Section B   Total Marks

X012/201

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, 27 and 28

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

Section B (Questions 1 to 16)

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.

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

Fill in the details required on the answer sheet.

In questions 1 to 25 of this part of the paper, an answer is given by indicating the choice A, B, C or D by a stroke made in INK in the appropriate place in Part 1 of the answer sheet—see the sample question below.

For each question there is only ONE correct answer.

Rough working, if required, should be done only on this question paper, or on the rough working sheet provided—**not** on the answer sheet.

At the end of the examination the answer sheet for Section A **must** be placed **inside** 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 dots in 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 change, you should cancel the original answer and put a vertical stroke in the box you now consider to be correct. Thus, if you want to change an answer **D** to an answer **B**, your answer sheet would look like this:
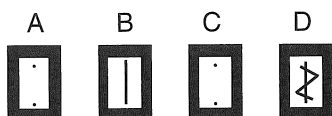
If you want to change back to an answer which has already been scored out, you should **enter a tick (✓)** to the RIGHT of the box of your choice, thus:
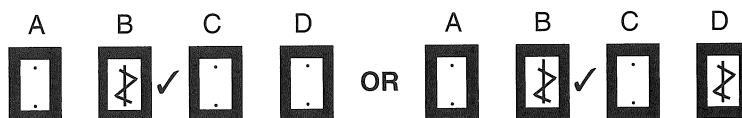
1. Which element is an alkali metal?

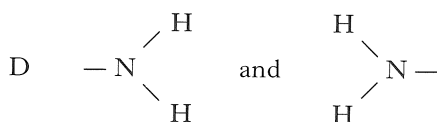   A   Aluminium

   B   Calcium

   C   Copper

   D   Sodium
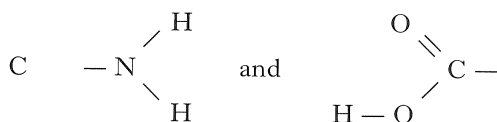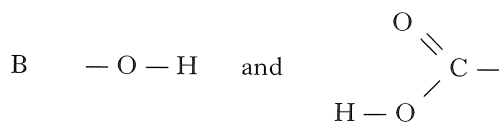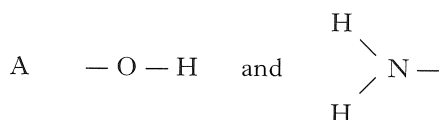
2. Which of the following is the electron arrangement for a metal?

   A   2, 8, 1

   B   2, 8, 5

   C   2, 8, 7

   D   2, 8, 8

3. Metallic bonding is a force of attraction between

   A   positive ions and delocalised electrons

   B   negative ions and delocalised electrons

   C   negative ions and positive ions

   D   a shared pair of electrons and two nuclei.

4. Which of the following groups can react together to form an amide (peptide) link?

   A $-O-H$ and $\overset{\displaystyle H}{\underset{\displaystyle H}{>}}N-$

   B $-O-H$ and $\overset{\displaystyle O}{\underset{\displaystyle H-O}{>}}C-$

   C $-N\overset{\displaystyle H}{\underset{\displaystyle H}{<}}$ and $\overset{\displaystyle O}{\underset{\displaystyle H-O}{>}}C-$

   D $-N\overset{\displaystyle H}{\underset{\displaystyle H}{<}}$ and $\overset{\displaystyle H}{\underset{\displaystyle H}{>}}N-$

5. Which pair of reactants would produce hydrogen most slowly?

   A   Magnesium powder and 4 $mol\,l^{-1}$ acid

   B   Magnesium ribbon and 2 $mol\,l^{-1}$ acid

   C   Magnesium powder and 2 $mol\,l^{-1}$ acid

   D   Magnesium ribbon and 4 $mol\,l^{-1}$ acid

6. The charge on the iron ion in $Fe_2(SO_4)_3$ is

   A 2^+

   B 3^+

   C 2^-

   D 3^-.

7. In a reaction, $60\,cm^3$ of gas were collected in $20\,s$.

   The average rate at which gas was given off, in $cm^3\,s^{-1}$, was

   A $\dfrac{1}{20}$

   B $\dfrac{1}{60}$

   C $\dfrac{20}{60}$

   D $\dfrac{60}{20}$
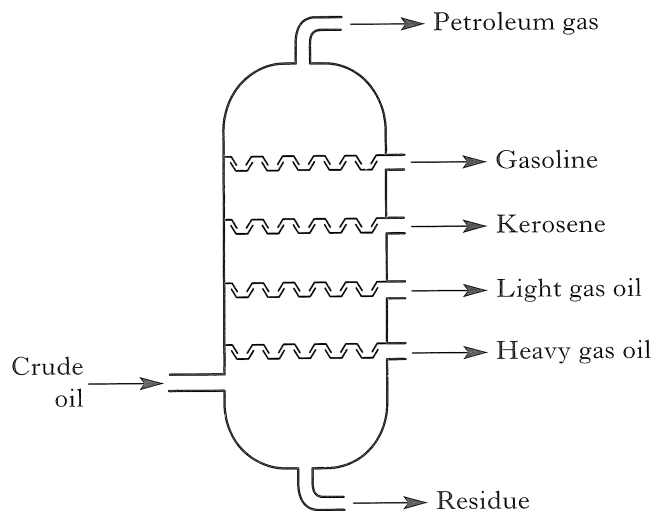
8. The gram formula mass of sodium carbonate is $106\,g$.

   How many moles are present in $5\cdot3\,g$ of sodium carbonate?

   A $0\cdot05$

   B $0\cdot5$

   C   2

   D   20

[Turn over

Questions 9 and 10 refer to the following information.

The fractional distillation of crude oil produces a number of different fractions.


9. Which properties apply to a fraction which has a high boiling point?

   A   High viscosity and low flammability

   B   Low viscosity and low flammability

   C   High viscosity and high flammability

   D   Low viscosity and high flammability

10. Which molecule is most likely to be present in kerosene?

   A C_5H_{12}

   B $C_{12}H_{26}$

   C $C_{19}H_{40}$

   D $C_{26}H_{54}$

11.
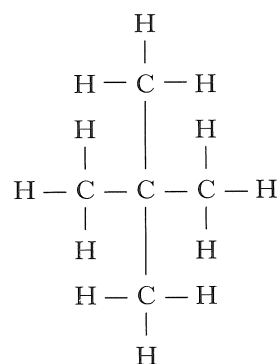
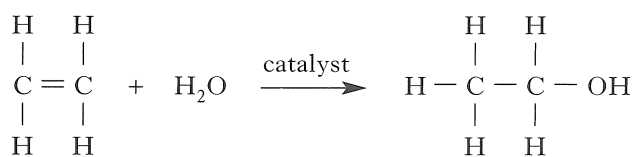Which compound is an isomer of the one shown above?

A

B

C

D
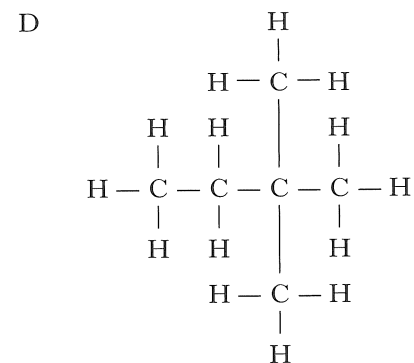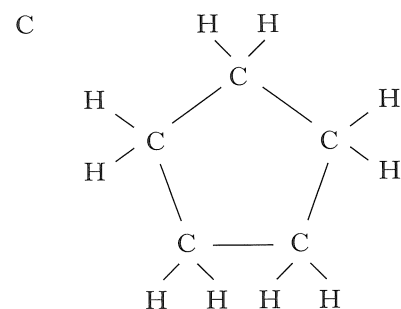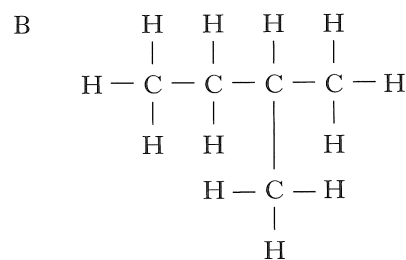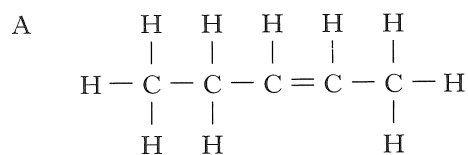
12. A compound burns in air. The only products of the reaction are carbon dioxide, sulphur dioxide and water vapour.

The compound **must** contain

A   carbon and hydrogen only

B   carbon and sulphur only

C   carbon, hydrogen and sulphur

D   carbon, hydrogen, sulphur and oxygen.

13. One way in which ethanol is produced industrially is shown below.

$$\underset{\substack{|\\H}}{\overset{\substack{H\\|}}{C}} = \underset{\substack{|\\H}}{\overset{\substack{H\\|}}{C}} \ + \ H_2O \ \xrightarrow{\text{catalyst}} \ H - \underset{\substack{|\\H}}{\overset{\substack{H\\|}}{C}} - \underset{\substack{|\\H}}{\overset{\substack{H\\|}}{C}} - OH$$

What name is given to this type of reaction?

A   Condensation

B   Hydration

C   Hydrolysis

D   Oxidation

14. Biopol is a polymer which is

A   natural and biodegradeable

B   synthetic and biodegradeable

C   natural and non-biodegradeable

D   synthetic and non-biodegradeable.

15. A section of a polymer is shown below.

$$- O - \overset{\substack{O\\||}}{C} - C_6H_4 - \overset{\substack{O\\||}}{C} - O - (CH_2)_4 - O - \overset{\substack{O\\||}}{C} - C_6H_4 -$$
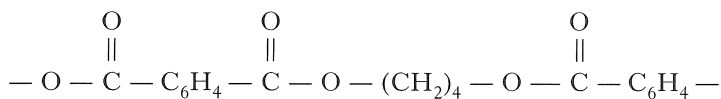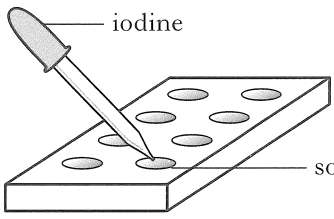
The polymer is

A   a polyamide formed by addition polymerisation

B   a polyamide formed by condensation polymerisation

C   a polyester formed by addition polymerisation
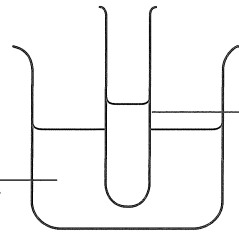
D   a polyester formed by condensation polymerisation.

16. A solution containing two carbohydrates was tested as shown.

Iodine test

iodine

solution

Result:

The iodine turned blue-black

Benedict's test

solution and 5 drops of Benedict's solution

hot water

Result:

The Benedict's solution turned orange.

The solution could have contained

A   starch and sucrose

B   starch and glucose

C   glucose and maltose

D   fructose and sucrose.

17. Which of the following correctly shows the elements present in carbohydrates and proteins?

|	Carbohydrates	Proteins
A	C and H	C, H and O
B	C and H	C, H, O and N
C	C, H and O	C, H, O and N
D	C, H, O and N	C, H and O

18. Ammonia dissolves in water to produce a solution with a pH of

    A   1

    B   4

    C   7

    D   11.

19. An acidic solution contains

    A   only hydrogen ions

    B   equal numbers of hydrogen and hydroxide ions

    C   more hydrogen ions than hydroxide ions
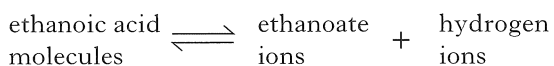
    D   more hydroxide ions than hydrogen ions.

20.

$$ZnO(s) + 2HNO_3(aq) \rightarrow Zn(NO_3)_2(aq) + H_2O(\ell)$$
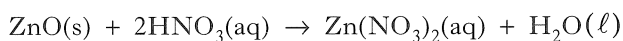
What type of chemical reaction is represented by the above equation?

    A   Condensation

    B   Dehydration

    C   Neutralisation

    D   Precipitation

21. Dilute ethanoic acid exists as an equilibrium mixture.

ethanoic acid molecules $\rightleftharpoons$ ethanoate ions $+$ hydrogen ions

Which statement about the mixture is correct?

    A   The ethanoic acid molecules have stopped dissociating into ions.

    B   The ethanoic acid molecules have all dissociated into ions.

    C   The concentrations of ethanoate ions and hydrogen ions are equal.

    D   The concentrations of ethanoic acid molecules and ethanoate ions are equal.

22. Which of the following **does not happen** during the corrosion of iron?

    A   The iron is reduced.

    B   A compound is formed.

    C   Iron(II) ions lose one electron to become iron(III) ions.

    D   Iron atoms lose two electrons to form iron(II) ions.

23. In which experiment would the iron nail **not** rust?

    A

    B

    C

    D
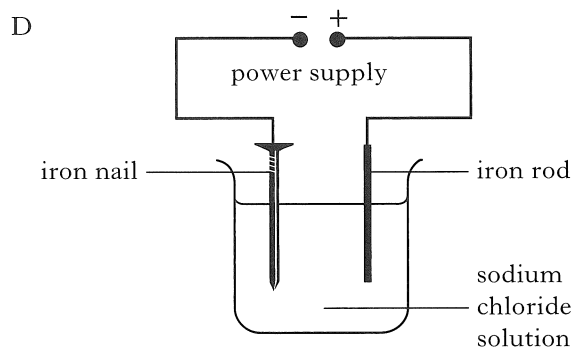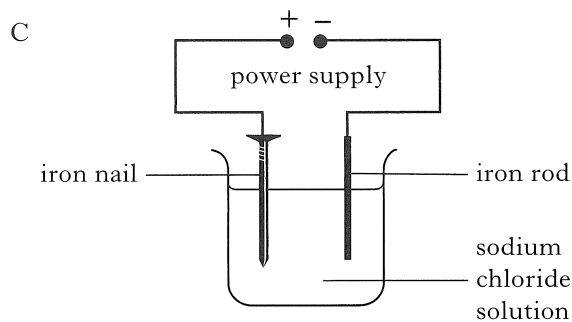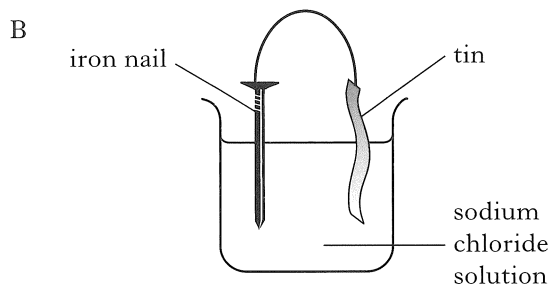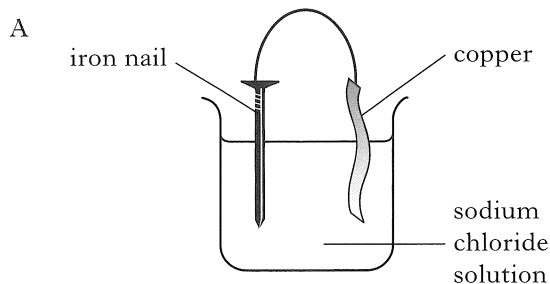
24. Which solution will react with magnesium metal?

You may wish to refer to page 7 of the Data Booklet.

A   Magnesium chloride

B   Potassium chloride

C   Sodium chloride

D   Zinc chloride

25. Which pair of metals, when connected in a cell, would give the highest voltage and a flow of electrons from X to Y?
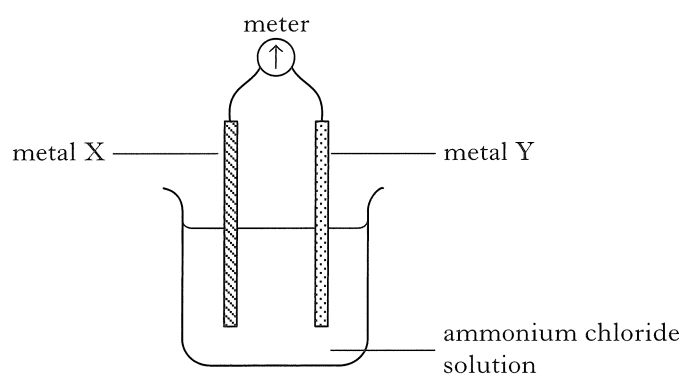
	Metal X	Metal Y
A	magnesium	copper
B	copper	magnesium
C	zinc	tin
D	tin	zinc

SECTION A

PART 2

In Questions 26, 27 and 28 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.

Ⓐ	B	C
D	E	F

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

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

A	Ⓑ	C
D	E	Ⓕ

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.

Ⓐ	B	C
D	Ⓔ	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:

A̶	B	C
Ⓓ	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:

✓A̶	B	C
D̶	E	F

26. Ions are formed when atoms lose or gain electrons.

A fluorine	B oxygen
C potassium	D sulphur

Which **two** elements form ions with the same electron arrangement as **argon atoms**?

A	B
C	D

27. Caesium forms a compound with fluorine.

Which statement(s) can be applied to this compound?

A	The formula is CsF_2
B	The bonding is covalent
C	The melt conducts electricity
D	The solid conducts electricity
E	The melting point is higher than $0\,°C$

A
B
C
D
E

[Turn over

28. The grid shows some sulphur compounds.

A	B
$CH_3 - S - C_2H_5$	$C_2H_5 - S - C_2H_5$

C	D

C:
$$CH_3 - \underset{\underset{H}{|}}{\overset{\overset{CH_3}{|}}{C}} - S - H$$

D:
$$\begin{array}{cc} CH_2 - CH_2 \\ | \quad\quad | \\ CH_2 \quad CH_2 \\ \diagdown \quad \diagup \\ S \end{array}$$

(a) Identify the **two** compounds which have the same molecular formula.

A	B
C	D

(b) Identify the compound which has the general formula $C_nH_{2n}S$.

A	B
C	D

Candidates are reminded that the answer sheet MUST be returned INSIDE this answer book.

SECTION B

50 marks are available in this section of the paper.

1. The most common isotope of potassium is $^{39}_{19}K$.

   (a) Complete the table to show the number of particles in an atom of $^{39}_{19}K$.

Type of particle	Number of particles
proton	
neutron	
electron	

   1

   (b) How do isotopes of potassium differ from each other?

   _____

   _____ 1

   (2)

   [Turn over

2. A very hot flame is produced when ethyne gas (C_2H_2) burns in a plentiful supply of oxygen.

   (a) Name the products formed in this reaction.

   _____ 1

   (b) Ethyne is the first member of an homologous series called the alkynes.
   Ethyne has the following structure.

   $$H-C \equiv C-H$$
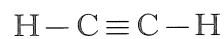
   All the members of the alkyne series have a triple carbon to carbon bond.
   Complete the table below.

Position in series	Name	Molecular formula
1st	ethyne	C_2H_2
2nd		C_3H_4
3rd	butyne	

   2
   (3)

Marks

3. Poly(ethenyl ethanoate) is an addition polymer. Part of its structure is shown below.

$$\begin{array}{c}
\quad\;\; H \qquad\qquad OCOCH_3 \;\; H \qquad\qquad OCOCH_3 \;\; H \qquad\qquad OCOCH_3 \\
\quad\;\; | \qquad\qquad\quad | \qquad\quad\;\; | \qquad\qquad\quad | \qquad\quad\; | \qquad\qquad\quad | \\
-\!C\!-\!-\!-\!-\!C\!-\!-\!-\!-\!C\!-\!-\!-\!-\!C\!-\!-\!-\!-\!C\!-\!-\!-\!-\!C\!-\!-\!- \\
\quad\;\; | \qquad\qquad\quad | \qquad\quad\;\; | \qquad\qquad\quad | \qquad\quad\; | \qquad\qquad\quad | \\
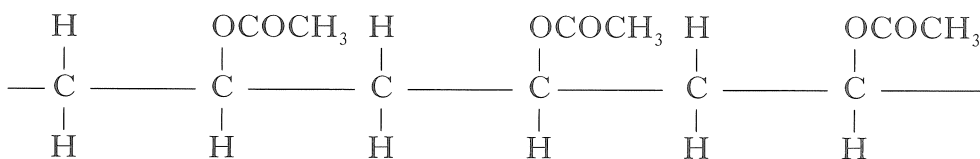\quad\;\; H \qquad\qquad\;\; H \qquad\quad\; H \qquad\qquad\;\; H \qquad\quad\; H \qquad\qquad\;\; H
\end{array}$$

(a) Draw the structural formula for the monomer used to make this polymer.

1

(b) Poly(ethenyl ethanoate) is used to make the polymer poly(ethenol).

poly(ethenyl ethanoate) + methanol → poly(ethenol) + methyl ethanoate
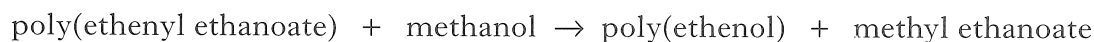
Methyl ethanoate is also formed in the reaction.

(i) What property of poly(ethenol) makes it useful for laundry bags?

_____

_____ 1

(ii) Draw a structural formula for methyl ethanoate.

1

(3)

[Turn over

Marks

4. (*a*) Write the formula for copper(II) nitrate.

1

(*b*) Calculate the number of moles of solute contained in $250\,cm^3$ of $0 \cdot 2\,mol\,l^{-1}$ copper(II) nitrate solution.
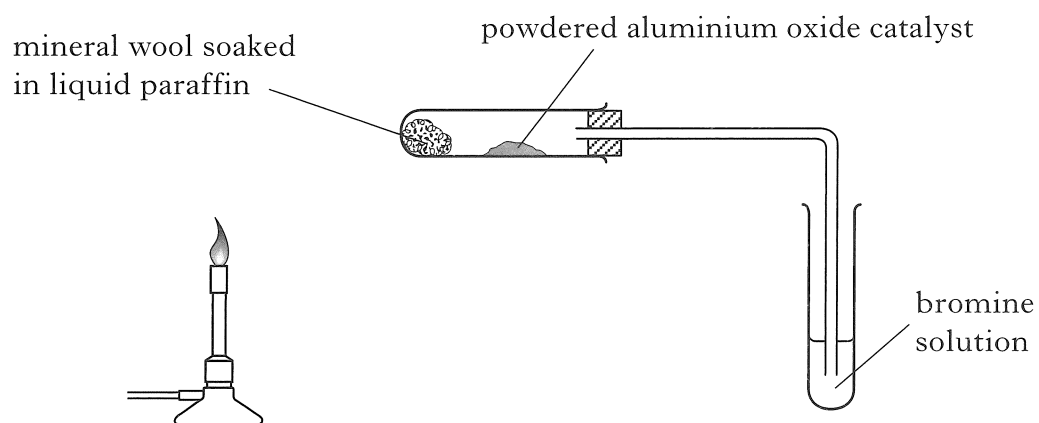
Answer _____ moles

1

(2)

5. Students set up the apparatus below to carry out the **PPA "Cracking"**.

mineral wool soaked
in liquid paraffin

powdered aluminium oxide catalyst

bromine
solution

(a) The PPA gives special instructions as to how the test tube should be heated.

Describe how the test tube should be heated.

_____

_____

_____

_____   1

(b) (i) The bromine solution is decolourised.

What does this tell you about the gases produced by cracking?

_____

_____   1

(ii) How is "suck back" avoided?

_____

_____   1

(c) In this experiment, the aluminium oxide is acting as a heterogeneous catalyst.

What is meant by a **heterogeneous** catalyst?

_____

_____   1

(4)

[Turn over

Marks

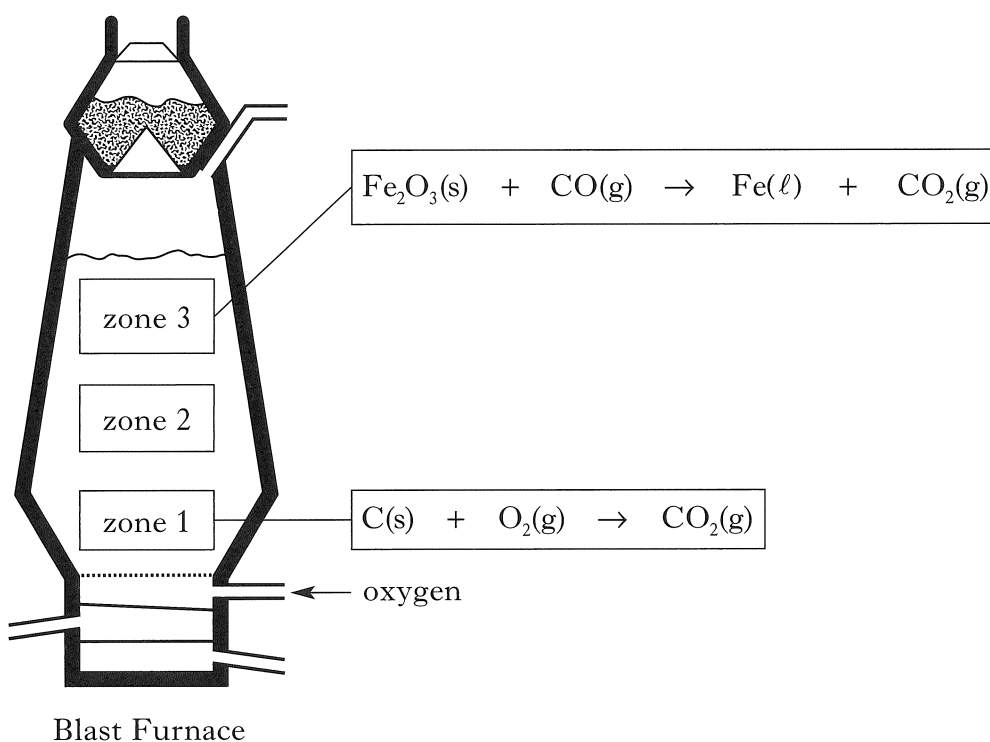**6.** (*a*) What type of chemical reaction takes place when a metal is obtained from a metal oxide?

_____

1

(*b*) Name a metal which can be obtained from its oxide using only heat.

_____

1

(*c*) Iron is produced from iron oxide in a Blast Furnace.

$$Fe_2O_3(s) \quad + \quad CO(g) \quad \rightarrow \quad Fe(\ell) \quad + \quad CO_2(g)$$

zone 3

zone 2

zone 1 | $C(s) \quad + \quad O_2(g) \quad \rightarrow \quad CO_2(g)$

← oxygen

Blast Furnace

In zone 1, the coke (carbon) initially reacts with oxygen to produce carbon dioxide.
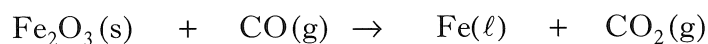
In zone 3, the iron oxide in the ore reacts with carbon monoxide to produce molten iron metal.

(i) How is the carbon dioxide converted to carbon monoxide in zone 2?

_____

_____

1

(ii) The equation for the reaction taking place in zone 3 is shown below.

$$Fe_2O_3(s) \quad + \quad CO(g) \quad \rightarrow \quad Fe(\ell) \quad + \quad CO_2(g)$$
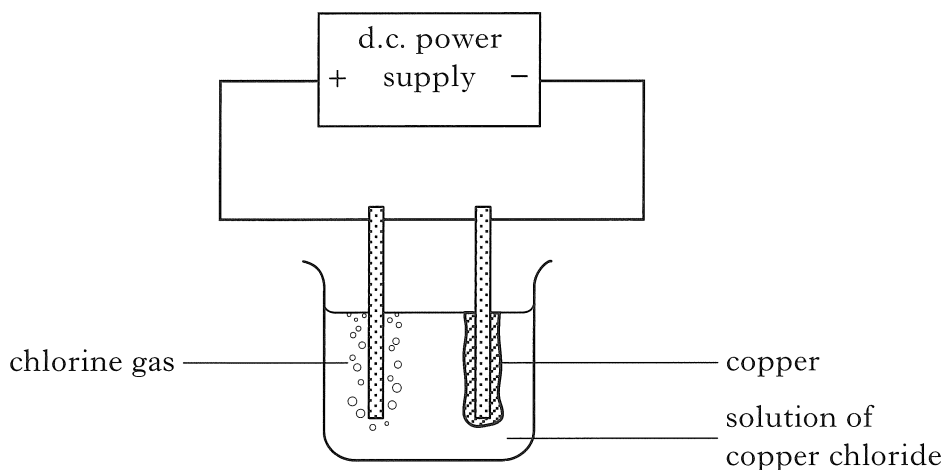
Balance this equation.

1

(4)

7. A copper chloride solution was electrolysed as shown.

(a) Why would a d.c. supply have been used?

_____

_____ 1

(b) The chlorine gas can be identified using pH paper or blue litmus paper. Describe how chlorine gas affects pH paper or blue litmus paper.

_____

_____ 1

(2)

[Turn over

8. **A dilute solution has a lower concentration of dissolved substance than a concentrated solution.**

Describe an experiment which could be used to show that $0{\cdot}1$ mol l^{-1} sodium chloride solution has less dissolved salt than $0{\cdot}2$ mol l^{-1} sodium chloride solution.

You may wish to use some or all of the apparatus shown below. You may use other apparatus if required.

_____

_____

_____

_____

_____

_____

_____

_____ **(2)**
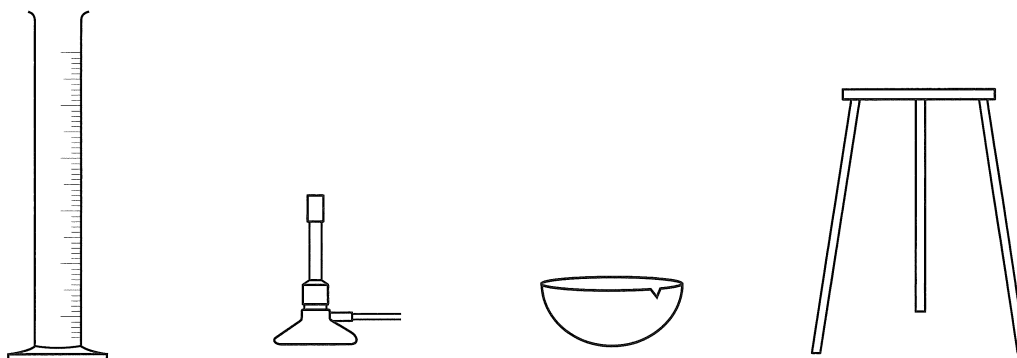
9. (*a*) (i) Describe the test for oxygen gas.

_____

_____ **1**

(ii) Explain why this test is not positive with air.

_____

_____ **1**

(*b*) The astronauts in a space station require a constant supply of oxygen.

In emergencies, oxygen can be produced by decomposing lithium perchlorate ($LiClO_4$).

The equation for the decomposition is shown below.

$$LiClO_4(s) \quad \rightarrow \quad LiCl(g) \quad + \quad 2O_2(g)$$

Calculate the mass of oxygen produced when $1000\,g$ of lithium perchlorate completely decomposes.
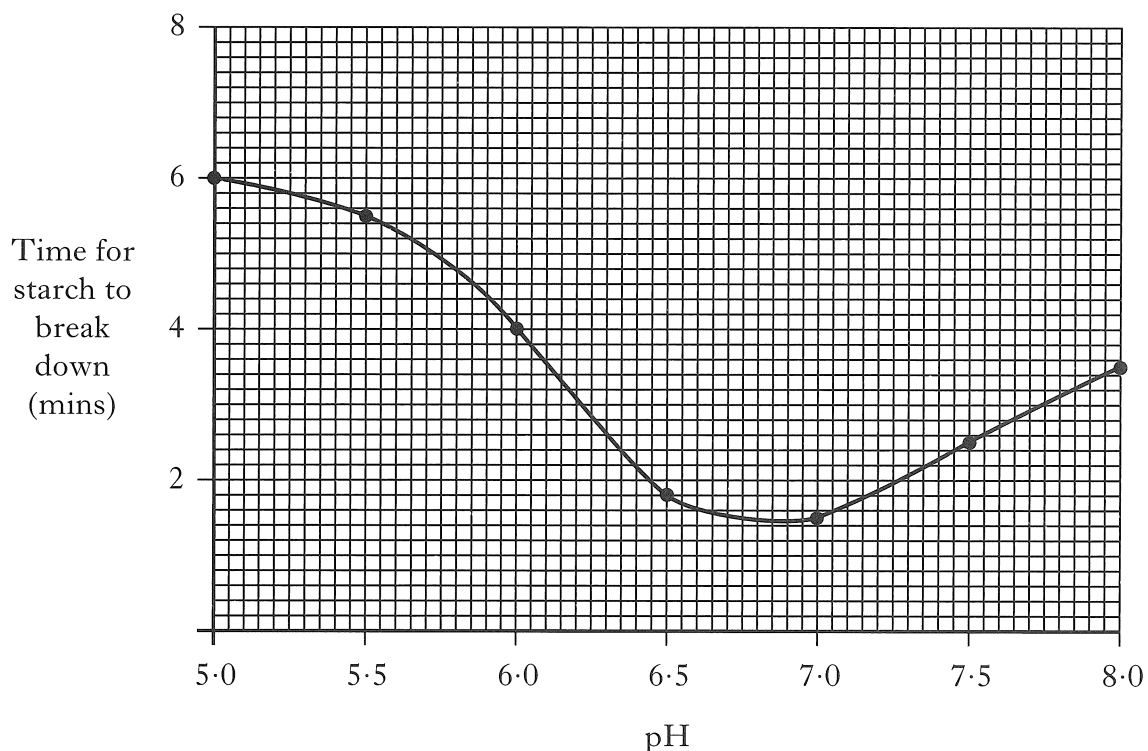
Answer = _____ g   **2**

(4)

[Turn over

Marks

10. Enzymes are biological catalysts. A chemistry class was investigating how the activity of an enzyme changed with pH.

They carried out experiments at different pH values and timed how long it took for the enzyme to break down starch. The more active the enzyme, the shorter the time taken to break down the starch.

Here are their results.

(*a*) Name the type of chemical reaction taking place when starch is broken down.

_____

1

(*b*) To which class of compounds do enzymes belong?

_____

1

(*c*) What effect does increasing the pH from 5 to 6 have on the **activity of the enzyme**?

_____

_____

1

10. (continued)

(*d*) Some students suggested speeding up the rate of the reaction by heating the starch and enzyme mixtures in boiling water baths.

Why would this **not** speed up the reaction rate?

_____

_____ 1

(*e*) During the experiment, small samples were removed and tested with iodine solution to see if all the starch had been broken down.

Suggest how the students would have known that all the starch had been broken down.

_____

_____ 1

(5)

[Turn over

11. Hydrochloric acid is a strong acid. The table shows the pH values of some hydrochloric acid solutions.

Concentration (mol l^{-1})	1·0	0·1	0·01	0·001
pH	0	1	2	3

(a) Predict the concentration of hydrochloric acid solution with a pH of 5.

_____ mol l^{-1} 1

(b) Ethanoic acid is a weak acid. The pH of a 0·1 mol l^{-1} solution of ethanoic acid is 3.
 Why does this solution have a higher pH than a 0·1 mol l^{-1} solution of hydrochloric acid?

_____

_____   1

(c) Describe an experiment which you could carry out to compare the rate of reaction of hydrochloric acid and ethanoic acid with magnesium.

_____

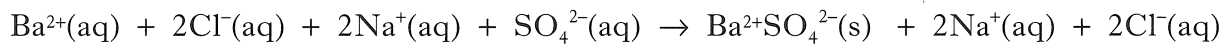_____

_____

_____

_____

_____

_____

_____   2

(4)

Marks

12. Metal salts can be made by using different methods.

(*a*) Barium sulphate can be made by reacting solutions of barium chloride and sodium sulphate.
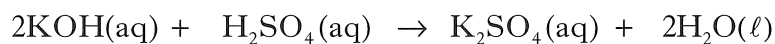The ionic equation for this reaction is:

$$Ba^{2+}(aq) + 2Cl^-(aq) + 2Na^+(aq) + SO_4^{2-}(aq) \rightarrow Ba^{2+}SO_4^{2-}(s) + 2Na^+(aq) + 2Cl^-(aq)$$

(i) Rewrite the equation omitting spectator ions.

1

(ii) Name the type of reaction taking place.

_____

1

(*b*) Potassium sulphate can be made by titrating sulphuric acid with potassium hydroxide solution.

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

If $12 \cdot 5 \, cm^3$ of dilute sulphuric acid were required to neutralise $20 \, cm^3$ of $0 \cdot 1 \, mol \, l^{-1}$ potassium hydroxide solution, calculate the concentration of the sulphuric acid.

2

(4)

[Turn over

Marks

13. Human blood contains Fe^{3+} ions.

To find the concentration of Fe^{3+} in blood, the Fe^{3+} ions are first converted into Fe^{2+} ions.

(*a*) Write an ion-electron equation for this change.

_____

1

(*b*) Fe^{2+} ions are then reacted to form a purple compound.

When the solution is placed in a beam of light only some of the light is transmitted.

These results show the percentage of light transmitted for a series of solutions of known Fe^{2+} concentration.

Concentration of Fe^{2+} (mg l^{-1})	1·0	2·0	3·0	4·0	6·0	8·0
% transmittance	79	65	55	44	27	18

(i) Plot the results as a line graph.

(Additional graph paper, if required, can be found on page 28.)
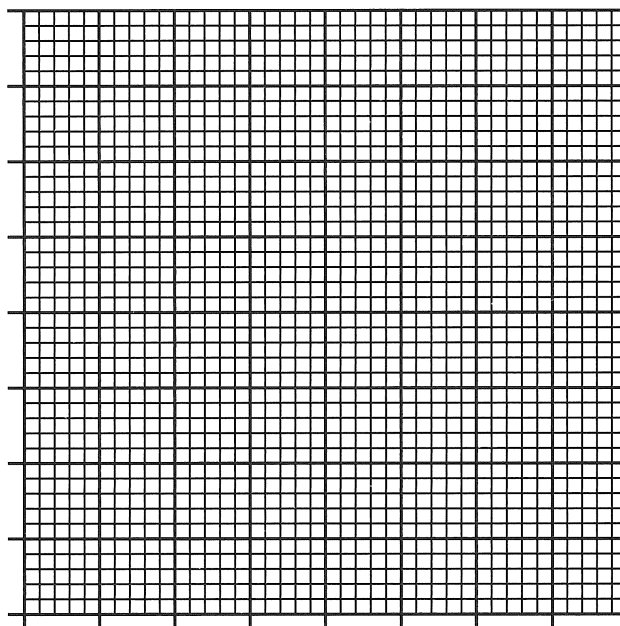
2

(ii) Using your graph, estimate the concentration of Fe^{2+} ions present in a solution with a transmittance of 36%.
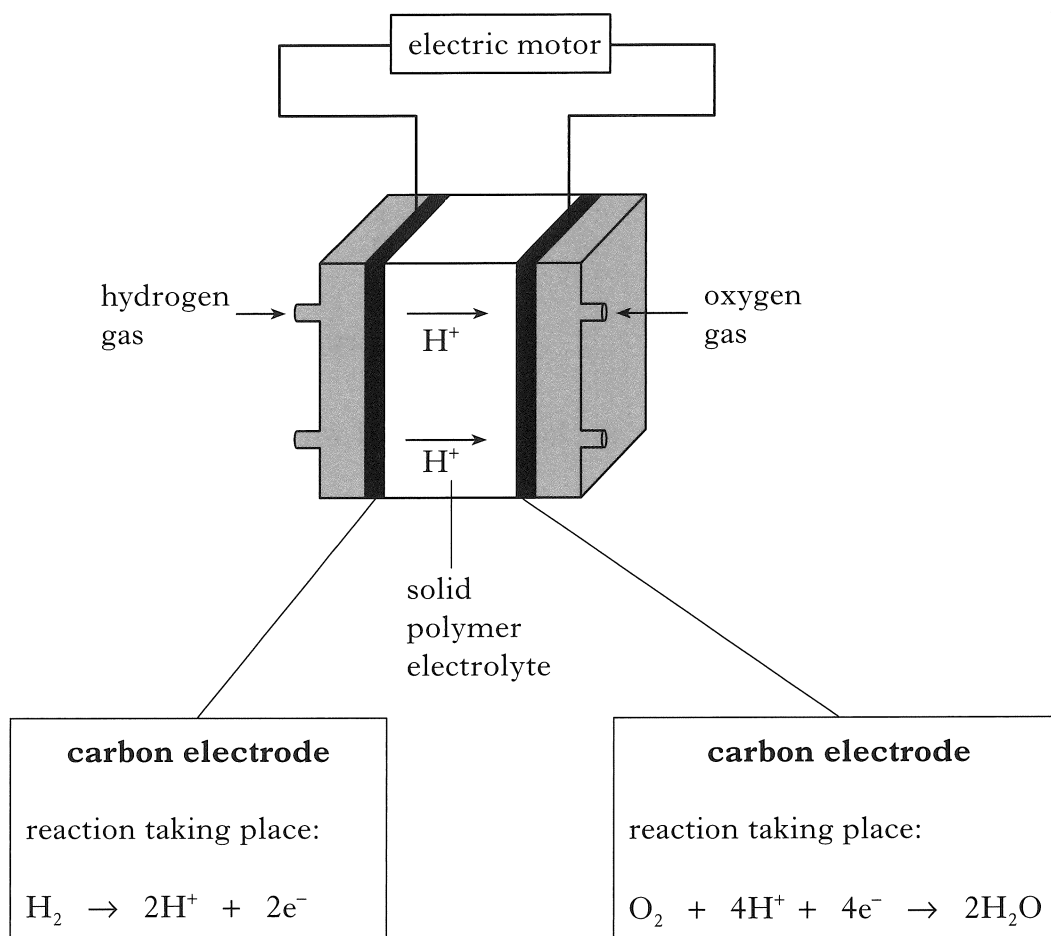
_____ mg l^{-1}

1

(4)

Marks

14. A fuel cell which can supply electricity to run a car uses hydrogen and oxygen. The electrodes are made of carbon cloth which is coated with finely divided platinum. The electrodes press against a solid polymer electrolyte.

carbon electrode

reaction taking place:

$$H_2 \rightarrow 2H^+ + 2e^-$$

carbon electrode

reaction taking place:

$$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$$

(*a*) Combine the 2 ion-electron equations for the electrode reactions to produce a **balanced** REDOX equation.

_____ 1

(*b*) Although the polymer is solid, it acts as an electrolyte.
What is an electrolyte?

_____ 1

(*c*) The platinum catalyst has been finely divided to increase the surface area.
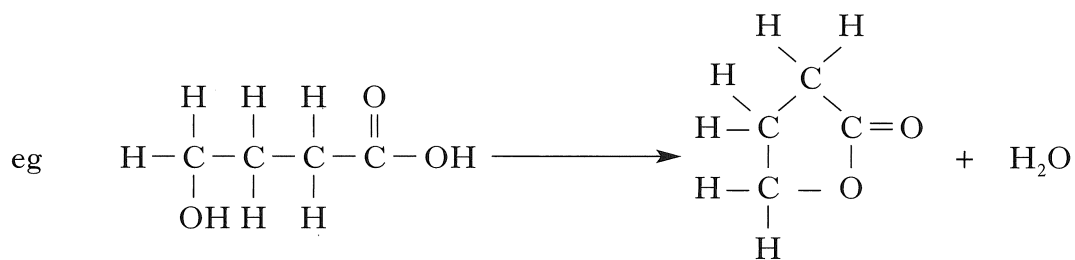Why does increasing the surface area increase the rate of reaction?

_____ 1

(3)

[Turn over

15. Hydroxy acids are compounds that contain both a hydroxyl group and a carboxylic acid group within the same molecule.
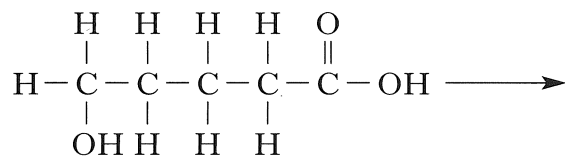
These compounds are able to form cyclic esters called lactones.

eg

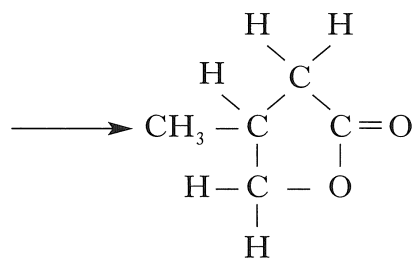$$H-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle OH}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle O}{\|}}{C}-OH \longrightarrow$$

hydroxy acid   a lactone

$+$ H_2O

(*a*) Draw the structural formula for the lactone formed when this hydroxy acid reacts.

$$H-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle OH}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle O}{\|}}{C}-OH \longrightarrow$$

1

(*b*) Draw the structural formula for the hydroxy acid from which this lactone was formed.

$$\longrightarrow CH_3 - C \overset{}{\underset{}{\Big\backslash}} C=O$$

1

(2)

16.

INTERMEDIATE 2 CHEMISTRY	Reaction of Metals with Oxygen	Unit 3 PPA 3

Aim: The aim of this experiment is to place zinc, copper and magnesium in order of reactivity by observing the ease with which they react with oxygen.

Requirements: Samples of metals, potassium permanganate, mineral wool, dry test tubes, clamp stand and clamp, bunsen.

(*a*) Complete and label the diagram of the test tube to show how it would be set up to burn a metal in oxygen.
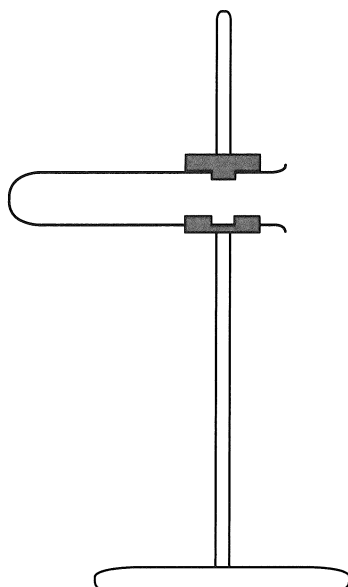
1

(*b*) During the experiment, safety goggles must be worn.

State **one** other safety precaution which must be taken when heating the test tube.
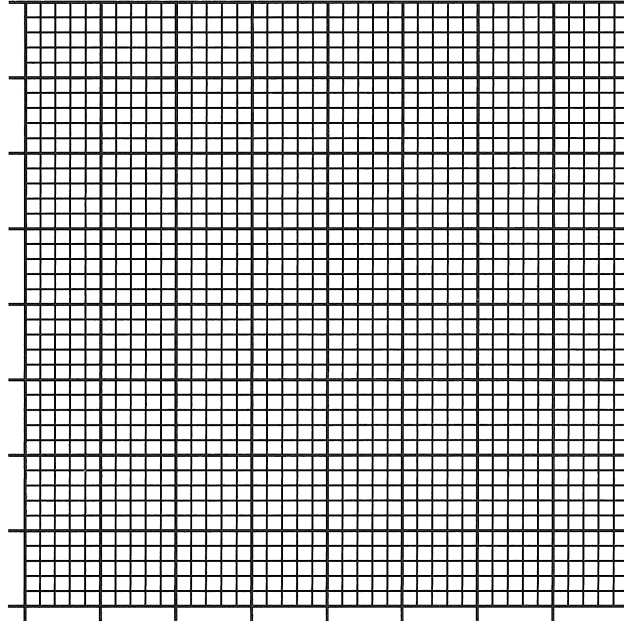
_____

_____ 1

(2)

[END OF QUESTION PAPER]

ADDITIONAL SPACE FOR ANSWERS

ADDITIONAL GRAPH PAPER FOR QUESTION 13(*b*)(i)

ADDITIONAL SPACE FOR ANSWERS

ADDITIONAL SPACE FOR ANSWERS

ADDITIONAL SPACE FOR ANSWERS

ADDITIONAL SPACE FOR ANSWERS