FOR OFFICIAL USE

Section B **Total Marks**

X012/11/02

NATIONAL QUALIFICATIONS 2012

MONDAY, 14 MAY
1.00 PM – 3.00 PM

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.

Section A – Questions 1–30 (30 marks)

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

For this section of the examination you must use an **HB pencil**.

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.

Read carefully

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

2 For this section of the examination you must use an **HB pencil** and, where necessary, an eraser.

3 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.

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

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

6 The answer to each question is **either** A, B, C or D. Decide what your answer is, then, using your pencil, 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 examination, 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 chromatography

B fractional distillation

C fractional crystallisation

D filtration.

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

Changing an answer

If you decide to change your answer, carefully erase your first answer and using your pencil, fill in the answer you want. The answer below has been changed to **D**.

SECTION A

1. An element, **X**, has the following properties.

- It is a gas.
- It is **not** made up of molecules.
- It does **not** react with other elements.

Element, **X**, is likely to be in group

A 0

B 1

C 2

D 7.

2. Which of the following would react fastest with 2 mol l^{-1} hydrochloric acid?

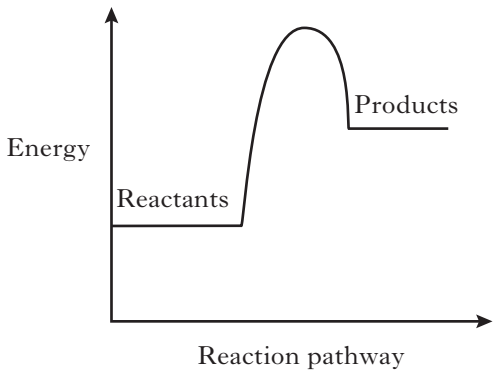
A Magnesium ribbon

B Magnesium powder

C Zinc ribbon

D Zinc powder

3. The diagram shows the energy changes during a reaction.



Which of the following statements is true?

A The reaction is endothermic.

B Energy is given out to the surroundings.

C The reaction is exothermic.

D The products have less energy than the reactants.

4. Which of the following numbers is the same for lithium and oxygen atoms?

A Mass number

B Atomic number

C Number of outer electrons

D Number of occupied energy levels

5. Atoms of an element form ions with a single positive charge and an electron arrangement of 2, 8.

The element is

A fluorine

B lithium

C sodium

D neon.

6. Which of the following substances is made up of molecules containing polar covalent bonds?

A Calcium oxide

B Chlorine

C Sodium bromide

D Water

7. Which of the following pairs of elements combine to form an ionic compound?

A Lead and fluorine

B Sulphur and oxygen

C Carbon and nitrogen

D Phosphorus and chlorine

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

A Carbon monoxide

B Sulphur dioxide

C Nitrogen trihydride

D Carbon tetrachloride

[Turn over

9. The shapes and names of some molecules are shown below.

			
tetrahedral	pyramidal	bent	linear

Phosphine is a compound of phosphorus and hydrogen. The shape of a molecule of phosphine is likely to be

A tetrahedral

B pyramidal

C bent

D linear.

10. Solid ionic compounds do not conduct electricity because

A the ions are not free to move

B the electrons are not free to move

C solid substances never conduct electricity

D there are no charged particles in ionic compounds.

11. Which of the following alkanes will produce 3 moles of carbon dioxide when 1 mole of it is completely burned?

A Ethane

B Propane

C Butane

D Pentane

12. Fractional distillation of crude oil produces a number of different fractions.

Which of the following properties apply to a fraction containing large hydrocarbon molecules?

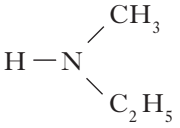
A High viscosity and low flammability

B Low viscosity and low flammability

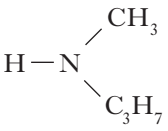
C High viscosity and high flammability

D Low viscosity and high flammability

13. The following structure represents an amine called ethylmethylamine:



Another amine has the following structure:



This amine is called

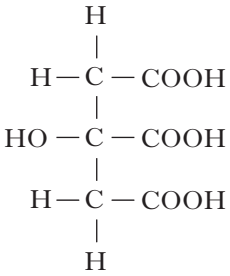
A methylamine

B butylamine

C propylamine

D methylpropylamine.

14. The structure of citric acid is



How many moles of sodium hydroxide would be required to exactly neutralise **one** mole of citric acid?

A 1

B 2

C 3

D 4

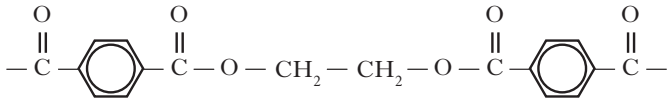
15. $C_8H_{18} \xrightarrow{\text{Process X}}$ Ethene + Compound Y

Which line in the table correctly identifies Process X and Compound Y?

	Process X	Compound Y
A	cracking	hexane
B	cracking	hexene
C	distillation	hexane
D	distillation	hexene

16. Polyethene terephthalate (PET) is used to make plastic bottles which can easily be recycled by heating and reshaping.

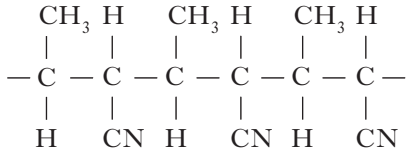
A section of the PET structure is shown.



Which line in the table best describes PET?

	Type of polymer	Property
A	addition	thermoplastic
B	condensation	thermosetting
C	addition	thermosetting
D	condensation	thermoplastic

17. Part of a polymer structure is shown.



Which of the following gases could **not** be produced when this polymer is burned?

A CO

B CO_2

C HCl

D HCN

18. Which of the following plastics could be used to make a soluble coating for a dishwasher tablet?

A PVC

B Biopol

C Polystyrene

D Poly(ethenol)

19. Which compound could be obtained by the hydrolysis of a fat?

A Ethanol

B Glucose

C Glycerol

D Propanol

20. To which class of compounds does the hormone insulin belong?

A Carbohydrates

B Fats

C Proteins

D Hydrocarbons

21. What is the most likely pH value that would be obtained when zinc oxide is added to water?

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

A 5

B 7

C 9

D 11

22. Reactions can be represented using ionic equations. Which ionic equation shows a neutralisation reaction?

A $2H_2O(\ell) + O_2(g) + 4e^- \longrightarrow 4OH^-(aq)$

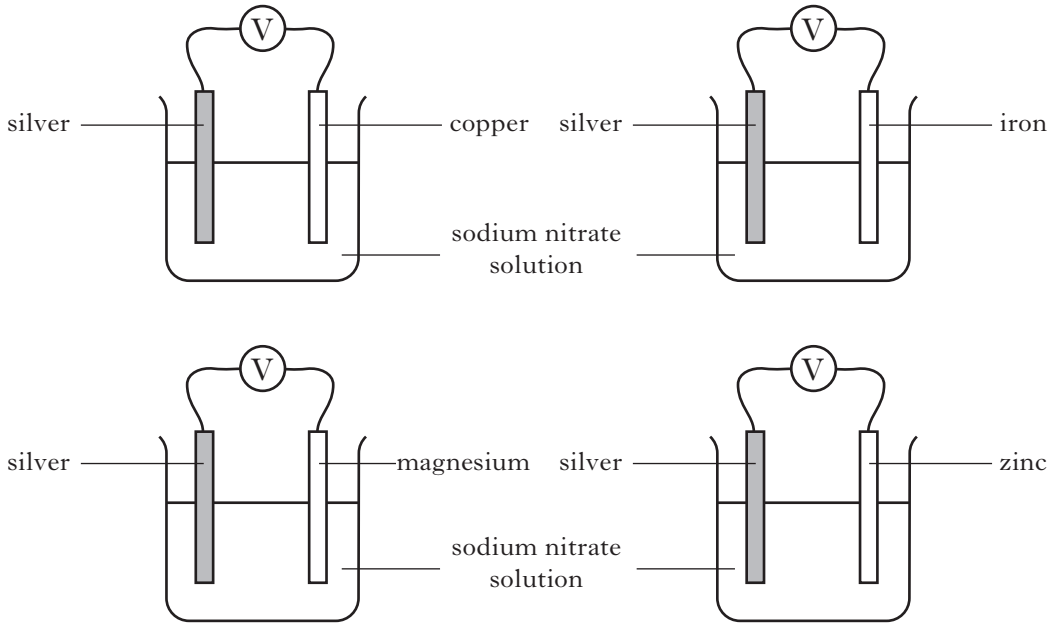
B $H^+(aq) + OH^-(aq) \longrightarrow H_2O(\ell)$

C $SO_2(g) + H_2O(\ell) \longrightarrow 2H^+(aq) + SO_3^{2-}(aq)$

D $NH_4^+(s) + OH^-(s) \longrightarrow NH_3(g) + H_2O(\ell)$

[Turn over

23. Four cells were made by joining copper, iron, magnesium and zinc to silver. The four cells produced the following voltages 0·5 V, 0·9 V, 2·7 V and 1·1 V.



Which of the following will be the voltage of the cell containing silver joined to copper?

(You may wish to use page 7 of the data booklet to help you.)

A 0·5 V

B 0·9 V

C 1·1 V

D 2·7 V

24. Which acidic gas is produced by the sparking of air?

A Carbon dioxide

B Sulphur dioxide

C Nitrogen dioxide

D Hydrogen chloride

25. A student adds a powder to dilute hydrochloric acid. A gas which burns with a pop is produced.

The powder could be

A carbon

B calcium oxide

C sodium carbonate

D zinc.

26. Which of the following substances is **not** a salt?

A Copper sulphate

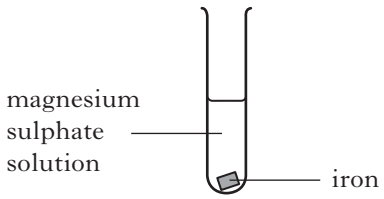
B Sodium oxide

C Magnesium chloride

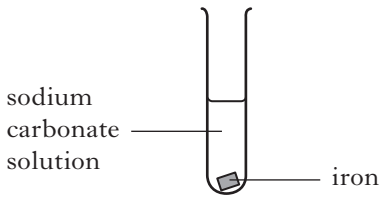
D Calcium nitrate

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

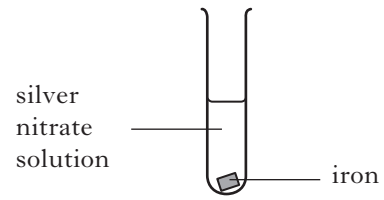
A



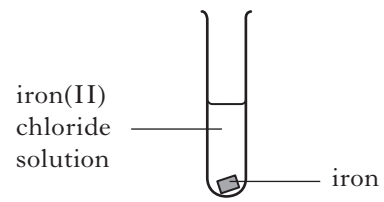
B



C



D



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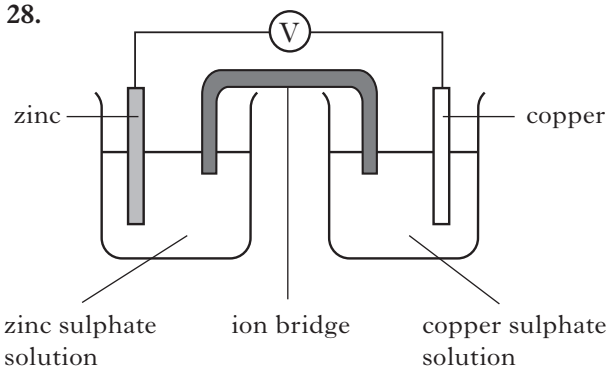


Which line in the table is correct for the above cell?

	Zinc electrode	Copper electrode
A	mass increases	mass increases
B	mass increases	mass decreases
C	mass decreases	mass decreases
D	mass decreases	mass increases

29. A metal can be extracted from its ore by heating the ore with carbon but **not** by heating the ore on its own.

The position of the metal in the reactivity series is most likely to be between

(You may wish to use page 7 of the data booklet to help you.)

A zinc and magnesium

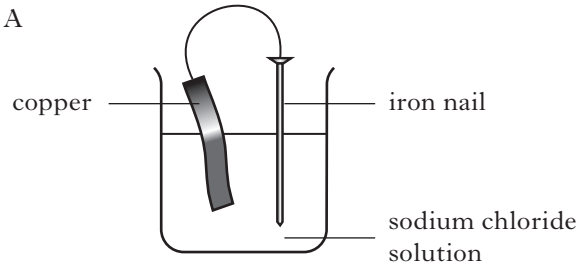
B magnesium and potassium

C zinc and copper

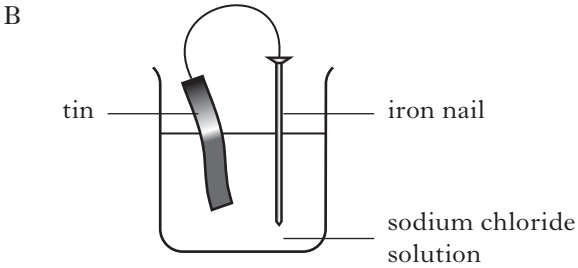
D copper and gold.

30. In which of the following experiments would the iron nail **not** rust?

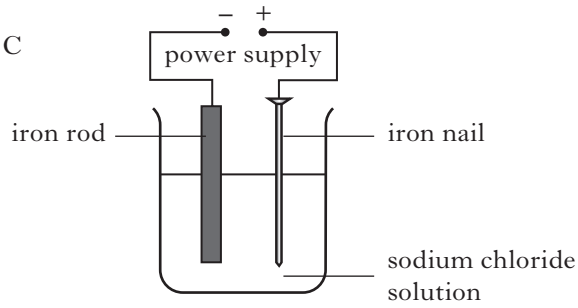
A



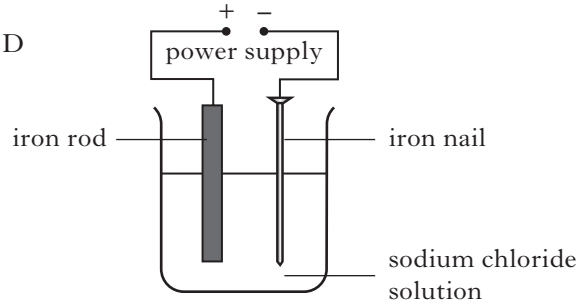
B



C



D



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

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SECTION B

Marks

50 marks are available in this section of the paper.

All answers must be written clearly and legibly in ink.

1. Glass is made from the chemical silica, SiO_2, which is covalently bonded and has a melting point of 1700 °C.

(*a*) What does the melting point of silica suggest about its **structure**?

_____ **1**

(*b*) Antimony(III) oxide is added to reduce any bubbles that may appear during the manufacturing process.

Write the chemical formula for antimony(III) oxide.

_____ **1**

(*c*) In the manufacture of glass, other chemicals can be added to alter the properties of the glass. The element boron can be added to glass to make oven proof dishes.

(i) Information about an atom of boron is given in the table below.

Particle	Number
proton	5
electron	5
neutron	6

Use this information to complete the nuclide notation for this atom of boron.

$$\_\_^{\_\_}B$$

1

(ii) Atoms of boron exist which have the same number of protons but a different number of neutrons from that shown in the table.

What name can be used to describe the different atoms of boron?

_____ **1**

(4)

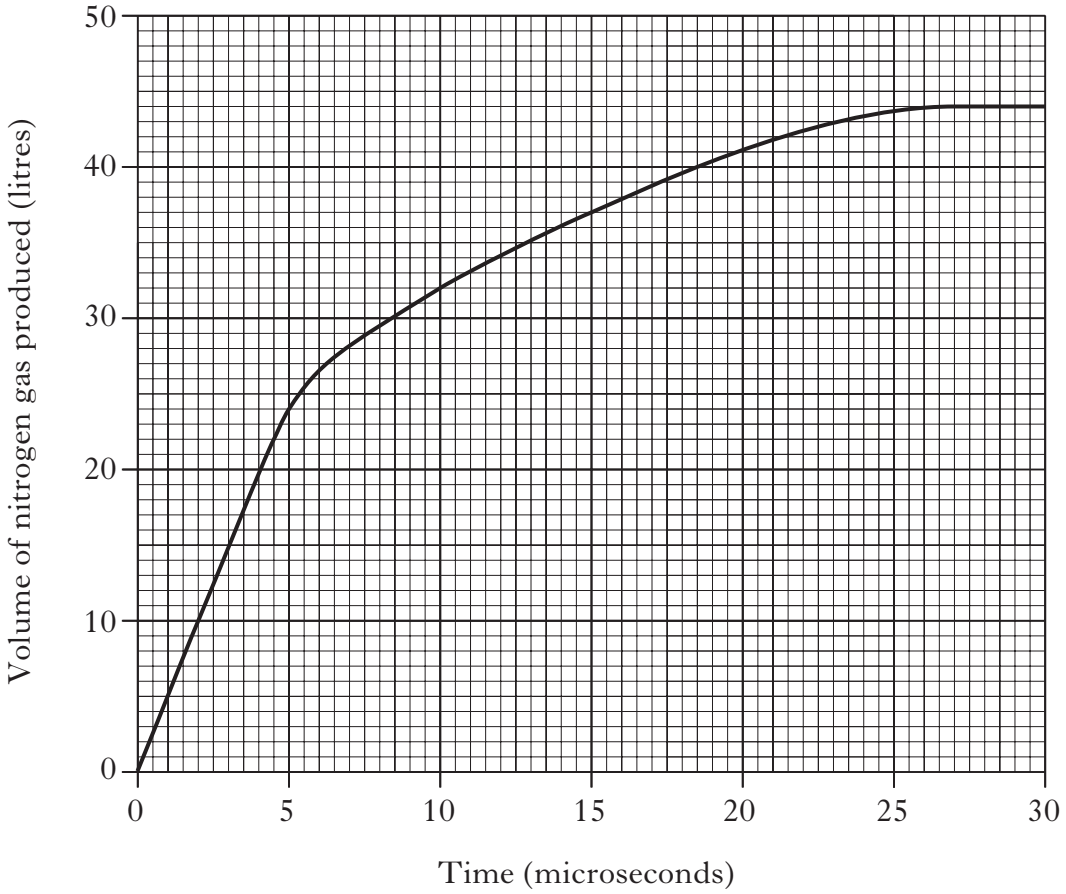
[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

2. Rapid inflation of airbags in cars is caused by the production of nitrogen gas.

The graph gives information on the volume of gas produced over 30 microseconds.



(*a*) (i) Calculate the average rate of reaction between 2 and 10 microseconds.

_____ litres per microsecond **1**

(ii) At what time has half of the final volume of nitrogen gas been produced?

_____ microseconds **1**

DO NOT WRITE IN THIS MARGIN

2. (continued) *Marks*

(*b*) In some types of airbag, electrical energy causes sodium azide, NaN_3, to decompose producing sodium metal and nitrogen gas.

Write a formula equation for this reaction.

1

(*c*) Potassium nitrate is also present in the airbag to remove the sodium metal by converting it into sodium oxide.

Why is it necessary to remove the sodium metal?

_____

_____ **1**

(4)

[Turn over

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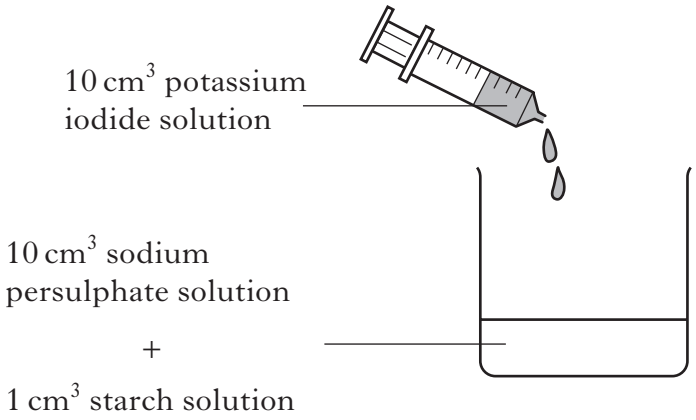
Marks

3. In the **PPA**, **"Effect of Concentration on Reaction Rate"**, the reaction between sodium persulphate and potassium iodide was investigated.



The results obtained during this PPA are shown in the table.

Experiment	Volume of sodium persulphate (cm^3)	Volume of water (cm^3)	Reaction time (s)
1	10	0	126
2	8		162
3	6		210
4	4		336

(*a*) Complete the results table to show the volumes of water used in experiments 2, 3 and 4. **1**

(*b*) How was the rate of reaction determined?

_____

_____ **1**

(*c*) Apart from using a timer, what allowed the accurate measurement of reaction times?

_____

_____ **1**

(3)

[Turn over for Question 4 on *Page fourteen*

Marks

4. Rhubarb contains oxalic acid, $C_2H_2O_4$.

Oxalic acid reacts with acidified potassium permanganate solution and decolourises it.

The equation for the reaction is:

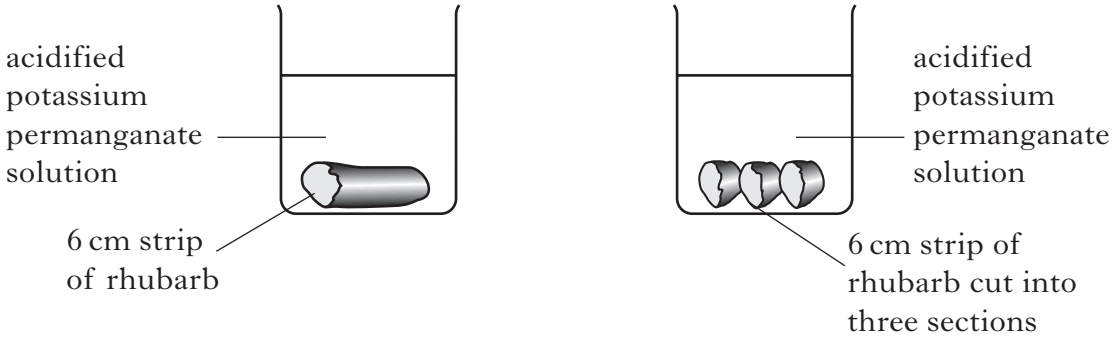
$$2MnO_4^-(aq) + 5C_2H_2O_4(aq) + 6H^+(aq) \longrightarrow 2Mn^{2+}(aq) + 10CO_2(g) + 8H_2O(\ell)$$

(*a*) The reaction is catalysed by the $Mn^{2+}(aq)$ ions produced in the reaction.

Using information from the equation, what type of catalyst is $Mn^{2+}(aq)$?

_____ **1**

(*b*) A student investigated the effect of surface area on the rate of reaction with acidified potassium permanganate solution.



It was found that when the rhubarb was cut into three sections the reaction was faster. Using collision theory, explain why cutting the rhubarb into three sections increases the rate of reaction.

_____

_____ **1**

DO NOT WRITE IN THIS MARGIN

4. (continued) *Marks*

(*c*) A strip of rhubarb was found to contain 1·8 g of oxalic acid.
How many moles of oxalic acid, $C_2H_2O_4$, are contained in 1·8 g.
(Formula mass of oxalic acid = 90)

_____ moles **1**

(3)

[Turn over

Marks

5. The alkanals are a homologous series of compounds that all contain the elements carbon, hydrogen and oxygen.

(*a*) What is meant by the term homologous series?

_____

_____ **1**

(*b*) The combustion of alkanals releases heat energy.

Name of alkanal	**Heat energy released when one mole burns (kJ)**
methanal	510
ethanal	1056
propanal	1624
butanal	2304

(i) Make a general statement linking the amount of heat energy released and the number of carbon atoms in the alkanal molecules.

_____

_____ **1**

(ii) Predict the amount of heat energy released, when 1 mole of pentanal burns.

_____ kJ **1**

(3)

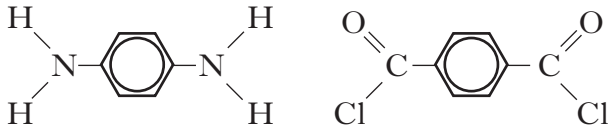
Marks

6. Kevlar is a polymer which is used in the manufacture of body armour.

(*a*) What property of Kevlar makes it suitable for use in body armour?

_____ **1**

(*b*) Kevlar is made from the following monomers.



(i) Draw the structure of the repeating unit formed from these two monomers.

1

(ii) Name the type of link formed.

_____ **1**

(3)

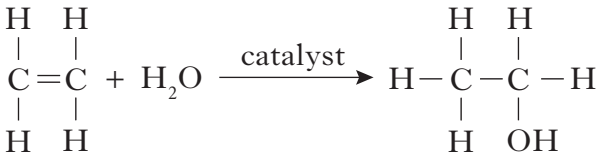
[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

7. Ethanol is a member of the alkanol family of compounds.

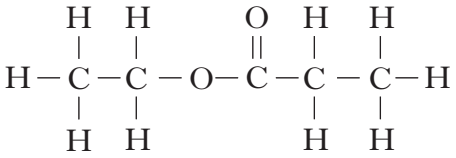
(*a*) Ethanol can be manufactured from ethene as shown in the following addition reaction.



What other name can be given to this type of addition reaction?

_____ **1**

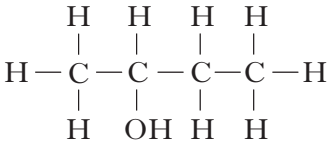
(*b*) Ethanol can be used to make esters which can be used as flavourings for food. The following ester is used to give ice cream a rum flavour.



Name this ester.

_____ **1**

(*c*) Butan-2-ol is another member of the alkanol family.



Draw the full structural formula for an isomer of butan-2-ol.

1

(3)

DO NOT WRITE IN THIS MARGIN

Marks

8. A student completed the **PPA "Testing for Unsaturation"**. Results from the experiment are shown in the table.

Hydrocarbon	Molecular Formula	Observation with bromine solution	Saturated or unsaturated
A	C_6H_{14}	no change	
B	C_6H_{12}		unsaturated
C	C_6H_{12}		saturated
D	C_6H_{10}	bromine decolourises	

(*a*) Complete the table. **2**

(*b*) Care had to be taken when using bromine solution. Give a safety precaution, **other** than eye protection, which should be taken when completing this PPA.

_____ **1**

(*c*) Suggest a possible name for hydrocarbon C.

_____ **1**

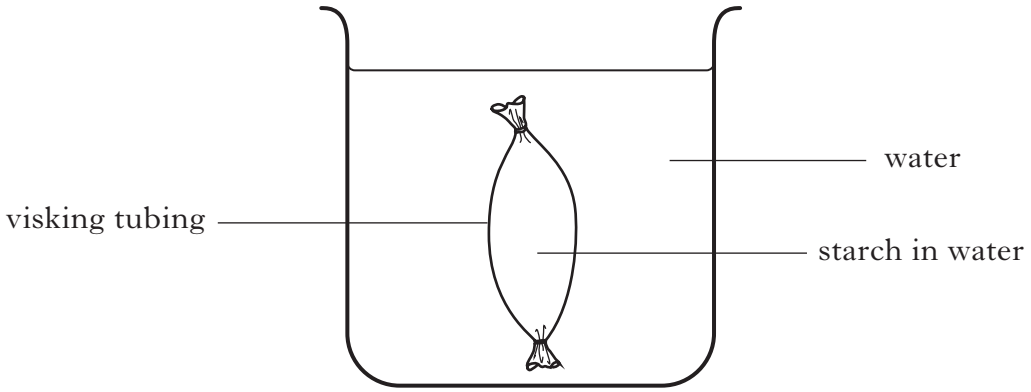
(4)

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

9. During digestion, molecules are broken down enabling them to pass through the gut wall. Visking tubing can be used to model the gut wall.



(*a*) Describe how you could use iodine solution to show that starch molecules are too large to pass through the visking tubing.

_____

_____

_____ **1**

(*b*) Starch is hydrolysed by the enzyme amylase during digestion.

(i) What is produced when starch is hydrolysed?

_____ **1**

(ii) Name another substance which can be used to hydrolyse starch.

_____ **1**

(3)

DO NOT WRITE IN THIS MARGIN

Marks

10.

The Dead Zone

In the summer of 2006, a 1000 square mile area of water at the bottom of the Pacific Ocean was found to be covered in dead crabs.

Scientists investigating this found an increased level of chlorophyll at the surface of the ocean and a zero level of oxygen at the bottom of the ocean. The increase in chlorophyll was due to increased numbers of plant plankton.

Scientists think that when plant plankton died they sank to the bottom of the ocean where they were broken down by bacteria during respiration. This used up all the oxygen from the water which resulted in the death of the crabs.

As respiration also produces carbon dioxide, scientists are monitoring the pH of the ocean water.

(*a*) What is the function of chlorophyll in plant plankton?

_____

_____ **1**

(*b*) Why is respiration essential to all living organisms?

_____

_____ **1**

(*c*) The pH of ocean water is normally around 8·2.

What effect will the carbon dioxide gas produced during respiration have on the pH of the ocean water?

_____

_____ **1**

(3)

[Turn over

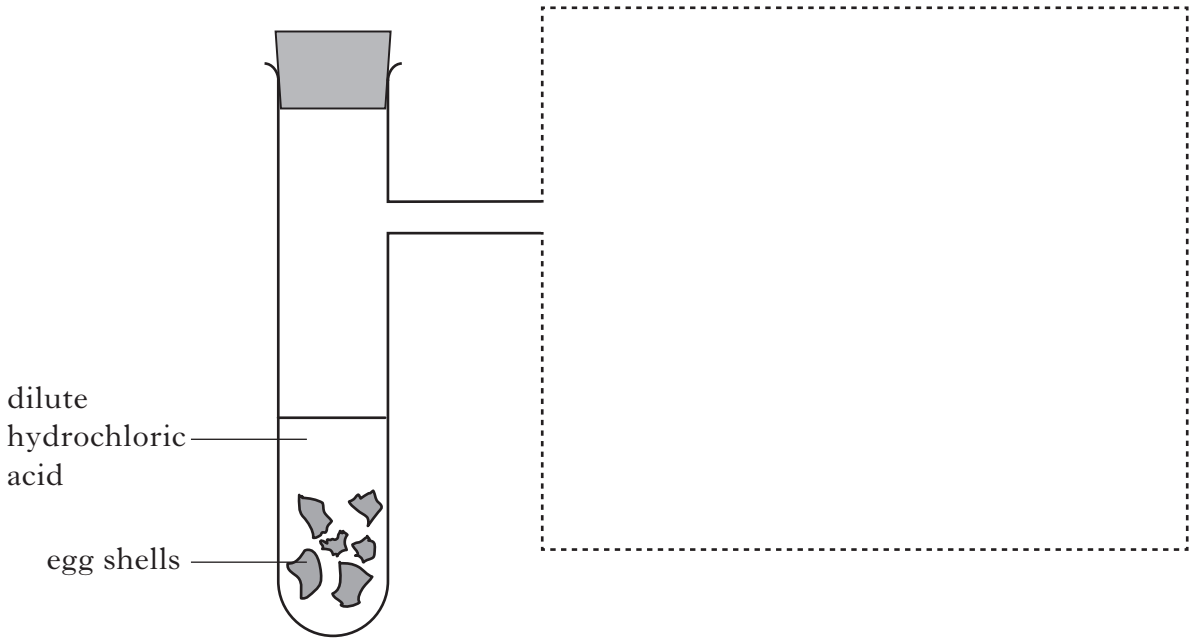
DO NOT WRITE IN THIS MARGIN

Marks

11. Egg shells are made up mainly of calcium carbonate. A pupil carried out an experiment to react egg shells with dilute hydrochloric acid. A gas was produced.

(*a*) Complete the diagram to show the apparatus which could have been used to measure the volume of gas produced.

(Additional paper, if required, can be found on *Page twenty-eight*.)



1

(*b*) Name the salt produced in this reaction.

_____ **1**

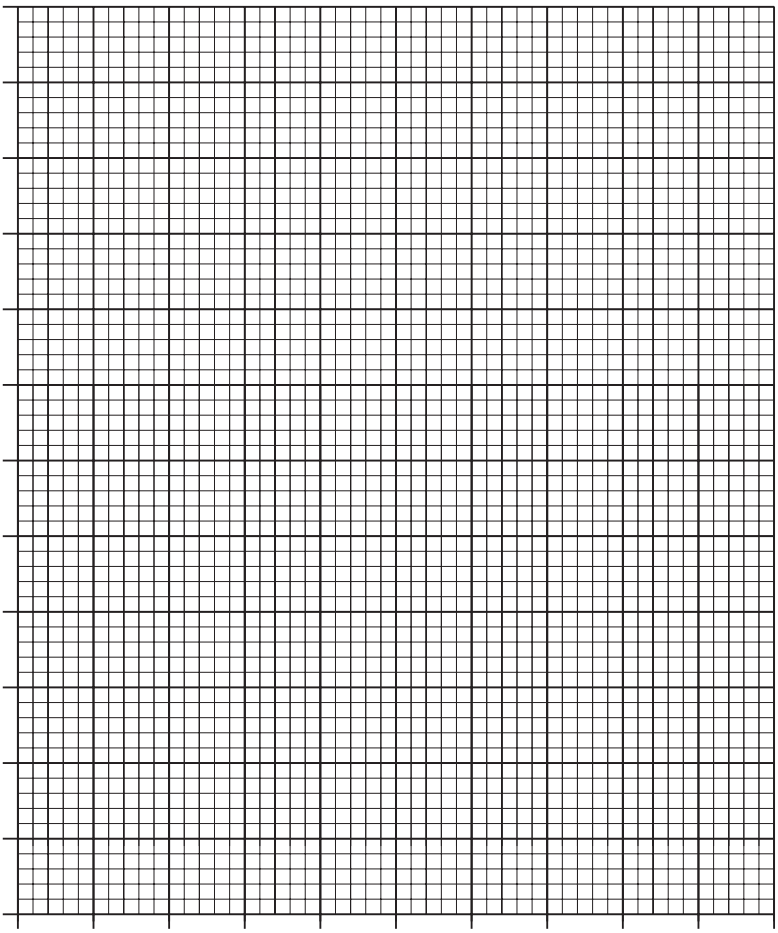
(*c*) The volume of gas produced during the reaction was measured.

Time (min)	Volume of gas (cm^3)
0	0
2	47
4	92
6	114
8	118
10	118

11. (*c*) (continued) *Marks*

Plot these results as a line graph.

(Additional graph paper, if required, can be found on *Page twenty-nine*.)



2

(4)

[Turn over

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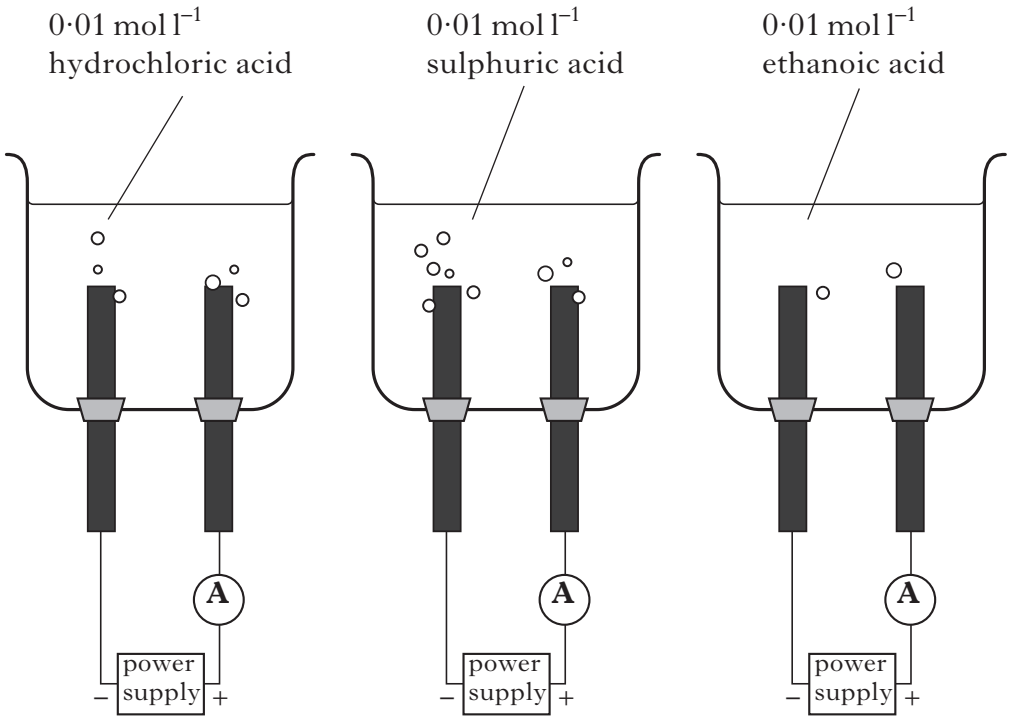
12. Three experiments were carried out to compare the pH and conductivity of weak and strong acids.

Marks



(*a*) The same gas was produced at the negative electrode in each experiment.

Name the gas that was produced.

_____ **1**

(*b*) Ethanoic acid is a weak acid.

What is meant by a weak acid?

_____

_____ **1**

(*c*) Circle the correct words in the table to show how the properties of the sulphuric acid solution compare with the hydrochloric acid solution.

	0·01 mol l^{-1} hydrochloric acid solution	**0·01 mol l^{-1} sulphuric acid solution**		
pH	2	lower	the same	higher
Current in a conductivity cell (microamps)	45	lower	the same	higher

1

(3)

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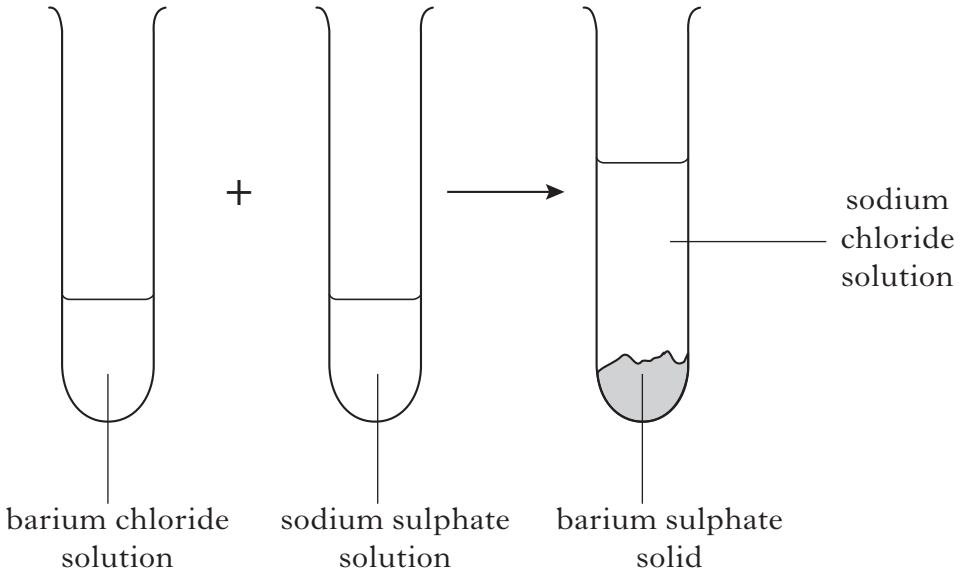
Marks

13. A student carried out the following experiment.



(*a*) During the reaction a solid was formed.

Name the type of chemical reaction taking place.

_____ **1**

(*b*) The equation for the reaction is

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

(i) Rewrite the equation showing only the ions which react.

1

(ii) What term is used to describe the ions which do not react?

_____ **1**

(3)

[Turn over

Marks

14. Cutlery can be coated with silver to prevent corrosion and to make it look attractive.

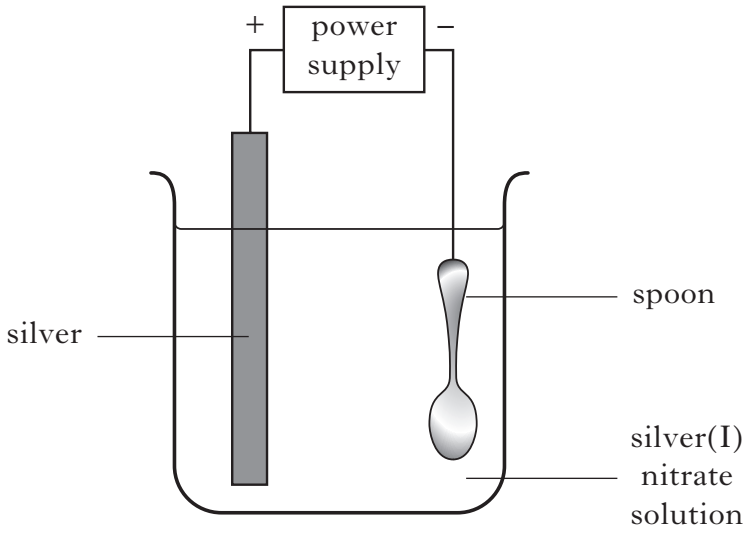
(*a*) What happens to atoms of a metal during corrosion?

_____

_____ **1**

(*b*) Electroplating is a process used to coat the cutlery with silver.

This diagram shows how this can be carried out.



(i) Write the ion-electron equation for the reaction taking place at the positive electrode.

(You may wish to use page 7 of the data booklet to help you.)

_____ **1**

(ii) Why must the cutlery be attached to the **negative** terminal of the power supply?

_____

_____ **1**

(3)

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15. Rust, iron(III) oxide, that forms on cars can be treated using rust remover which contains phosphoric acid. *Marks*

When painted on, rust remover changes iron(III) oxide into iron(III) phosphate.

$$Fe_2O_3 + 2H_3PO_4 \longrightarrow 2FePO_4 + 3H_2O$$

(*a*) The rust remover contains 250 cm^3 of 2 mol l^{-1} phosphoric acid.

(i) Calculate the number of moles of phosphoric acid in the rust remover.

_____ mol **1**

(ii) Using your answer in part (i), calculate the mass of iron(III) oxide that will be removed by 250 cm^3 of 2 mol l^{-1} phosphoric acid.

_____ grams **2**

(*b*) The iron(III) phosphate forms an insoluble coating which can be left on to protect the metal from further corrosion.

How does the iron(III) phosphate protect the iron from further corrosion?

_____

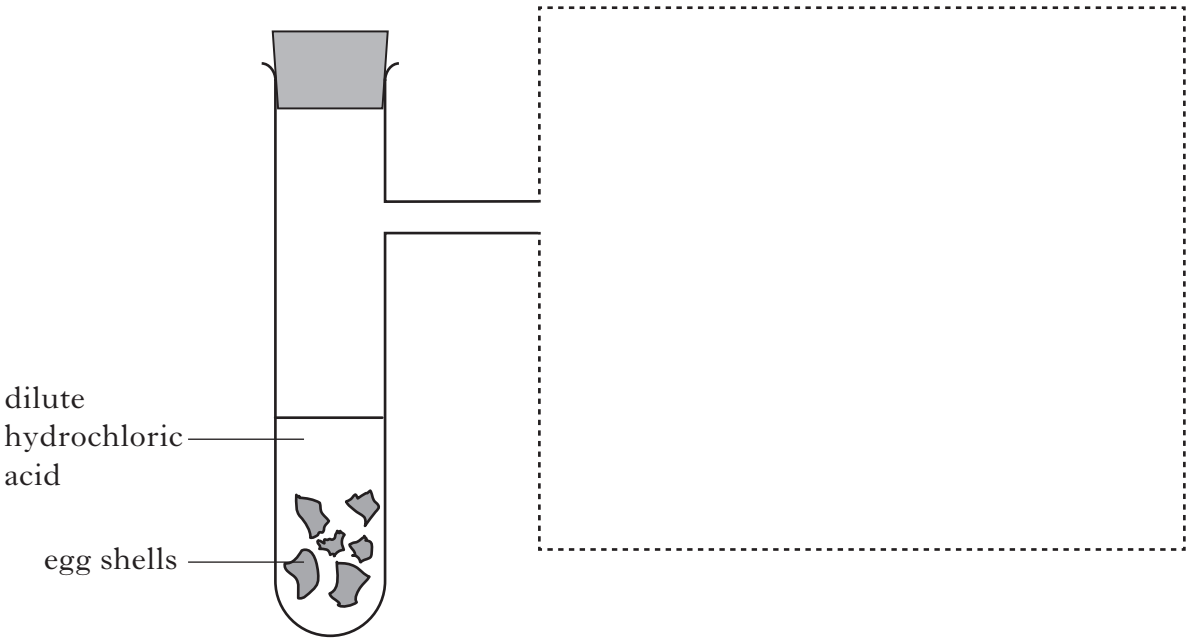
_____ **1**

(4)

[*END OF QUESTION PAPER*]

ADDITIONAL SPACE FOR ANSWERS

ADDITIONAL PAPER FOR QUESTION 11(*a*)



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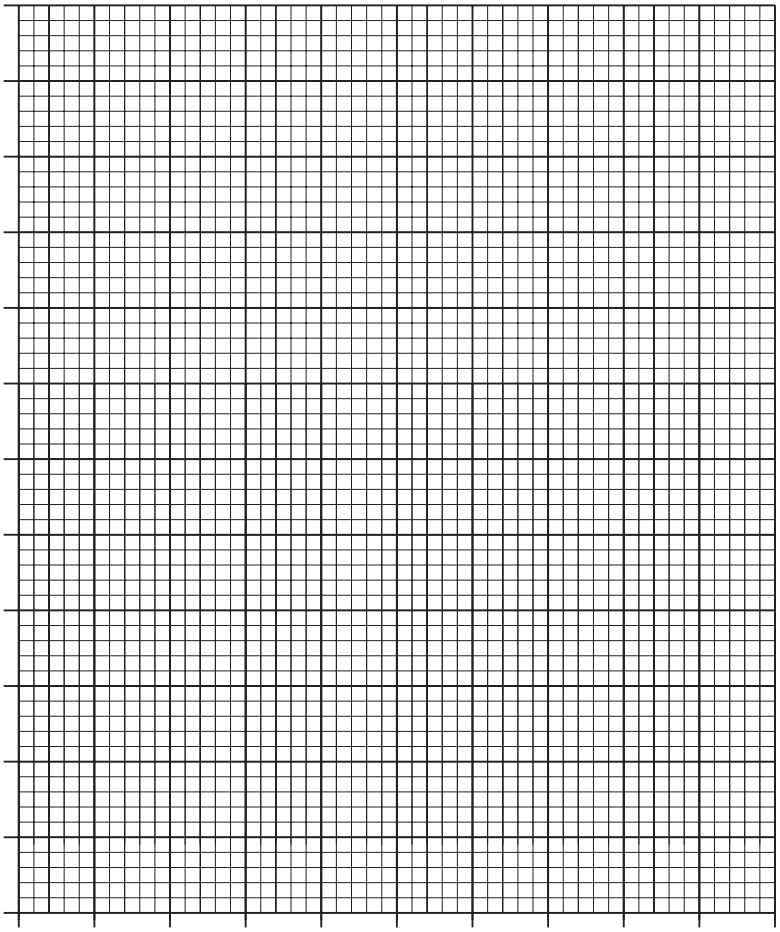
ADDITIONAL GRAPH PAPER FOR QUESTION 11(*c*)



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