **1**

(*d*) Why would increasing the concentration of the acid increase the rate of the reaction?

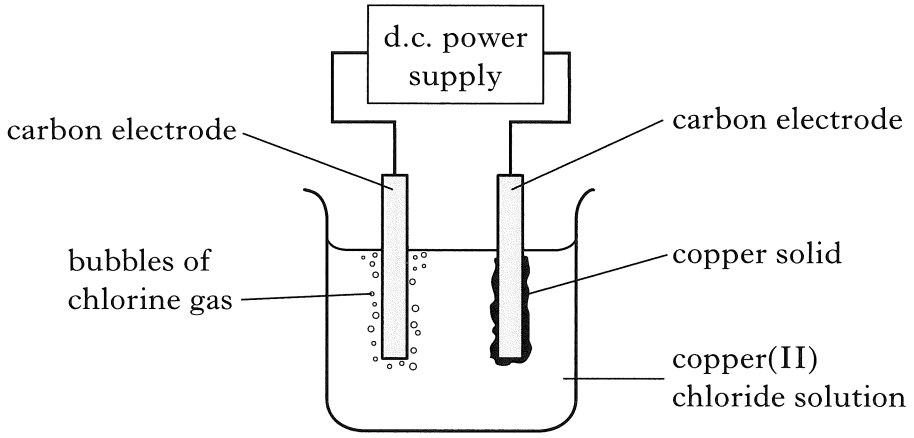
_____

_____ **1**

(7)

Marks

4. In the **PPA "Electrolysis"**, copper(II) chloride is separated into its elements.



(*a*) Label the diagram to show the charge on each electrode. **1**

(*b*) Describe how to smell chlorine gas safely.

_____

_____ **1**

(*c*) During the electrolysis reaction, copper ions are changed to copper atoms.

(i) Why is this reaction described as reduction?

_____ **1**

(ii) At the end of this experiment 1·27 g of copper was deposited. Calculate the number of moles of copper deposited.

_____ moles **1**

(4)

DO NOT WRITE IN THIS MARGIN

Marks

5. Plants release ethene gas. A build up of ethene in florists shops will cause flowers to wither quickly. Florists can use a solid titanium dioxide catalyst to break down ethene gas to make flowers last longer.

In the reaction, ethene reacts with the oxygen of the air to produce carbon dioxide and water.

(*a*) Balance the equation for this reaction.

$$C_2H_4(g) + O_2(g) \rightarrow CO_2(g) + H_2O(\ell)$$ **1**

(*b*) What type of catalyst is titanium dioxide in this reaction?

_____ **1**

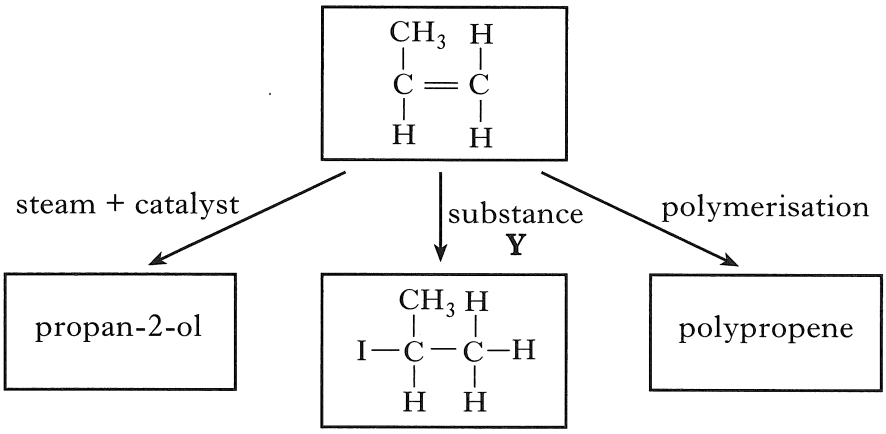
(2)

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

6. Propene can take part in addition reactions.



(*a*) (i) Draw the structural formula for propan-2-ol. **1**

(ii) Give another name for the addition reaction that produces propan-2-ol.

_____ **1**

(*b*) Identify substance **Y**.

_____ **1**

(*c*) Draw a section of the polymer formed from propene showing three monomer units linked together.

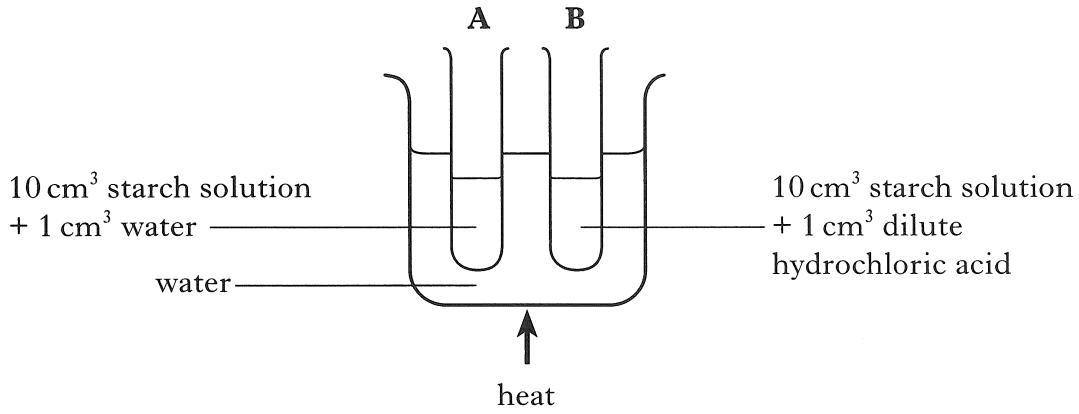
1

(4)

DO NOT WRITE IN THIS MARGIN

Marks

7. In the **PPA "Hydrolysis of starch"**, dilute hydrochloric acid can be used to break down the starch.



(*a*) After heating with dilute hydrochloric acid, solid sodium hydrogencarbonate is added to each reaction mixture.

Why is sodium hydrogencarbonate added at this stage?

_____

_____ **1**

(*b*) Complete the table to show the results which should be obtained when the reaction mixtures are tested with Benedict's solution.

Reaction mixture	Observation on heating with Benedict's solution
A	
B	

1

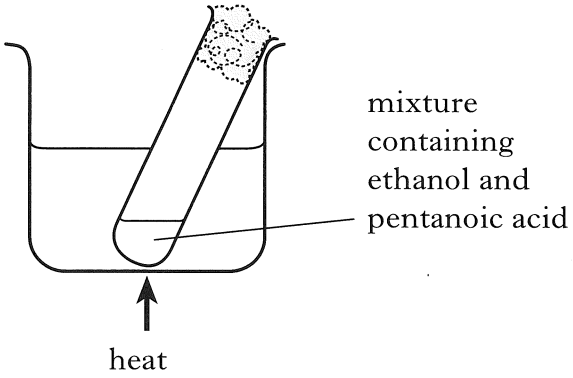
(2)

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

8. The diagram shows how an ester with a "pear drops" smell can be made.



ethanol + pentanoic acid $\rightarrow$ ester + water

(*a*) (i) Name the ester formed.

_____ **1**

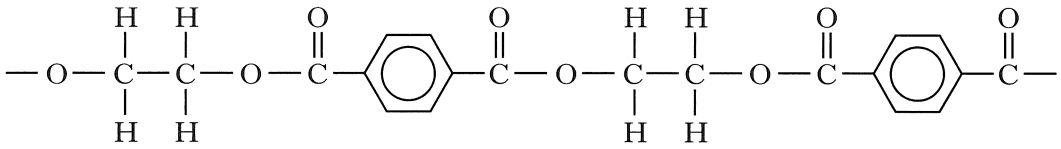
(ii) Why can this reaction be described as a condensation reaction?

_____

_____ **1**

(*b*) Polyesters are synthetic fibres.

Part of the structure of a polyester fibre is shown below.



(i) Why are polyester fibres described as synthetic?

_____ **1**

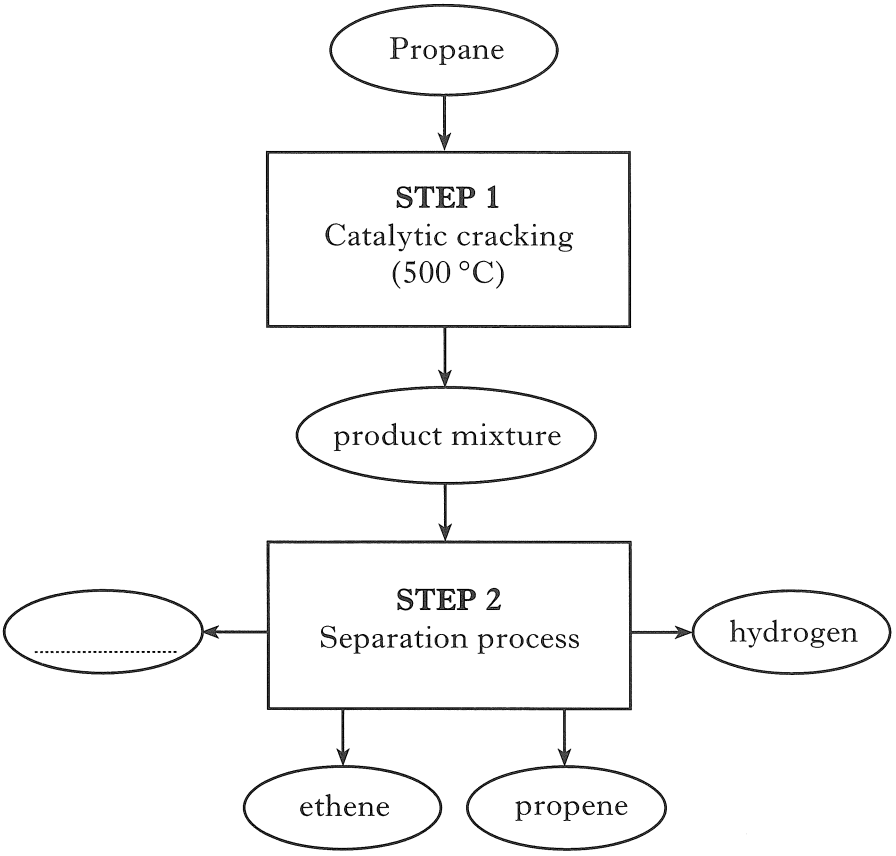
(ii) Circle an ester link in the polyester structure. **1**

(4)

DO NOT WRITE IN THIS MARGIN

Marks

9. Propane can be cracked to produce a mixture of smaller molecules.



(*a*) Catalysts can be used to speed up a chemical reaction.

Give another advantage of using a catalyst.

_____

_____ **1**

(*b*) Name the process used at step 2 to separate the product mixture.

_____ **1**

(*c*) Complete the flowchart by naming the other product separated from the mixture. **1**

(3)

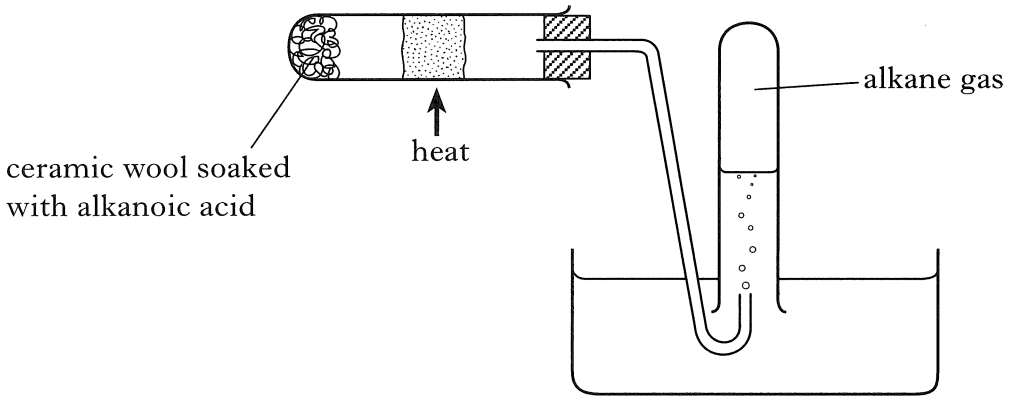
[Turn over

Marks

10. (*a*) Draw the full structural formula for propanoic acid.

1

(*b*) The diagram below shows how an alkane can be prepared from an alkanoic acid.



The equation for the reaction is:

alkanoic acid $\rightarrow$ alkane + carbon dioxide

Complete the table to show which alkanoic acid could be used to produce butane.

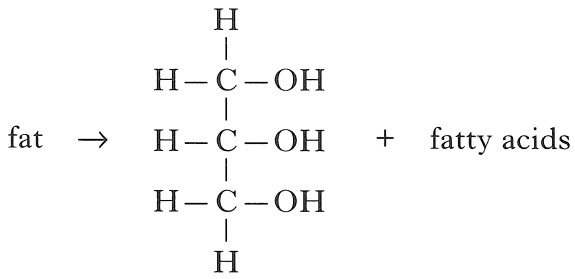
Alkanoic acid	**Alkane**
ethanoic acid	methane
propanoic acid	ethane
	butane

1

(2)

Marks

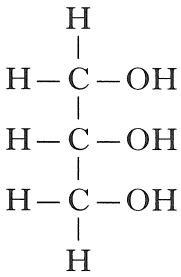
11. Fats are broken down in the body by hydrolysis.



(*a*) When one mole of fat is hydrolysed, how many moles of fatty acids are produced?

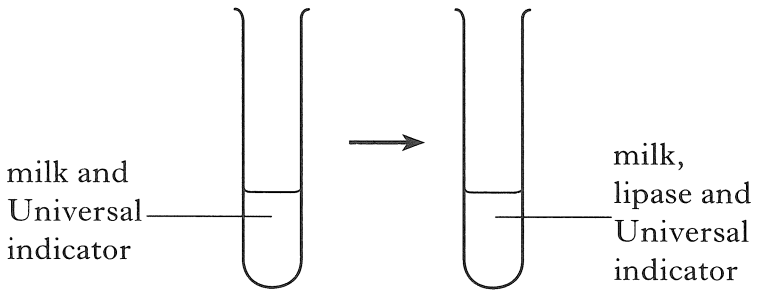
_____ moles **1**

(*b*) Name the molecule with the structure shown.



_____ **1**

(*c*) Lipase is an enzyme which can catalyse the hydrolysis of fats in milk. Complete the diagram to show how the indicator colour would change after lipase was added to the test-tube.



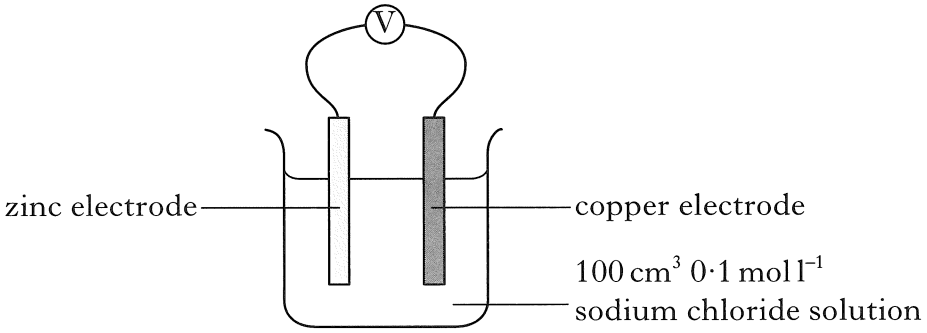
Colour: **green** Colour: _____ **1**

(3)

[Turn over

Marks

12. In the **PPA "Voltage"**, a student investigated the effect of changing the electrolyte.



(*a*) Draw and label the cell which would be used to measure the voltage produced when dilute hydrochloric acid is used as an electrolyte. **1**

(*b*) For each cell two voltage readings were taken.

What should have been done before taking the second reading?

_____

_____ **1**

(*c*) The voltage of a cell is also affected by the metals used as electrodes. A student recorded the voltage and direction of flow for different cells.

Use the information in the table to predict the **direction of electron flow** and **voltage** you would expect when nickel and zinc electrodes are used.

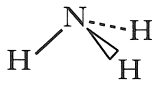
Electrodes	Direction of electron flow	Voltage (V)
Cu/Zn	Zn → Cu	1·0
Cu/Ni	Ni → Cu	0·5
Fe/Ni	Fe → Ni	0·2
Fe/Zn	Zn → Fe	0·3
Ni/Zn		

2

(4)

Marks

13. The diagram represents the structure of a molecule of ammonia.



(*a*) Why are the bonds between the nitrogen and the hydrogen in an ammonia molecule described as polar covalent?

_____

_____ **1**

(*b*) The equation shows what happens when ammonia gas dissolves in water.

$$NH_3(g) + H_2O(\ell) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$$

(i) Why is the solution formed alkaline?

_____

_____ **1**

(ii) What does the sign, $\rightleftharpoons$, indicate about the reaction?

_____

_____ **1**

(*c*) Ammonia gas can be produced in the lab by heating ammonium chloride with sodium hydroxide.

Calculate the mass of ammonia produced by heating 10 g of ammonium chloride.

$$NH_4Cl + NaOH \rightarrow NaCl + H_2O + NH_3$$

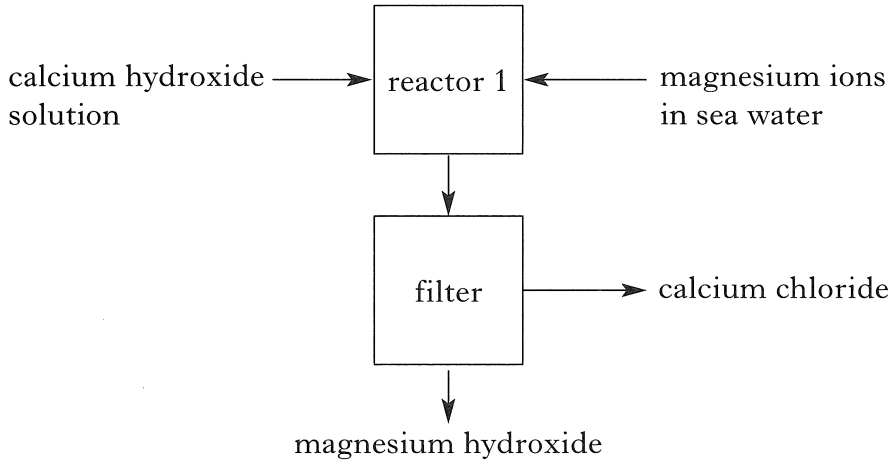
_____ g **2**

(5)

Marks

14. The main source of magnesium in Britain is sea water.

(*a*) The first stage in the production of magnesium is to remove the magnesium ions from the sea water by reaction with calcium hydroxide solution.



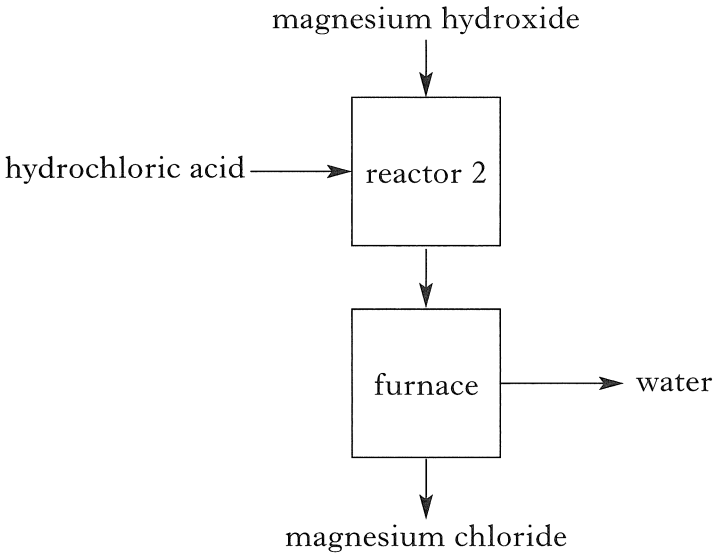
Why can magnesium hydroxide and calcium chloride be separated by filtration?

(You may wish to use page 5 of the data book to help you.)

_____

_____ 1

(*b*) In the next stage magnesium hydroxide is reacted with hydrochloric acid.



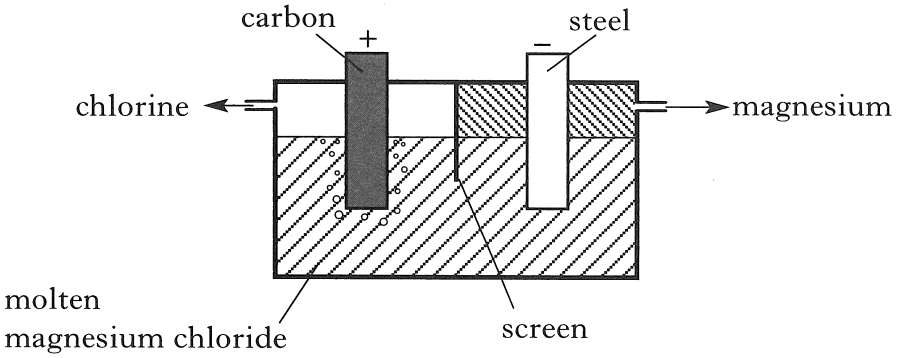
Name the type of chemical reaction occuring in reactor 2.

_____ 1

Marks

14. (continued)

(*c*) The last stage is the electrolysis of molten magnesium chloride.



Write the ion-electron equation for the production of magnesium.

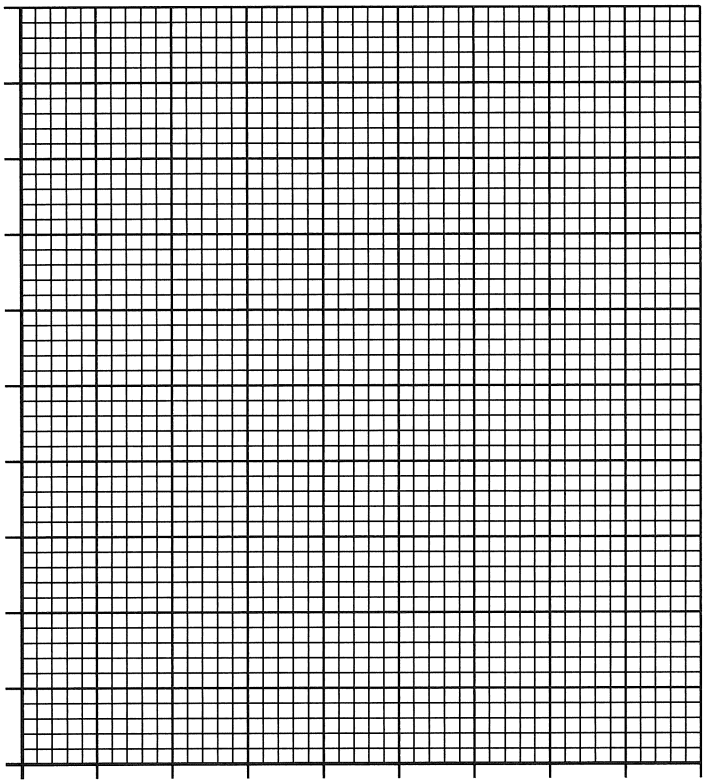
_____ **1**

(3)

[*END OF QUESTION PAPER*]

ADDITIONAL SPACE FOR ANSWERS

ADDITIONAL GRAPH PAPER FOR QUESTION 3(*b*)(i)



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