



Rewarding Learning

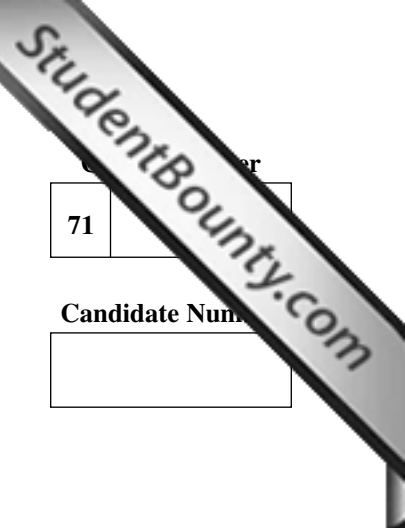
General Certificate of Secondary Education
2009

Science: Chemistry

Paper 2
Higher Tier

[G1404]

WEDNESDAY 17 JUNE, MORNING



71	
Candidate Number	
<input type="text"/>	

TIME

2 hours.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all seven** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 160.
Quality of written communication will be assessed in question 2(c)(ii).
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
A Data Leaflet which includes a Periodic Table of the Elements is provided.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
Total Marks	<input type="text"/>

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1 The Periodic Table contains all known elements. It evolved from the study of the trends and patterns in the physical and chemical properties of the elements.

(a) (i) Name the Russian chemist who devised a Periodic Table very similar to the modern Periodic Table used today.

_____ [1]

(ii) Fill in the blanks in the following passage.

The modern Periodic Table arranges the elements in order of increasing atomic _____ whereas early versions of the Periodic Table arranged them in order of increasing atomic _____.

[2]

(iii) State one other difference between the modern Periodic Table and early versions of the Periodic Table.

_____ [1]

(iv) Name the English chemist who devised “a law of octaves” for the elements.

_____ [1]

(b) The Periodic Table groups together elements with similar properties.

(i) How many groups are there in the Periodic Table?

_____ [1]

(ii) In which group would you find the most reactive metals?

_____ [1]

(iii) Name the group which contains only non-metals which are unreactive.

_____ [1]

(iv) How does the reactivity of the elements in Group II change on descending the group?

_____ [1]

Examiner Only

Marks Remark

(c) There are many patterns and trends in the Periodic Table.

(i) What is the name given to the horizontal rows in the Periodic Table?

_____ [1]

(ii) What is the relationship between the position of an element in the Periodic Table and the number of electrons in the outer shell of an atom of the element?

_____ [1]

(iii) Describe the trend in atomic size on moving across the Periodic Table from sodium to argon.

_____ [1]

(iv) Most elements may be classified as metals or non-metals. Name one element which is classified as a semi-metal and state one reason why it may be classified in this way.

Element: _____

Reason: _____

_____ [2]

Examiner Only	
Marks	Remark

- (d) Samples of oxides of elements were tested for their solubility in water. The pH of any resulting solution was recorded. The reaction of the oxides with dilute hydrochloric acid was also noted. The results are summarised in the table below.

Unknown oxide	Soluble in water	pH of solution	Reaction with dilute hydrochloric acid
A	YES	14	YES
B	NO	—	YES
C	YES	2	NO
D	YES	4	NO

- (i) Which **letters** represent oxides of non-metal elements?

_____ [2]

- (ii) Which **letter** represents an alkali?

_____ [1]

- (iii) Suggest a chemical name for the unknown oxide, **B**.

_____ [1]

- (e) Some **elements** form neutral oxides. Name one **element** which forms a neutral oxide and write the formula of this oxide.

Element: _____

Formula of oxide: _____ [2]

Examiner Only

Marks Remark

- 2 (a) Gunpowder is an explosive material which contains the salt potassium nitrate. In the 15th and 16th centuries potassium nitrate was obtained from urine. Nowadays potassium nitrate can be manufactured by neutralisation.



- (i) What do you understand by the term **salt**?

_____ [2]

- (ii) Write the formula for potassium nitrate.

_____ [1]

- (iii) Name **two compounds** which would react together to form potassium nitrate.

1. _____

2. _____ [2]

Examiner Only

Marks Remark

(b) Copper(II) chloride is a soluble salt which may be prepared by adding excess copper(II) carbonate to hydrochloric acid.

(i) What would you observe when solid copper(II) carbonate is added to dilute hydrochloric acid?

_____ [3]

(ii) Write a balanced symbol equation for the reaction of copper(II) carbonate with hydrochloric acid.

_____ [3]

(iii) How would you remove the excess copper(II) carbonate from the solution of the salt?

_____ [1]

(iv) Hydrated copper(II) chloride contains 2 moles of water of crystallisation. Write the formula of hydrated copper(II) chloride.

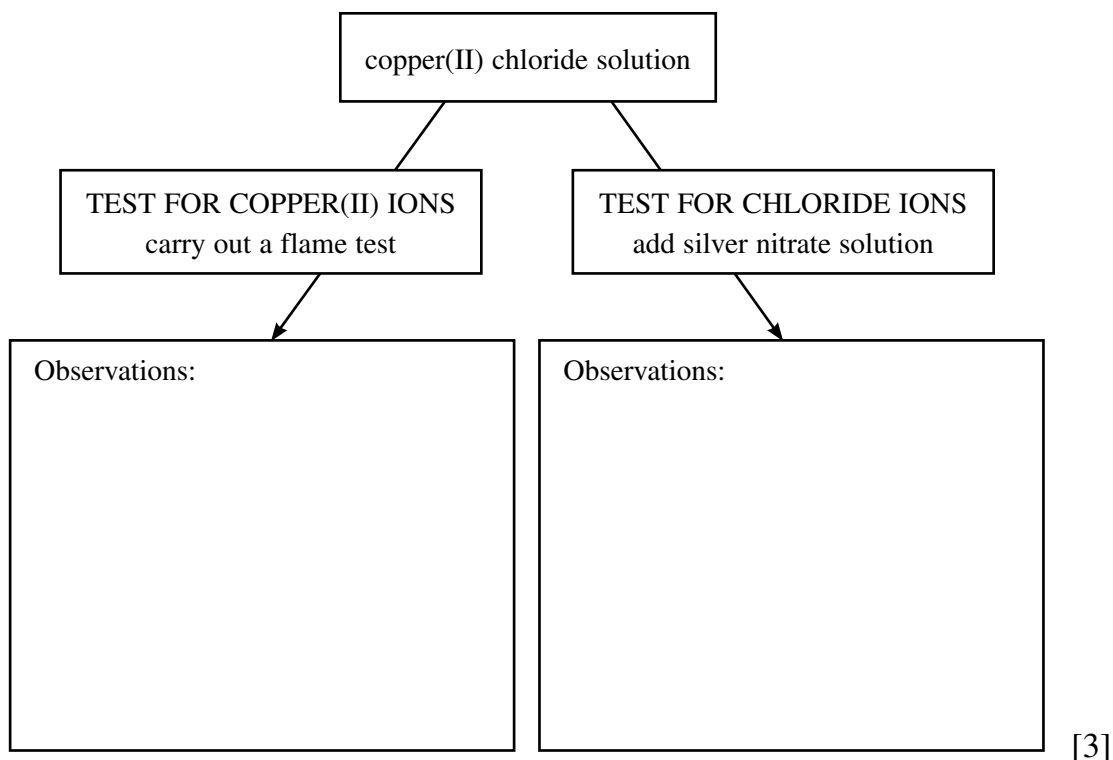
_____ [1]

(v) Describe how you prove **experimentally** that the hydrated copper(II) chloride crystals contain water.

_____ [4]

Examiner Only	
Marks	Remark

- (c) (i) A pure solution of the copper(II) chloride was tested as shown in the diagram below. Complete the boxes to state what you would observe when the two tests are carried out.



- (ii) Describe how you would carry out a flame test.

[4]

Quality of written communication

[2]

Examiner Only	
Marks	Remark

(d) Zinc hydroxide reacts with both acids and alkalis to form different salts.

(i) What name is given to a compound like zinc hydroxide which reacts with acids **and** alkalis?

_____ [1]

(ii) Write a balanced symbol equation for the reaction of zinc hydroxide with hydrochloric acid.

_____ [3]

(iii) What is the name of the salt produced when zinc hydroxide reacts with sodium hydroxide solution?

_____ [1]

(iv) Name one other compound which reacts with both acids and alkalis.

_____ [1]

Examiner Only

Marks

Remark

- 3 Bordeaux mixture is a combination of copper(II) sulphate and calcium hydroxide invented in the vineyards of the Bordeaux region of France, and used mainly to control fungus on grapes, apples and peaches.



Source: http://www.organiccatalog.com/catalog/product_info.php?cPath=61_181&products_id=517

- (a) Bordeaux mixture is prepared by making a solution of copper(II) sulphate and a solution of calcium hydroxide, and the two solutions are then poured together through a strainer.

(i) What colour is copper(II) sulphate solution?

_____ [1]

(ii) What colour is calcium hydroxide solution?

_____ [1]

(iii) What is the common name for a solution of calcium hydroxide?

_____ [1]

(iv) Name the gas which can be positively identified by using a solution of calcium hydroxide.

_____ [1]

Examiner Only

Marks Remark

(b) To prepare a solution of copper(II) sulphate for use in Bordeaux mixture, 6.8 g of hydrated copper(II) sulphate crystals were crushed and added to 20 g of water in a boiling tube.

The mixture was stirred with a thermometer and heated very gently in a water bath. All the crystals dissolved and a **saturated solution** was obtained at 50 °C.

(i) Draw a **labelled diagram** of the assembled apparatus used to heat and dissolve the copper(II) sulphate crystals.

[4]

(ii) Explain what is meant by the term **saturated solution**.

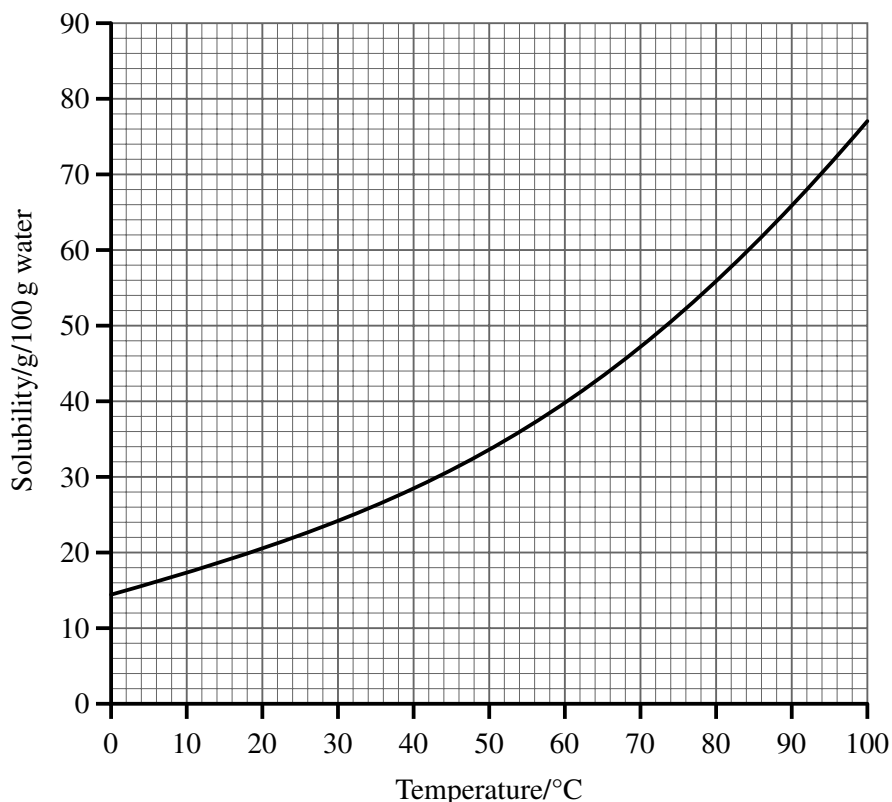
[2]

(iii) Calculate the solubility of copper(II) sulphate at 50 °C.

_____ g/100 g water [2]

Examiner Only	
Marks	Remark

(c) A solubility curve for copper(II) sulphate is shown below.



Use the solubility curve to answer the questions which follow.

(i) Suggest why the temperature axis does not go above 100 °C.

_____ [1]

(ii) What is the solubility of copper(II) sulphate at 70 °C?

_____ g/100 g water [1]

(iii) A hot solution of copper(II) sulphate containing 40 g of copper sulphate in 100 g of water was cooled from 80 °C to 30 °C. At what temperature would crystals begin to form?

_____ °C [1]

Examiner Only	
Marks	Remark

(iv) A saturated solution of copper(II) sulphate in 50 g of water at 60 °C was cooled from 60 °C to 30 °C. What mass of crystals was deposited?

_____ g [4]

(d) Like Bordeaux mixture, sulphur dioxide gas is used to control fungus on grapes.

(i) How does the solubility of sulphur dioxide gas change as the temperature increases?

_____ [1]

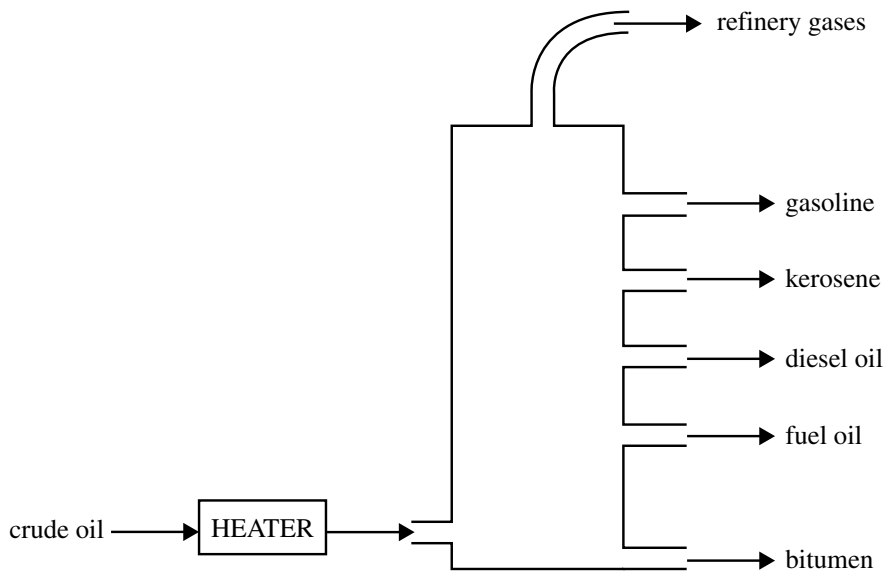
(ii) State one other use for sulphur dioxide.

_____ [1]

Examiner Only

Marks Remark

4 (a) The diagram shows how crude oil is separated into useful products.



(i) Name the process of separation shown in the diagram.

_____ [2]

(ii) The products contain compounds which contain only two elements. Name these two elements.

_____ [2]

(b) When the oil has been separated in this way there is often too much fuel oil. The large molecules of fuel oil can be broken down into smaller, more useful molecules as shown below.



(i) What is the name of process X?

_____ [1]

(ii) State **one** condition which is used in process X.

_____ [1]

Examiner Only	
Marks	Remark

(c) In the United Kingdom there are a large number of pipes carrying different gases. Two of the main gases carried by pipeline are methane and propene.

(i) Draw the structural formula of methane and propene in the table below.

Methane	Propene

[2]

(ii) Gas may leak from damaged pipes. Describe a chemical test which could be used to identify if a sample of the leaked gas was methane or propene.

[4]

(iii) Methane is the gas used for cooking and heating in many homes. Write a balanced symbol equation for the combustion of methane in excess air.

[3]

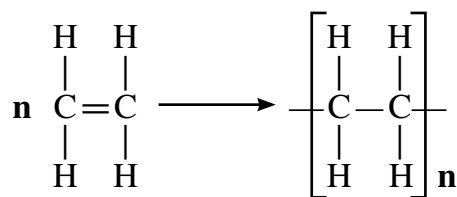
(iv) If a heating system is not serviced the methane may burn in a limited supply of air. Explain why this is dangerous.

[2]

Examiner Only

Marks Remark

(d) Ethene is used in many industrial reactions such as the one represented below.



(i) State fully the type of chemical reaction shown above.

_____ [2]

(ii) Name the product formed in this reaction.

_____ [1]

(iii) State **one** use of this product.

_____ [1]

(iv) What does **n** represent in the equation above?

_____ [1]

(e) Ethene is also used in industry to make ethanol.

(i) Write a balanced symbol equation for the manufacture of ethanol from ethene.

_____ [2]

(ii) Draw the structural formula of ethanol.

[2]

(iii) Suggest **one** reason why ethanol is used as a solvent in perfumes.

_____ [1]

Examiner Only

Marks

Remark

(f) Ethanol can also be produced by fermentation of sugar solution.

(i) What must be added to the sugar solution to allow fermentation to occur?

_____ [1]

(ii) What two conditions are required for fermentation?

1. _____

2. _____ [2]

Examiner Only	
Marks	Remark

5 Metals show a variety of physical and chemical properties. Some metals react with cold water and others, which do not react with cold water, will react with steam.

(a) (i) Some of the physical properties of metals and their meanings are given in the table below. Complete the table.

Physical Property	Meaning
	can be drawn out into wires
lustrous	

[2]

(ii) Explain in terms of structure why metals are malleable.

_____ [2]

(b) Both potassium and calcium react with cold water. Complete both of the tables below stating the observations and writing a balanced symbol equation for each reaction.

potassium and water	
observations	[4]
balanced symbol equation	[3]

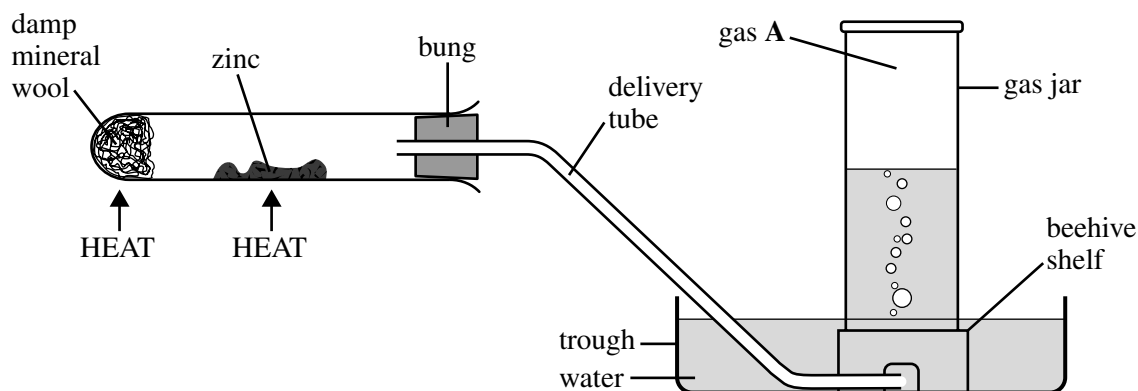
calcium and water	
observations	[3]
balanced symbol equation	[3]

Examiner Only

Marks Remark

(c) Zinc does not react with cold water, but does react with steam.

The diagram below shows the apparatus used to react zinc with steam and to collect the gaseous product.



(i) Explain why the damp mineral wool is heated.

_____ [1]

(ii) What is the name of gas A?

_____ [1]

(iii) Write a balanced symbol equation for the reaction of zinc with steam.

_____ [2]

(iv) Name **one other** metal which does not react with cold water but does react with steam.

_____ [1]

Examiner Only	
Marks	Remark

6 Heat plays an important role in many industrial processes, such as the production of iron in the blast furnace and the production of aluminium by electrolysis.

(a) In the blast furnace, blasts of hot air are blown in at the bottom of the furnace. This causes one of the raw materials, limestone, to break down. Carbon dioxide is a waste gas produced in the blast furnace.

(i) Name an ore from which iron may be extracted.

_____ [1]

(ii) What term is used to describe the breaking down of a compound using heat?

_____ [2]

(iii) Write a balanced symbol equation for the breaking down of limestone using heat.

_____ [2]

(iv) What is the main purpose of adding limestone to the blast furnace?

_____ [1]

(v) State one environmental problem caused by the release of carbon dioxide into the atmosphere.

_____ [1]

Examiner Only

Marks Remark

(b) Aluminium is extracted from its ore, bauxite, which is an impure form of aluminium oxide. The ore is purified and the pure aluminium oxide is added to molten cryolite before it is electrolysed.

(i) Write the formula of aluminium oxide.

_____ [1]

(ii) At what temperature is the electrolysis carried out?

_____ [1]

(iii) State **two** purposes of the cryolite.

1. _____

2. _____ [2]

(iv) Suggest two reasons why the extraction of aluminium from its ore is much more expensive than the extraction of iron from its ore.

1. _____

2. _____

_____ [2]

(v) Bauxite is obtained from the earth by open cast mining. Identify two negative effects of mining on the local environment.

1. _____

2. _____

_____ [2]

(vi) State **one** use of aluminium.

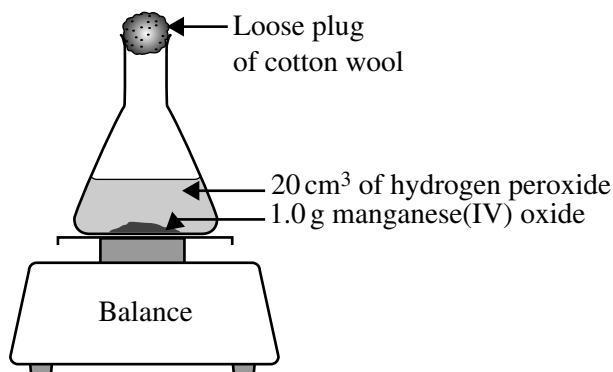
_____ [1]

Examiner Only

Marks Remark

7 Hydrogen peroxide decomposes in the presence of solid manganese(IV) oxide to produce water and oxygen. The apparatus shown below was used to investigate the rate of decomposition of hydrogen peroxide solution.

(a) 20 cm³ of hydrogen peroxide solution were added to 1.0 g of solid manganese(IV) oxide at 20 °C.



The following results were obtained.

Time (minutes)	Mass of oxygen lost (g)
0	0.00
1	0.23
2	0.34
4	0.45
5	0.47
6	0.48
7	0.48

(i) Write a balanced symbol equation for the decomposition of hydrogen peroxide.

_____ [3]

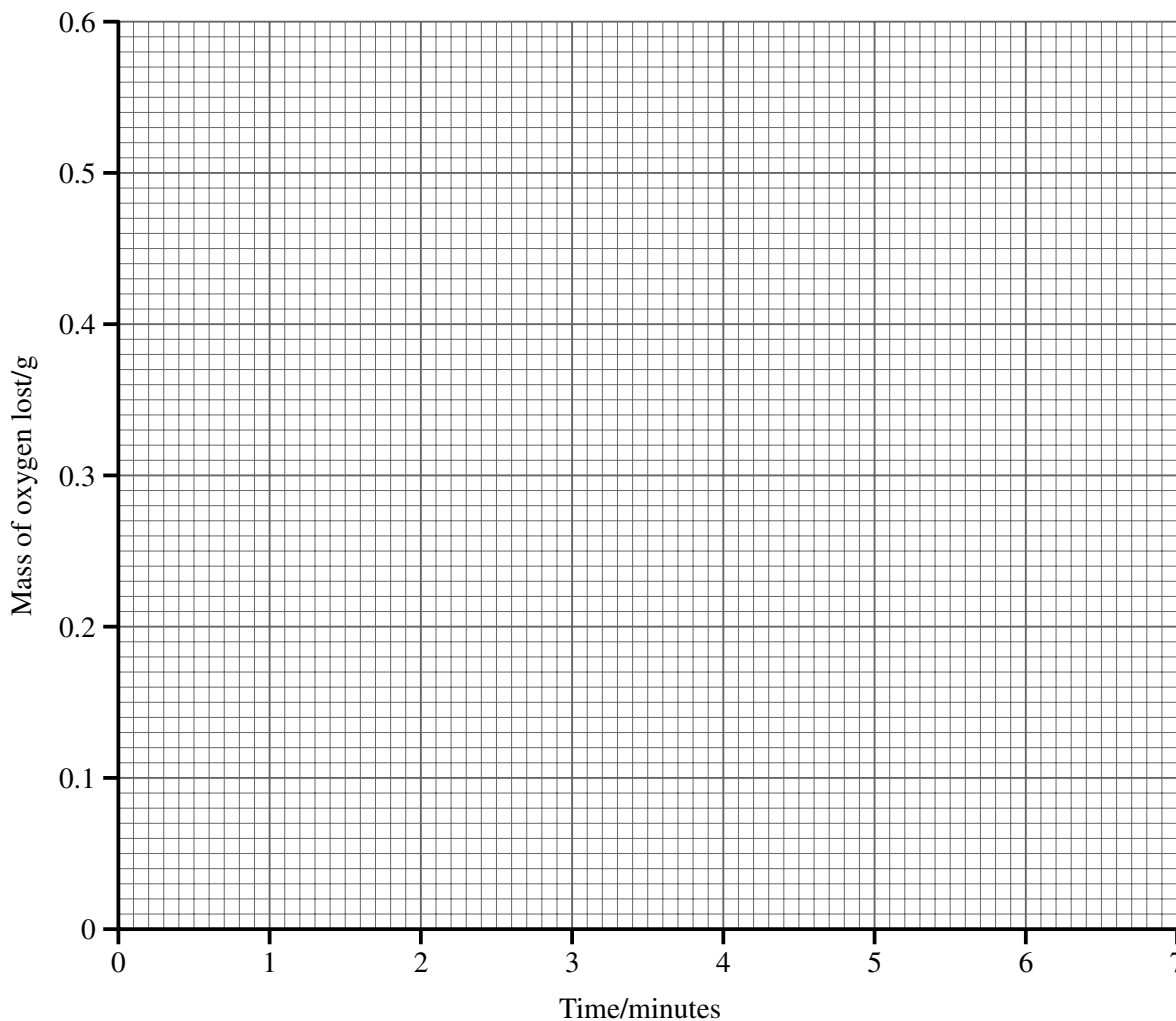
(ii) What is the purpose of the cotton wool plug?

_____ [1]

Examiner Only

Marks Remark

(iii) Plot a graph of mass of oxygen lost (g) against time (minutes) on the axes given below.



[3]

(iv) Use the graph to determine the mass of oxygen lost after 3 minutes.

_____ [1]

(v) How could you experimentally investigate the rate of this reaction without measuring the mass of oxygen lost?

_____ [1]

Examiner Only	
Marks	Remark

[Turn over

(b) At the end of this experiment the manganese(IV) oxide can be recovered.

(i) Draw a **labelled diagram** of the assembled apparatus which could be used to recover the manganese(IV) oxide at the end of the experiment.

[3]

(ii) How would you experimentally prove that the manganese(IV) oxide was not used up in this experiment?

_____ [2]

(iii) What is the role of manganese(IV) oxide in this experiment?

_____ [1]

Examiner Only	
Marks	Remark

- (c) To investigate the effect of temperature on this reaction, 20 cm³ of hydrogen peroxide were heated to 40 °C and added to 1.0 g of manganese(IV) oxide in the same apparatus as shown in part (a). The reaction was over in 4 minutes.

State and explain, **in terms of particles**, the effect of increasing the temperature of the hydrogen peroxide on the rate of the reaction.

Effect: _____ [1]

Explanation: _____

_____ [3]

THIS IS THE END OF THE QUESTION PAPER

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