CCEA GCSE CHEMISTRY (2003 SPECIFICATION)

CHEMISTRY



EXAM QUESTION PACK

PAPER 2 HIGHER TIER G1404 PAPERS

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Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2012

Science: Chemistry

Paper 2
Higher Tier

[G1404]

G1404

FRIDAY 22 JUNE, AFTERNOON

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

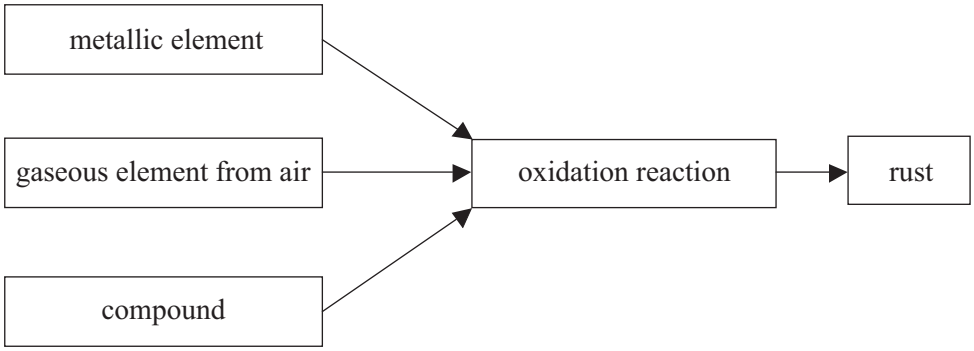
The total mark for this paper is 160.
Quality of written communication will be assessed in question **7(c)**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
A Data Leaflet which includes a Periodic Table of the Elements is provided.

For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
4	
5	
6	
7	
Total Marks	

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Examiner Only	
Marks	Remark

1 **(a)** The formation of rust is described as an oxidation reaction. The flow chart below shows the formation of rust during which a metallic element reacts with a gaseous element from the air and a compound.



(i) Name the metallic element which reacts to form rust.

_____ [1]

(ii) Name the gaseous element from the air which is required for the formation of rust.

_____ [1]

(iii) Name the compound which is required for the formation of rust.

_____ [1]

(iv) Explain what is meant by oxidation.

_____

_____ [1]

(v) Describe the appearance of rust.

_____

_____ [2]

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(b) The reaction of chlorine with hydrogen may be described as both an exothermic reaction and as a reduction.

chlorine + hydrogen → hydrogen chloride

(i) Write a balanced symbol equation for the reaction of chlorine with hydrogen.

_____ [3]

(ii) Explain why chlorine is described as being reduced in this reaction.

_____

_____

_____ [2]

(iii) Describe the colour of the reactants in this reaction.

chlorine _____

hydrogen _____ [2]

(iv) What is meant by the term exothermic?

_____

_____ [1]

(c) Copper(II) carbonate breaks down on heating in an endothermic reaction.

(i) What term is used to describe a reaction in which a substance breaks down on heating?

_____ [2]

(ii) Write a balanced symbol equation for the reaction which occurs when copper(II) carbonate is heated.

_____ [2]

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Marks	Remark

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(iii) State the colour change observed when copper(II) carbonate is heated.

_____

_____ [2]

(d) Magnesium reacts with copper(II) sulphate solution. The reaction is described as a redox reaction as both oxidation and reduction are occurring. The balanced symbol equation and ionic equation for the reaction are given below.

Balanced Symbol Equation: $Mg + CuSO_4 \rightarrow Cu + MgSO_4$

Ionic Equation: $Mg + Cu^{2+} \rightarrow Cu + Mg^{2+}$

(i) In this reaction, which ion does not undergo any change?

_____ [1]

(ii) What is oxidised in this reaction?

_____ [1]

(iii) Write a half equation for the oxidation process occurring in this reaction.

_____ [3]

(iv) Explain why copper ions are described as being reduced in this reaction.

_____

_____ [2]

Examiner Only

Marks	Remark

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2 Pharmaceutical drugs are manufactured and analysed in a specialised chemistry laboratory.



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(a) Amyl nitrite is a drug commonly used to treat patients with heart disease.
A sample of amyl nitrite was analysed and found to contain four elements in the following proportions: 72.0 g of carbon, 13.2 g of hydrogen, 16.8 g of nitrogen and 38.4 g of oxygen.

Determine the empirical formula of amyl nitrite.
(Relative atomic masses: H = 1; C = 12; N = 14; O = 16)

Empirical formula _____ [5]

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Marks	Remark

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Examiner Only	
Marks	Remark

(b) The pharmaceutical drug Eskalith is made from another carbon containing compound. The formula of this compound may be written as X_2CO_3. To determine the identity of X in this compound, a titration was carried out.

3.70 g of solid X_2CO_3 were dissolved in 1000 cm^3 of deionised water and mixed thoroughly. 25.0 cm^3 of this solution were placed in a conical flask with a few drops of methyl orange indicator. 20.0 cm^3 of 0.125 mol/dm^3 hydrochloric acid were required to reach the end-point.

(i) Calculate the number of moles of hydrochloric acid used in this titration.

moles _____ [2]

The balanced symbol equation for the reaction is:

$$X_2CO_3 + 2HCl \rightarrow 2XCl + CO_2 + H_2O$$

(ii) Use the balanced symbol equation to determine the number of moles of X_2CO_3 present in 25.0 cm^3 of the solution in the conical flask.

moles _____ [2]

(iii) Calculate the number of moles of X_2CO_3 present in 1000 cm^3 of solution.

moles _____ [2]

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(iv) Using the initial mass of X_2CO_3 and the answer to **(b) (iii)**, calculate the relative formula mass of X_2CO_3.

relative formula mass _____ [2]

(v) Calculate the relative atomic mass of X and use your Data Leaflet to determine the identity of X.
(Relative atomic masses: C = 12; O = 16)

relative atomic mass _____

identity of X _____ [2]

Examiner Only	
Marks	Remark

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(c) Nitrous oxide (N_2O), also known as laughing gas, is commonly used as an anaesthetic in dentistry. Nitrous oxide may be produced by heating a sample of ammonium nitrate, NH_4NO_3. The equation for this reaction is given below.

$$NH_4NO_3(s) \rightarrow 2H_2O(g) + N_2O(g)$$

Calculate the volume of nitrous oxide in dm^3 which can be produced when 2 kg of ammonium nitrate are fully decomposed on heating. (Relative atomic masses: H = 1; N = 14; O = 16; 1 mole of any gas occupies a volume of 24 dm^3 at room temperature and pressure.)

volume of N_2O _____ dm^3 [6]

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Marks	Remark

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(d) Nitrous oxide (N_2O) may also be produced by heating ammonia and oxygen in the presence of a catalyst. The equation for this reaction is given below.

$$2NH_3(g) + 2O_2(g) \rightarrow N_2O(g) + 3H_2O(g)$$

(i) State Avogadro's Law.

_____

_____

_____ [3]

(ii) Using Avogadro's Law, or otherwise, calculate the volume of ammonia (NH_3) in cm^3, required to produce 70 cm^3 of nitrous oxide (N_2O).

volume of NH_3 _____ cm^3 [2]

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Marks	Remark

3 **(a)** Acids, bases, alkalis and salts are used in many commonly available household products such as those shown below. One substance found in each is stated.

óThe following images have been removed from this page due to copyright issues:

ÅA bag of Bath Crystals containing magnesium chloride.
ÅA bottle of Milk of Magnesia liquid containing magnesium hydroxide.
ÅA can of Mr Muscle Oven Cleaner containing sodium hydroxide.
ÅA bag of Mosskiller & Lawn Tonic containing zinc sulphate.ô

(i) Classify each substance as an acid, base, alkali or salt by placing a tick (✔) in the correct column in the table below. Choose the most common classification for each substance. You may find your Data Leaflet useful in answering this question.

Substance	acid	base	alkali	salt
magnesium chloride				
magnesium hydroxide				
sodium hydroxide				
zinc sulphate				

[4]

(ii) Sodium hydroxide reacts with sulphuric acid. Write a balanced symbol equation for this reaction.

_____ [3]

(iii) Name the salt produced when magnesium hydroxide reacts with nitric acid.

_____ [1]

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(iv) Hydrated zinc sulphate has the formula $ZnSO_4.7H_2O$. What is meant by the term hydrated?

_____

_____ [2]

Examiner Only

Marks	Remark

(b) A pure, dry sample of potassium chloride can be prepared by the reaction of potassium hydroxide solution with hydrochloric acid.

The flow chart below explains how this is carried out.

Step 1 Place 25.0 cm^3 of potassium hydroxide solution into a conical flask

↓

Step 2 Add a few drops of phenolphthalein to the conical flask

↓

Step 3 Add hydrochloric acid from a burette until the indicator changes colour

↓

Step 4 Add charcoal, heat and filter the solution

↓

Step 5 Heat the solution in an evaporating basin to reduce the volume

↓

Step 6 Leave aside to cool and crystallise

↓

Step 7 Filter off the crystals and dry them

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(i) Name the piece of apparatus required to place 25.0 cm^3 of potassium hydroxide solution into the conical flask in **Step 1**.

_____ [1]

(ii) What colour change is observed in **Step 3**?

From _____ to _____ [2]

(iii) What is the purpose of the charcoal in **Step 4**?

_____ [1]

(iv) Draw a labelled diagram of the assembled apparatus used to heat the solution in **Step 5**.

[3]

(v) Explain why crystals form on cooling in **Step 6**.

_____

_____ [1]

(vi) State **one** method which may be used to dry the crystals in **Step 7**.

_____

_____ [1]

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Marks	Remark

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(c) The presence of anions in salts can be determined by mixing two solutions and observing the formation of a precipitate and its colour.

Examiner Only	
Marks	Remark

(i) What is an anion?

_____ [1]

(ii) What is meant by the term precipitate?

_____

_____ [2]

(iii) Name the solution which is used to test for the presence of sulphate ions.

_____ [1]

(iv) Potassium iodide solution was mixed with silver nitrate solution and a precipitate formed. State the colour of the precipitate.

_____ [1]

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Examiner Only	
Marks	Remark

4 Aluminium is the most abundant metal in the Earth's crust. Aluminium ore is first purified to give aluminium oxide and the metal is then extracted from the aluminium oxide by electrolysis.

(a) What is meant by the term electrolysis?

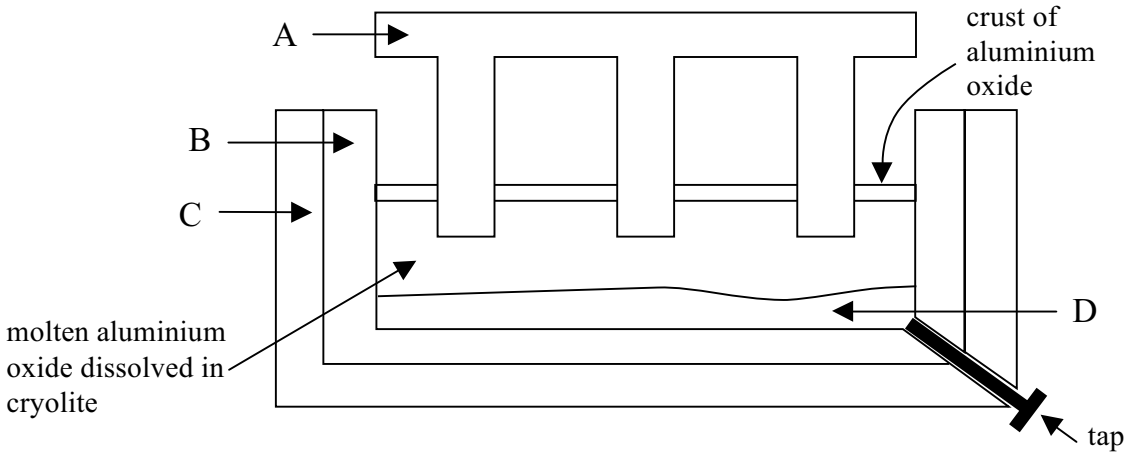
_____

_____ [2]

(b) Name the ore from which aluminium is extracted.

_____ [1]

(c) The electrolysis of the purified ore is carried out in the Hall-Héroult cell. The diagram below shows the cell used.



(i) Name parts A, B and C, and substance D.

A _____

B _____

C _____

D _____ [4]

(ii) Explain why the aluminium oxide will only conduct electricity when molten.

_____

_____ [2]

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(iii) At what temperature does the electrolysis take place?

Examiner Only	
Marks	Remark

_____ [1]

(iv) Suggest **one** reason why the aluminium oxide is dissolved in cryolite.

_____ [1]

(v) Name the products formed at the positive and negative electrodes and write half equations for the reactions taking place at each electrode.

	Positive electrode	**Negative electrode**
Name of product		
Half equation		

[2]

[6]

(vi) Which electrode must be replaced regularly? Write a balanced symbol equation to explain your answer.

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Marks	Remark

Electrode: _____ [1]

Equation: _____ [2]

(vii) Explain how the aluminium produced in the process is removed from the cell.

_____

_____ [1]

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Examiner Only	
Marks	Remark

5 The earth is a rich source of many raw materials. Some of these raw materials, including lignite, are extracted by open-cast mining.

(a) Lignite is a fossil fuel. Describe how lignite is formed.

_____

_____

_____ [3]

(b) Large deposits of lignite have been located near Ballymoney, County Antrim. The advantages and disadvantages associated with mining this lignite were debated in the Northern Ireland Assembly in July 2007.

(i) State **two** advantages for the local community of setting up a lignite mine.

1. _____

_____

2. _____

_____ [2]

(ii) State **two** disadvantages for the local community of setting up a lignite mine.

1. _____

_____

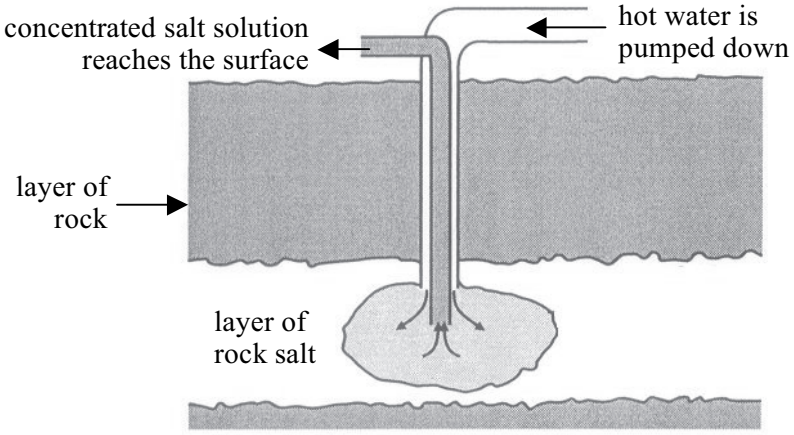
2. _____

_____ [2]

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Marks	Remark

(c) Another method used to extract raw materials from the earth is solution mining. This method is used to extract sodium chloride from the earth.



(i) On what physical property of sodium chloride does this process depend?

_____ [1]

(ii) Suggest **one** reason why solution mining uses a lot of energy.

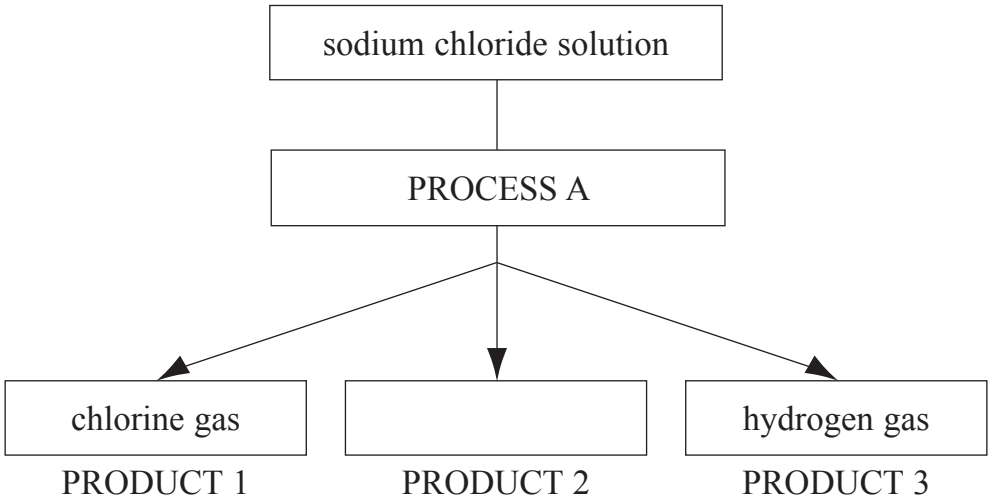
_____ [1]

(iii) Suggest **one** negative effect which solution mining has on the environment.

_____ [1]

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(d) The chlor-alkali industry uses a substantial percentage of the sodium chloride produced from solution mining. The main process involved is summarised in the diagram below.



(i) Name Process A.

_____ [1]

(ii) Write the chemical formula for Product 2.

_____ [1]

(iii) State **one** use of each of the gaseous products.

chlorine: _____

hydrogen: _____ [2]

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Marks	Remark

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Examiner Only	
Marks	Remark

6 On 14th April 2010 the volcano Eyjafjallajökull erupted in Iceland, creating an ash cloud which was dangerous for aircraft and led to the closure of many airports for about ten days.



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A large number of gases were released into the atmosphere from the volcano. These volcanic gases included carbon dioxide, hydrogen and hydrogen chloride.

(a) Complete the table below to describe the tests used to identify each of these gases in the laboratory, and state the result of a positive test for each gas.

Gas	Test	Result of positive test	
carbon dioxide			[2]
hydrogen			[2]
hydrogen chloride			[4]

Examiner Only	
Marks	Remark

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(b) Sulphur dioxide is also emitted when a volcano erupts. It is a pollutant gas which reacts with water in the air to form acid rain.

(i) Write a balanced symbol equation for the reaction of sulphur dioxide with water.

_____ [2]

(ii) State **two** harmful effects of acid rain on the environment.

1. _____

_____

2. _____

_____ [2]

(c) Volcanic ash contains many different minerals and can be used in cosmetics including skin scrubs. Some skin scrubs, such as the one shown below, contain sugar to give roughness.

óAn image of MAC Volcanic Ash Exfoliator has been removed from this page due to copyright issues.ô

(i) Describe the appearance of sugar.

_____ [2]

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Marks	Remark

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(ii) State **three** observations you would make when concentrated sulphuric acid is added to sugar.

_____

_____

_____ [3]

(d) Iron compounds are added to many cosmetics to give colour. Iron compounds may contain the iron(II) ion or the iron(III) ion. The presence of these ions in solution may be detected by adding ammonia solution.

(i) Complete the table to show what would be observed when ammonia solution is added to a solution of iron(II) ions and to a solution of iron(III) ions.

	Result of a positive test when ammonia solution is added
iron(II) ion	
iron(III) ion	

[4]

(ii) Write an ionic equation for the reaction of iron(II) ions with ammonia solution.

_____ [3]

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Marks	Remark

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7 Hydrogen peroxide, H_2O_2, decomposes very slowly to produce water and oxygen.

(a) Draw a labelled diagram of the assembled apparatus used to carry out this reaction and measure the volume of oxygen produced every minute. Include all apparatus required.

[4]

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Marks	Remark

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Marks	Remark

(b) The rate of decomposition of hydrogen peroxide may be increased by adding 1 g of manganese(IV) oxide (manganese dioxide) to the solution. The manganese(IV) oxide acts as a catalyst.

(i) Explain what you understand by the term catalyst.

_____

_____

_____ [3]

(ii) What mass of manganese(IV) oxide will be recovered at the end of the reaction?

_____ [1]

(iii) Catalysts are important in many industrial processes. Complete the table below.

Industrial Process	**Catalyst used**	**Balanced symbol equation for the catalysed reaction**	
The Haber Process	iron		[3]
The Contact Process		$2SO_2 + O_2 \rightarrow 2SO_3$	[1]
Production of Nitric acid	platinum/ rhodium		[3]

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(c) Another method of increasing the rate of decomposition of hydrogen peroxide is to increase the temperature of the solution. Explain, in terms of particles, how increasing the temperature of the solution increases the rate of reaction.

_____

_____

_____

_____

_____

_____

_____ [3]

Quality of written communication [2]

(d) In the Haber Process, a pressure of 250 atmospheres is used even though a higher yield of ammonia can be obtained at a higher pressure. Suggest **two** reasons why a higher pressure is not used in the process.

1. _____

_____

_____

2. _____

_____

_____ [2]

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Marks	Remark

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General Certificate of Secondary Education
2012

Science: Chemistry

Paper 2
Higher Tier

[G1404]

FRIDAY 22 JUNE, AFTERNOON

MARK SCHEME

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					AVAILABLE MARKS
1	(a)	(i)	iron	[1]	
		(ii)	oxygen	[1]	
		(iii)	water	[1]	
		(iv)	gain of oxygen	[1]	
		(v)	red-brown [1] flaky [1] solid [1]	maximum [2]	
	(b)	(i)	$H_2 + Cl_2 \rightarrow 2HCl$	[3]	
		(ii)	chlorine gains hydrogen [1] gain of hydrogen is reduction [1]	[2]	
		(iii)	chlorine: yellow-green [1] hydrogen: colourless [1]	[2]	
		(iv)	gives out heat	[1]	
	(c)	(i)	thermal [1] decomposition [1]	[2]	
		(ii)	$CuCO_3 \rightarrow CuO + CO_2$	[2]	
		(iii)	green [1] to black [1]	[2]	
	(d)	(i)	sulphate	[1]	
		(ii)	magnesium	[1]	
		(iii)	$Mg \rightarrow Mg^{2+} + 2e^-$	[3]	
		(iv)	(copper ions) gain electrons [1] gain of electrons is reduction [1]	[2]	27

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			AVAILABLE MARKS
2	**(a)**	moles of carbon = $\frac{72}{12}$ = 6 [1]	
		moles of hydrogen = $\frac{13.2}{1}$ =13.2 [1]	
		moles of nitrogen = $\frac{16.8}{14}$ =1.2 [1]	
		moles of oxygen = $\frac{38.4}{16}$ = 2.4 [1]	
		$C_5H_{11}NO_2$ or ratio: C:H:N:O = 5:11:1:2 [1] [5]	
	(b) **(i)**	$\frac{20 \times 0.125}{1000}$ [1] = 0.0025 [1] [2]	
	(ii)	$\frac{0.0025}{2}$ [1] = 0.00125 [1] [2]	
	(iii)	0.00125 × 40 (**or** $\frac{0.00125 \times 1000}{25}$) [1] = 0.05 [1] [2]	
	(iv)	$\frac{3.7}{0.05}$ [1] = 74 [1] [2]	
	(v)	74 – 60 = 14/2 = 7 [1] lithium/Li_2CO_3/Li [1] [2]	
	(c)	mass of NH_4NO_3 = 2000 g [1]	
		RFM of NH_4NO_3 = 80 [1]	
		moles of NH_4NO_3 = $\frac{2000}{80}$ = 25 [1]	
		moles of N_2O = 25 [1] 25 × 24 [1] = 600 [1] dm^3 [6]	
	(d) **(i)**	equal volumes of gases [1] under the same conditions of temperature and pressure [1] contain the same number of particles [1] [3]	
	(ii)	70 × 2 [1] = 140 [1] cm^3 [2]	26

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AVAILABLE MARKS

3 (a) (i)

Substance	acid	base	alkali	salt
magnesium chloride				✓ [1]
magnesium hydroxide		✓ [1]		
sodium hydroxide		✓	✓	
	accept either tick for sodium hydroxide [1]			
zinc sulphate				✓ [1]

[4]

(ii) $2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$ [3]

(iii) magnesium nitrate [1]

(iv) contains water [1]
contains water of crystallisation [2] [2]

(b) (i) pipette [1]

(ii) pink [1] to colourless [1]
[1] if wrong way round [2]

(iii) remove the indicator [1]

(iv) Individual marks are awarded for correctly labelled and recognisable drawings of assembled apparatus.
No labels = no marks.

evaporating basin [1]
tripod and gauze [1]
heat/Bunsen burner [1] [3]

(v) solubility decreases/solution becomes saturated [1]

(vi) any **one** from:
dry between two sheets of filter paper [1]
dry in a low temperature oven [1]
dry in a desiccator [1] [1]

(c) (i) negative ion [1]

(ii) solid [1] appearing when two solutions are mixed [1] [2]

(iii) barium chloride/barium nitrate [1]

(iv) yellow [1]

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AVAILABLE MARKS

4 **(a)** decomposition/breaking down [1]
of a substance using electricity [1] [2]

(b) bauxite [1]

(c) **(i)** A is anode [1]
B is cathode [1]
C casing [1]
D is (molten) aluminium [1] [4]

(ii) ions are free to move [1]
idea that ions are charge carriers [1] [2]

(iii) 900–1000 °C [1]

(iv) lower melting point (of aluminium oxide)/increase conductivity [1]

(v)

	Positive electrode	**Negative electrode**	
Name of product	oxygen [1]	aluminium [1]	[2]
Half equation	$2O^{2-} \rightarrow O_2 + 4e^-$ [3]	$Al^{3+} + 3e^- \rightarrow Al$ [3]	[6]

(vi) electrode: anode [1]
equation: $C + O_2 \rightarrow CO_2$ [2]

(vii) aluminium is tapped off [1] at the bottom of the cell [1]

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				AVAILABLE MARKS
5	**(a)**	anaerobic (decay) [1] of dead plants and animals [1] over millions of years [1] under the action of (heat and) pressure [1]	maximum [3]	
	(b)	**(i)** any **two** from: creates employment local/cheap fuel supply benefits local economy improved transport links	[2]	
		(ii) any **two** from: eyesore destroys habitats dust pollution noise pollution depletion of resources	[2]	
	(c)	**(i)** soluble in water	[1]	
		(ii) heating water/evaporate salt solution	[1]	
		(iii) subsidence/landslides	[1]	
	(d)	**(i)** electrolysis	[1]	
		(ii) NaOH	[1]	
		(iii) chlorine: bleach/PVC manufacture/water sterilisation [1] hydrogen: rocket fuel/weather balloons [1]	[2]	14

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AVAILABLE MARKS

6 (a)

Gas	Test	Result of positive test	
carbon dioxide	bubble into **limewater** [1]	milky [1]	[2]
hydrogen	apply a lit splint [1]	pop [1]	[2]
hydrogen chloride	glass rod dipped in **concentrated** [1] **ammonia** [1]	white [1] smoke [1]	[4]

(b) (i) $SO_2 + H_2O \rightarrow H_2SO_3$ [2]

(ii) any **two** from:
corrodes statues/buildings [1]
kills fish [1]
kills trees/ vegetation [1] [2]

(c) (i) correct colour of sugar [1]
crystalline [1]
solid [1] maximum [2]

(ii) sugar (initially) goes brown [1]
swells/rises up beaker/pillar [1]
reaction not immediate [1]
heat released [1]
caramel smell [1]
pungent odour [1]
gas/vapour/hisses/bubbles/porous solid/steamy fumes [1]
black [1] solid remains maximum [3]

(d) (i)

	Result of a positive test when ammonia solution is added
iron(II) ion	green [1] ppt [1]
iron(III) ion	red-brown/brown [1] ppt [1]

[4]

(ii) $Fe^{2+} + 2OH^- \rightarrow Fe(OH)_2$ [3]

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AVAILABLE MARKS

7 **(a)** Individual marks are awarded for correctly labelled and recognisable drawings of assembled apparatus which will work.
No labels = no marks.

reaction vessel [1]
delivery tube [1]
*sealed system [1]
gas syringe [1]
stopclock [1]
* = essential mark maximum [4]

(b) **(i)** substance that speeds up [1]
a (chemical) reaction [1]
without being used up [1] [3]

(ii) 1g [1]

(iii)

Industrial Process	**Catalyst used**	**Balanced symbol equation for the catalysed reaction**
The Haber Process	iron	$\mathbf{N_2 + 3H_2 \rightarrow 2NH_3}$ [3]
The Contact Process	**vanadium(V) oxide/ vanadium pentoxide/ $\mathbf{V_2O_5}$** [1]	$2SO_2 + O_2 \rightarrow 2SO_3$
Production of Nitric acid	platinum/ rhodium	$\mathbf{4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O}$ [3]

(c) particles gain energy/move faster [1]
more successful collisions [1]
in a given period of time/idea of frequency [1] [3]

Quality of written communication [2]

(d) any **two** from:
vessels to contain high pressure expensive
high pressure dangerous/safety
reduce risk of explosion [2] 22

Total **160**

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Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2011

Science: Chemistry

Paper 2
Higher Tier

G1404

[G1404]

TUESDAY 7 JUNE, AFTERNOON

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 **6(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	

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Examiner Only	
Marks	Remark

1 Two of the most important compounds of nitrogen are ammonia and nitric acid.

(a) Complete the table below giving the physical properties of ammonia.

Name	Ammonia
State at room temperature and pressure	
Colour	
Odour	
pH of aqueous ammonia	

[4]

(b) The presence of ammonia can be detected chemically by reacting it with hydrogen chloride gas. The hydrogen chloride gas is released from concentrated hydrochloric acid.

The information given below describes how the test is carried out.

1. Wear safety glasses.
2. Dip a glass rod into concentrated hydrochloric acid.
3. Apply the glass rod to ammonia.

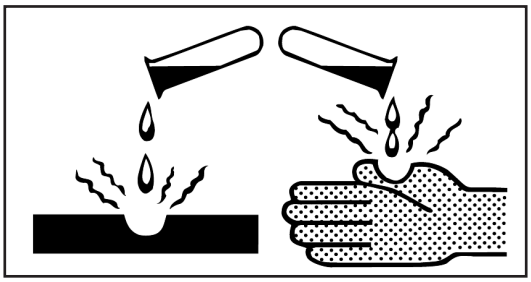
(i) What observations would you make for a positive test?

_____ [2]

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Examiner Only	
Marks	Remark

(ii) The hazard symbol below is found on the bottle of concentrated hydrochloric acid.



© Crown Copyright

Name this hazard symbol.

_____ [1]

(iii) Apart from wearing safety glasses, state one safety precaution you should take when carrying out this test.

_____ [1]

(c) Ammonia reacts with dilute nitric acid forming ammonium nitrate which is used as a fertiliser. Excessive use of ammonium nitrate can lead to an increased growth of algae in lakes and rivers.

Due to copyright an image of a lake has been removed which is not essential to answer this question.

(i) Write a balanced symbol equation for the reaction of ammonia with nitric acid.

_____ [2]

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(ii) What name is given to the process of increased growth of algae in rivers and lakes?

_____ [1]

(iii) Explain how the increased growth of algae can lead to the death of fish in these lakes and rivers.

_____

_____

_____

_____ [3]

Examiner Only	
Marks	Remark

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Examiner Only	
Marks	Remark

(d) In November 2004 the Churchill House office block in Belfast was demolished to make way for the new Victoria Square building. 90 kg of explosive were used. The explosive used was manufactured using nitric acid.



© Paul Faith/PA Archive/Press Association Images

Explain in detail the industrial manufacture of nitric acid.
Your answer should include:

- names of reactants for all reactions
- conditions required
- balanced symbol equations for all reactions

_____

_____

_____

_____ [15]

Examiner Only	
Marks	Remark

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Examiner Only	
Marks	Remark

2 In the United States of America, magnesium chloride is used as a de-icer on roads and pavements. It is much less toxic to plant life and less corrosive to concrete and steel than other de-icers.



© Snowplowing-Contactors.com 12 April 2007

(a) Name one other compound which can be used as a road de-icer.

_____ [1]

(b) Magnesium chloride can be prepared by the reaction of magnesium metal with hydrochloric acid.

To determine the effect of temperature on the rate of reaction between magnesium and hydrochloric acid, two experiments were set up, and the time taken for the reaction to be completed was recorded. The table shows the results.

Temperature (°C)	Concentration of acid (mol/dm^3)	Volume of acid (cm^3)	Mass of magnesium (g)	Form of magnesium	Time (s)	Rate (s^{-1}) $\left(\frac{1}{\text{time}}\right)$
20	1.0	20	0.1	ribbon	100	0.01
30	1.0	20	0.1	ribbon	50	

(i) Calculate the rate of reaction at 30 °C and enter the value into the table.

[1]

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(ii) State and explain fully, **in terms of particles**, the effect of a change in temperature on the rate of the reaction between magnesium and hydrochloric acid.

Effect of temperature: _____

_____

Explanation: _____

_____

_____

_____

_____ [4]

(iii) Explain why this set of experiments can be considered to be a fair test.

_____

_____ [1]

(iv) How could this experiment be changed to determine the effect of the surface area of magnesium on the rate of the reaction between magnesium and hydrochloric acid?

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

(c) To determine the effect of the concentration of hydrochloric acid on the rate of the reaction, the experiment detailed below was carried out.

A 3 cm piece of magnesium ribbon was placed in 50 cm^3 of hydrochloric acid of concentration 0.5 mol/dm^3 in a conical flask and the time taken for the reaction to be completed was recorded.

The experiment was repeated using 50 cm^3 portions of different concentrations of hydrochloric acid and the results recorded in the table below. There was an excess of acid in all the experiments.

Concentration of hydrochloric acid (mol/dm^3)	0.5	0.6	0.8	1.0	1.4	2.0
Time (s)	225	150	75	50	30	20

(i) Draw a labelled diagram of the assembled apparatus used to carry out this experiment.

[3]

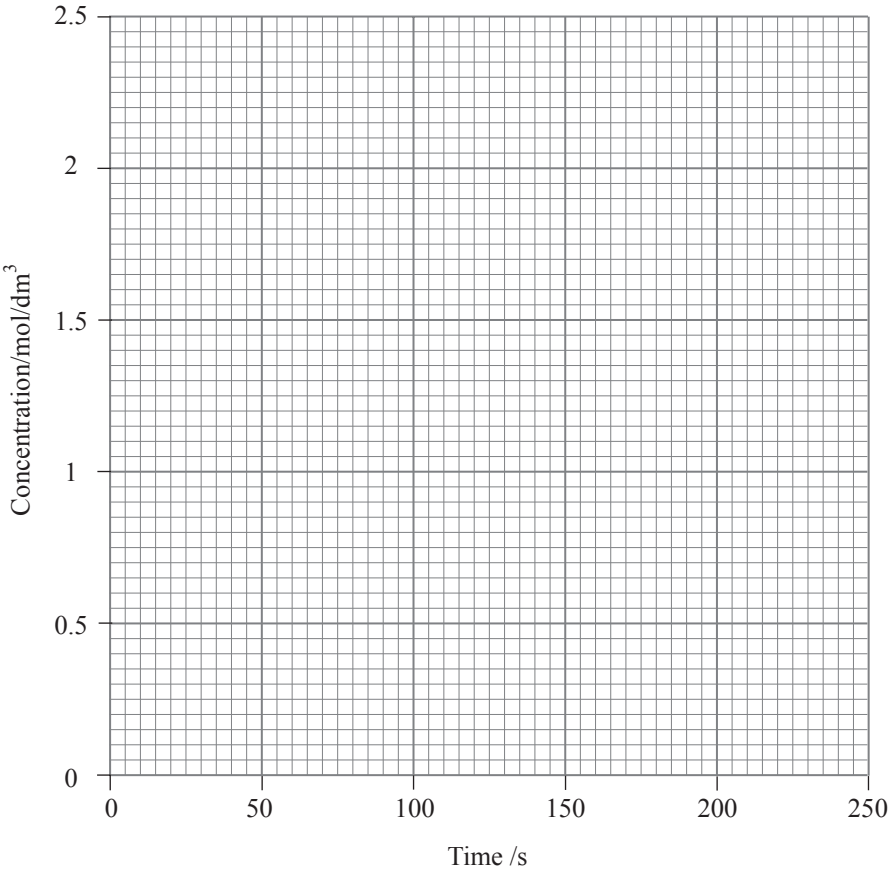
(ii) How could you tell when the reaction is complete?

_____

_____ [1]

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(iii) Use the results in the table to plot a graph of concentration against time. [3]



(iv) How long did it take for the reaction to complete when 50 cm^3 of 1.5 mol/dm^3 of hydrochloric acid was used?

_____ [1]

(v) State the effect of decreasing the concentration of hydrochloric acid on the rate of the reaction between magnesium and hydrochloric acid.

_____

_____ [1]

(d) Magnesium chloride is used as a catalyst for the polymerisation of ethene. What is meant by the term **catalyst**?

_____

_____

_____ [3]

Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

3 Some substances, for example molten lead(II) bromide and molten sodium chloride, are electrolytes. Other substances, for example copper metal, are conductors.

(a) Explain how the following substances conduct electricity:

- copper metal and
- molten lead(II) bromide

and state any effect the passage of electricity has on each substance.

_____

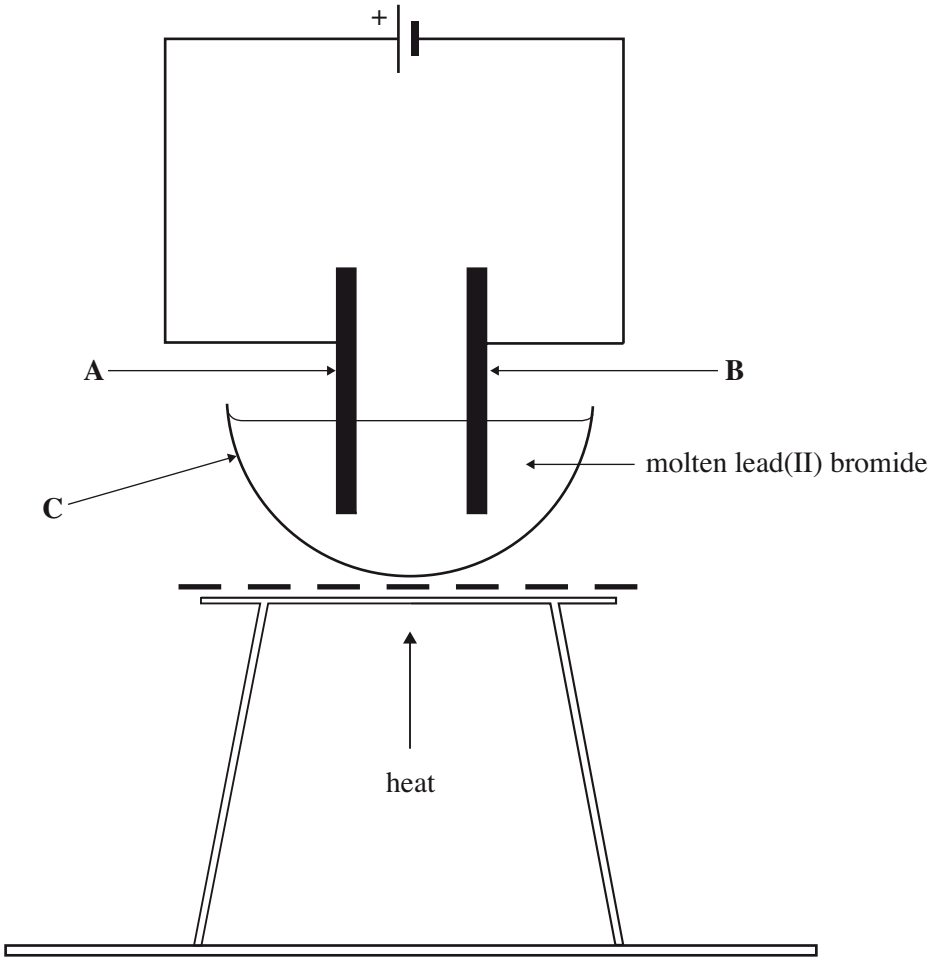
_____

_____

_____

_____ [4]

(b) An experiment to investigate the electrolysis of molten lead(II) bromide was set up as shown in the diagram below.



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(i) Some pieces of apparatus in the diagram are labelled A–C. Complete the table by stating the correct name for each piece of apparatus.

Label	Name of apparatus
A	
B	
C	

[3]

(ii) Name a piece of apparatus which could be connected in the circuit to show that an electric current is flowing through the molten lead(II) bromide.

_____ [1]

(iii) Complete the table to state the observations at electrode **A**, the name of the product at electrode **B** and the half equations for the reactions at both electrodes.

Electrode	Observations	Name of Product	Half equation
A		bromine	
B	silvery grey bead		

[7]

(iv) Why does this electrolysis need to be carried out in a fume cupboard?

_____

_____ [1]

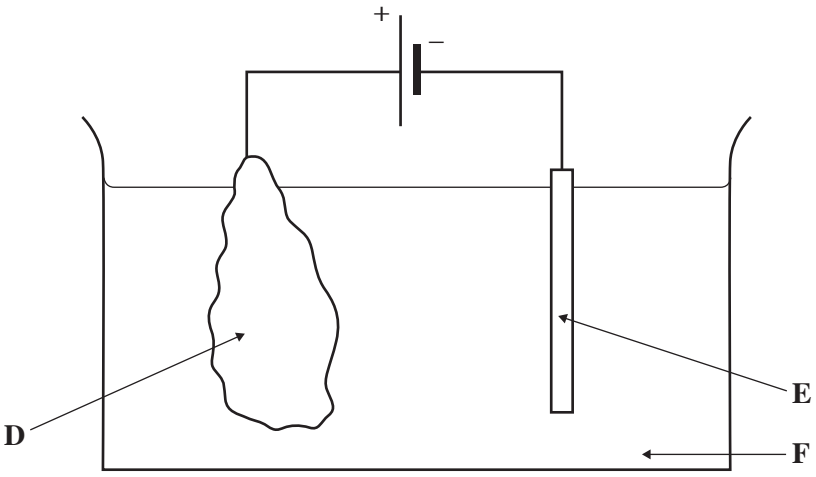
Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

(c) Copper metal is a good conductor of electricity and is often used in electrical wires. Impure copper is not used to make wires because the impurities greatly reduce the conductivity. Impure copper is refined by electrolysis as shown in the diagram below.



(i) State the name of the materials which are used to make electrodes **D** and **E**.

D _____

E _____ [2]

(ii) Name the electrolyte **F** which is used in this electrolysis.

_____ [1]

(iii) Write a half equation for the reaction occurring at electrode **E**.

_____ [2]

(iv) Apart from electrical conductivity, state one other physical property of copper which makes it suitable for use in electrical wiring.

_____ [1]

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Examiner Only	
Marks	Remark

4 **(a)** Five solutions were tested to find their pH. The results are recorded in the table below.

Solution	pH value
Soap solution	10
Sulphuric acid	1
Water	7
Sodium hydroxide	14
Lemon juice	5

(i) Describe the method the student should use to determine the pH of each solution.

_____

_____

_____ [2]

(ii) Using only the solutions given in the table above, state an example of each of the following:

A weak acid _____

A strong alkali _____

Neutral _____ [3]

(iii) Hydrogen ions are found in all acidic solutions. Write the symbol for a hydrogen ion including its charge.

_____ [1]

(iv) The ion found in all alkalis is OH^-. Name this ion.

_____ [1]

(v) **Name** the salt produced when sulphuric acid reacts with sodium hydroxide solution.

_____ [1]

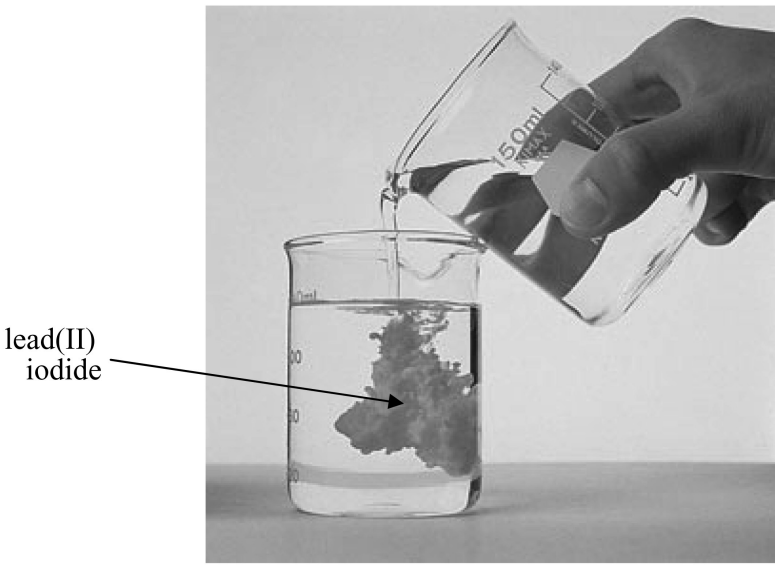
(vi) Write a balanced symbol equation for the reaction between sulphuric acid and sodium hydroxide solution.

_____ [3]

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Examiner Only	
Marks	Remark

(b) Lead(II) iodide, PbI_2, is a toxic yellow solid used as a pigment by painters in the nineteenth century. It is insoluble in water. The picture below shows two solutions mixing and lead(II) iodide forming.



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(i) Name two solutions which would react together to form insoluble lead(II) iodide.

Solution 1: _____

Solution 2: _____ [2]

(ii) Draw a labelled diagram of the assembled apparatus used to recover the insoluble lead(II) iodide when the reaction is finished.

[3]

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(iii) Write a balanced ionic equation to show the formation of lead(II) iodide.

_____ [3]

(c) Barium sulphate is another insoluble salt. It may be prepared by mixing solutions of barium chloride and sodium sulphate. The barium sulphate is dried after it is prepared.

(i) Write a balanced symbol equation for the reaction of barium chloride with sodium sulphate to form barium sulphate.

_____ [3]

(ii) How would you dry the sample of barium sulphate?

_____ [1]

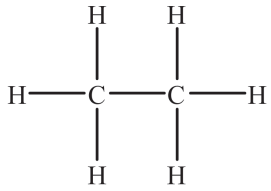
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Marks	Remark

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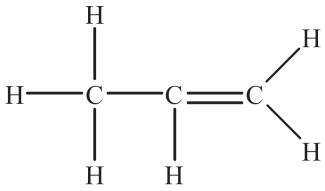
Examiner Only	
Marks	Remark

5 **(a)** Alkanes and alkenes are two homologous series of organic compounds. The four structural formulae given below labelled **A**, **B**, **C** and **D** represent some alkanes and alkenes.

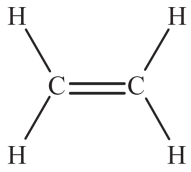
A



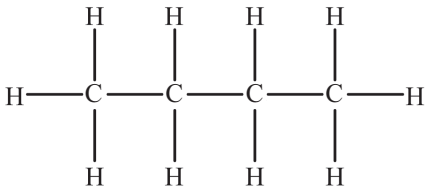
B



C



D



(i) Name **A**, **B**, **C** and **D**.

A _____

B _____

C _____

D _____ [4]

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(ii) Write the molecular formula for substance **D**.

_____ [1]

(iii) Which one of the substances (**A**, **B**, **C** or **D**) has the empirical formula CH_3?

_____ [1]

(iv) Write a balanced symbol equation for the complete combustion of substance **B**.

_____ [3]

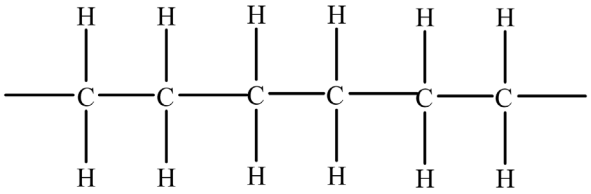
(v) What is meant by the term homologous series?

_____

_____

_____ [3]

(b) Polythene is described as a hydrocarbon polymer whereas polyvinylchloride (PVC) is not. Part of the structure of polythene is shown below.



(i) What is meant by the term hydrocarbon?

_____

_____ [2]

(ii) What type of polymerisation is used to form polythene?

_____ [1]

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Marks	Remark

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(iii) Explain what you understand by the term polymer.

_____

_____

_____ [2]

(iv) Name the monomer from which polythene is formed.

_____ [1]

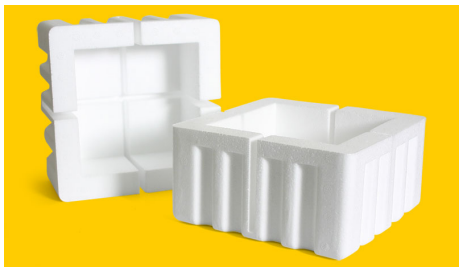
(v) Write a structural equation to show the polymerisation of vinyl chloride to form polyvinylchloride (PVC).

[4]

Examiner Only	
Marks	Remark

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(c) The three items below are all made from polymers. Write the name of the polymer used to make these items in the table.

Item	Polymer
 *É Custompac Ltd* packaging	
shopping bags	
window frames	

[3]

Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

6 Chemical reactions are either exothermic or endothermic.

(a) What do you understand by the term exothermic?

_____

_____ [1]

(b) The table below gives the word equations for several exothermic reactions.

Reaction	Word Equation
A	hydrogen + oxygen → water
B	sodium hydroxide + hydrochloric acid → sodium chloride + water
C	copper(II) sulphate + magnesium → magnesium sulphate + copper
D	magnesium + carbon dioxide → magnesium oxide + carbon

(i) Name the type of reaction represented by **A** and **B**.

A _____ [1]

B _____ [1]

(ii) Write a balanced symbol equation for Reaction **B**.

_____ [2]

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(iii) Write a balanced symbol equation for reaction **D**

_____ [3]

(iv) Describe what would be observed during reaction **D**.

_____

_____

_____ [3]

(c) Reaction **C** is a redox reaction.

(i) Describe what would be observed when a piece of magnesium ribbon is added to copper(II) sulphate solution.

_____

_____

_____ [3]

(ii) Explain, in terms of electrons, why reaction **C** is described as a redox reaction. You may use half equations to help answer this question.

_____

_____

_____

_____

_____

_____

_____

_____

_____ [7]

Quality of Written Communication [2]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

7 In the United Kingdom 45 million mobile phone users discard about 15 million handsets every year. Only about 2% of these handsets are recycled, with the remainder going to landfill dumps. Recycling mobile phones means an overall reduction in carbon dioxide emissions as well as saving precious metals such as gold, silver and copper.

Due to copyright an image of a pile of discarded mobile phones has been removed which is not essential to answer this question.

(a) (i) State two environmental disadvantages of landfill dumps.

_____

_____

_____ [2]

(ii) Name the environmental problem caused by carbon dioxide emissions.

_____ [1]

(iii) Suggest why it is important to recycle phones to recover metals such as gold, silver and copper.

_____

_____ [1]

(iv) Suggest why metals such as gold are used in the circuit boards and wiring of mobile phones.

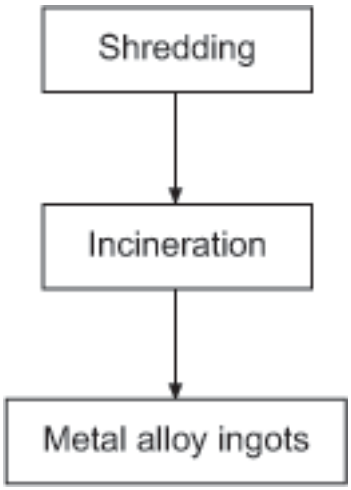
_____

_____ [1]

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Examiner Only	
Marks	Remark

(b) In the recycling process the phones are first placed in a shredder, and then the shredded material is heated in ovens to incinerate the plastic. The remains from this process enter a melting furnace to produce a metal alloy covered with slag, which consists mainly of silicates. The metal alloy bars from one tonne of mobile phones can contain 2.3 kg of silver and 227 g of gold.



(i) State one advantage and one disadvantage of incineration as a method of disposal of plastics.

Advantage: _____

_____

Disadvantage: _____

_____ [2]

(ii) What is meant by the term alloy?

_____ [1]

(iii) The silicate ion found in slag has the formula SiO_3^{2-}. Write the formula for aluminium silicate.

_____ [1]

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Examiner Only	
Marks	Remark

(c) Slag is also produced in the Blast Furnace during the extraction of iron from haematite. Limestone and haematite are two of the solid raw materials added to the Blast Furnace. Both haematite and limestone are mined.

(i) Complete the table which gives details of the two raw materials.

Raw material	Formula	Name of chemical
Haematite		iron(III) oxide
Limestone	$CaCO_3$	

[2]

(ii) Name the other solid raw material added to the Blast Furnace.

_____ [1]

(iii) State two advantages to a local community of a limestone mine.

_____

_____ [2]

(iv) Name the reducing agent in the Blast Furnace.

_____ [1]

(v) Write a balanced symbol equation for the formation of slag in the Blast Furnace.

_____ [2]

THIS IS THE END OF THE QUESTION PAPER

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Rewarding Learning

General Certificate of Secondary Education
2011

Science: Chemistry

Paper 2
Higher Tier

[G1404]

TUESDAY 7 JUNE, AFTERNOON

MARK SCHEME

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Guidelines for marking equations

Equations where the stoichiometry is 1 gain [2] maximum

[1] for correct formula of reactant/s
[1] for correct formula of product/s

e.g. $CaO + H_2O \rightarrow Ca(OH)_2$ [2]
[1] [1]

$CaO + \mathbf{2}H_2O \rightarrow Ca(OH)_2$ [1]
[0] [1]

However:
$2CaO + 2H_2O \rightarrow 2Ca(OH)_2$ [2]
[1] [1]

Equations where the stoichiometry is more than 1 gain [3]

[1] for correct formula of reactant/s
[1] for correct formula of product/s
[1] for correct balancing

e.g. $2Na + 2H_2O \rightarrow 2NaOH + H_2$
[1] [1]

+ [1] for balancing = [3]

$2Na + H_2O \rightarrow 2NaOH + H_2$
[1] [1]

No balancing mark = [2]

AVAILABLE MARKS

1 (a)

Name	Ammonia
State at room temperature and pressure	gas [1]
Colour	colourless [1]
Odour	pungent [1]
pH of aqueous ammonia	9–11 [1]

[4]

(b) (i) white [1] smoke/fumes/solid/cloud [1] [2]

(ii) corrosive [1]

(iii) gloves/lab coat/fume cupboard [1]

(c) (i) $NH_3 + HNO_3 \rightarrow NH_4NO_3$ [2]

(ii) eutrophication [1]

(iii) some algae die [1]
decomposing bacteria/organisms use up oxygen [1]
less oxygen available for fish [1] [3]

(d) ammonia [1] excess [1] air [1]
900–1000°C [1] } units essential and must be
1–10 atm [1] } related to this first step
Pt/Rh [1] catalyst [1]
$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$ [3]

nitrogen monoxide [1] mixed with (more) air [1]
$2NO + O_2 \rightarrow 2NO_2$ [3]

nitrogen dioxide [1] mixed with more air [1] and
(passed up tower of glass beads with) water [1] running down
$4NO_2 + O_2 + 2H_2O \rightarrow 4HNO_3$ [3] max [15]

29

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AVAILABLE MARKS

2 **(a)** sodium chloride [1]

(b) **(i)** 0.02 [1]

(ii) Effect: increasing temperature increases rate
or decreasing temperature decreases rate [1] * essential

Explanation: particles have more energy/move faster [1]
more collisions [1]
more successful collisions [1]
in a given period of time/idea of frequency [1] max [3]
Converse argument for decrease in temperature [4]

(iii) only temperature has been changed/one factor changed/all other variables same [1]

(iv) powdered Mg [1]
all other factors kept the same [1] [2]

(c) **(i)** individual marks are for correctly labelled and recognisable drawings
No labels = 0 marks

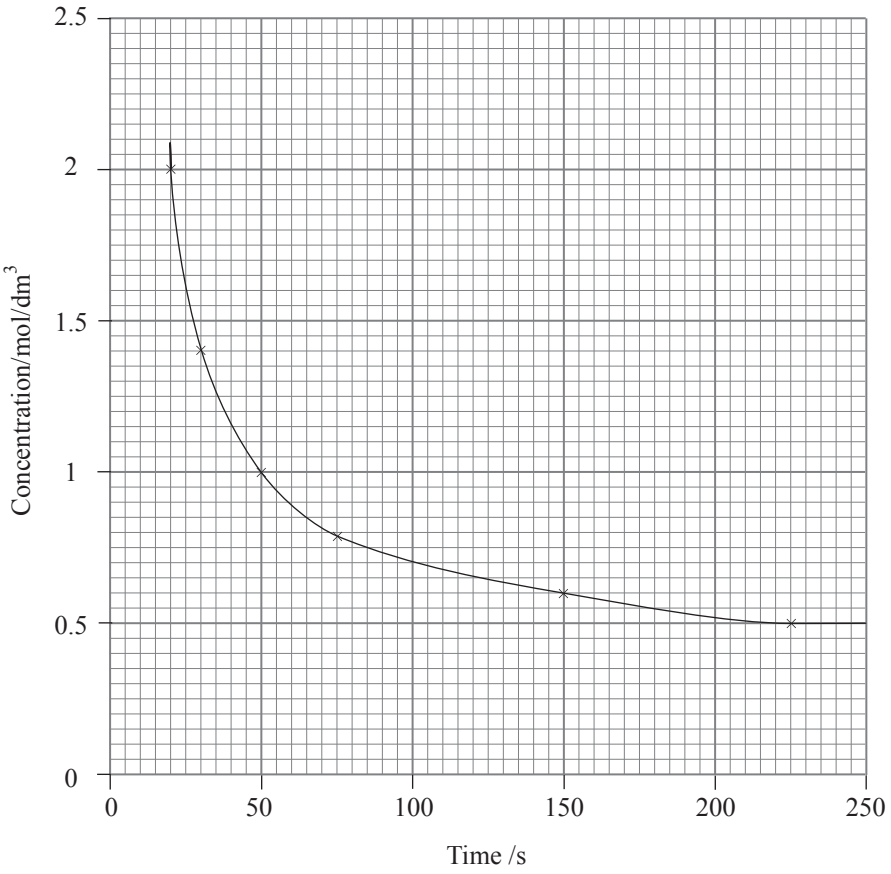
conical flask [1]
Mg ribbon + acid in contact [1]
stop clock [1] [3]

(ii) no more bubbles/Mg disappears [1]

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AVAILABLE MARKS

(iii) 5 or 6 points plotted correctly [2]
3 or 4 points plotted correctly [1]
0, 1, 2 points plotted correctly [0]
curve [1] [3]



(iv) 27 [1] s (accept 25–30) [1]

(v) decreases [1]

(d) a substance which increases [1] rate of reaction [1]
(or <u>speeds up</u> [1] a reaction [1])
without being used up/chemically unchanged at end [1] [3]

21

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AVAILABLE MARKS

3 **(a)** copper: electrons carry charge/electrons can move [1]
no effect/no decomposition [1]

molten lead(II) bromide: ions carry charge/ions can move [1]
decomposes [1] [4]

(b) **(i)** A = anode [1]
B = cathode [1]
C = evaporating basin/crucible/evaporating dish [1] [3]

(ii) bulb/ammeter [1]

(iii)

Electrode	Observations	Name of Product	Half equation
A	red-brown [1] pungent [1] gas [1] **max [2]**	bromine	$2Br^- \rightarrow Br_2 + 2e^-$ [2]
B	silvery grey bead	lead [1]	$Pb^{2+} + 2e^- \rightarrow Pb$ [2]

[7]

(iv) bromine/lead (fumes) are toxic/poisonous [1]

(c) **(i)** **D** impure copper [1]
E pure copper [1] [2]

(ii) copper sulphate/copper chloride/copper nitrate [1]

(iii) $Cu^{2+} + 2e^- \rightarrow Cu$ [2]

(iv) ductile [1]

22

AVAILABLE MARKS

4 **(a)** **(i)** add universal indicator/pH paper [1] compare to colour chart [1]
or use pH meter [1] read off value [1] [2]

(ii)

weak acid	lemon juice [1]
strong alkali	sodium hydroxide [1]
neutral	water [1]

[3]

(iii) H^+ [1]

(iv) hydroxide [1]

(v) sodium sulphate [1]

(vi) $2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$ [3]

(b) **(i)** lead nitrate [1]
any soluble iodide, e.g. sodium iodide, potassium iodide etc. [1] [2]

(ii) individual marks are for correctly labelled and recognisable pieces of assembled apparatus
labels: filter funnel [1]
filter paper [1]
conical flask/suitable container [1] [3]

(iii) $Pb^{2+} + 2I^- \rightarrow PbI_2$ [3]

(c) **(i)** $BaCl_2 + Na_2SO_4 \rightarrow 2NaCl + BaSO_4$ [3]

(ii) low temperature oven/desiccator [1]

23

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AVAILABLE MARKS

5 **(a)** **(i)** **A** = ethane [1]
B = propene [1]
C = ethene [1]
D = butane [1] [4]

(ii) C_4H_{10} [1]

(iii) **A** [1]

(iv) $2C_3H_6 + 9O_2 \rightarrow 6CO_2 + 6H_2O$ [3]

(v) same general formula [1]
differ by CH_2 unit [1]
similar/same chemical properties [1]
gradation in physical properties [1] max [3]

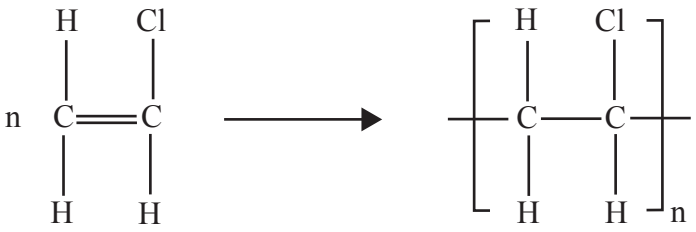
(b) **(i)** substance containing only [1] carbon and hydrogen [1] [2]

(ii) addition [1]

(iii) idea of large number [1] of
monomers/small molecules/repeating unit/alkene [1]
(bond) to form a chain [1] max [2]

(iv) ethene [1]

(v)



[1] for correct monomer structure
[1] for correct polymer structure in brackets
[1] for n before ethene
[1] for indicating repeat (repeat can be brackets and n after or a min of 3 repeating units) [4]

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			AVAILABLE MARKS
(c)	polystyrene [1] polythene [1] PVC [1]	[3]	25
6 **(a)**	gives out heat	[1]	
(b) **(i)**	A combustion	[1]	
	B neutralisation	[1]	
(ii)	$NaOH + HCl \rightarrow NaCl + H_2O$	[2]	
(iii)	$2Mg + CO_2 \rightarrow 2MgO + C$	[3]	
(iv)	magnesium continues to burn [1] white light [1] white [1] solid [1] black specks [1]	max [3]	
(c) **(i)**	blue [1] solution fades/changes to colourless [1] brown/black [1] solid [1] formed heat released [1]	max [3]	
(ii)	magnesium (atom) loses electrons [2] or $Mg \rightarrow Mg^{2+} + 2e^-$ [2] loss of electrons is oxidation [1] copper ions gain electrons [2] or $Cu^{2+} + 2e^- \rightarrow Cu$ [2] gain of electrons is reduction [1] oxidation and reduction occurring simultaneously/in same reaction [1]	[7]	
	Quality of written communication	[2]	23

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				AVAILABLE MARKS
7	**(a)**	**(i)**	wastes land [1] unpleasant smell [1] eyesore [1] loss of habitat [1] toxic waste leaches into land [1] max [2]	
		(ii)	greenhouse effect/global warming [1]	
		(iii)	idea of saves resources/prevents landfill or incineration [1]	
		(iv)	good conductors of electricity [1]	
	(b)	**(i)**	advantage: heat produced can be harnessed [1] disadvantage: toxic fumes/greenhouse effect [1] [2]	
		(ii)	mixture of metals [1]	
		(iii)	$Al_2(SiO_3)_3$ [1]	
	(c)	**(i)**		

Raw material	Formula	Name of chemical
Haematite	Fe_2O_3 [1]	iron(III) oxide
Limestone	$CaCO_3$	calcium carbonate [1]

[2]

		(ii)	coke/carbon [1]	
		(iii)	more employment [1] boosts local economy [1] improved road and transport infrastructure [1] max [2]	
		(iv)	carbon monoxide [1]	
		(v)	$CaO + SiO_2 \rightarrow CaSiO_3$ [2]	17
			Total	**160**

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Rewarding Learning

Centre Number	
71	

Candidate Number

General Certificate of Secondary Education
2010

Science: Chemistry

Paper 2
Higher Tier

[G1404]

WEDNESDAY 9 JUNE, AFTERNOON

G1404

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 **1(c)**.
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	

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Examiner Only
Marks Remark

1 Neutralisation occurs when an acid and an alkali react to form a salt and water.

(a) (i) Complete the table below to give the names and formulae of the ions present in all acids and alkalis.

	Name	**Formula**
Ion present in all acids		
Ion present in all alkalis		

[4]

(ii) Write an ionic equation for neutralisation.
Include state symbols.

_____ [2]

(b) Sulphuric acid can be neutralised using an alkali such as sodium hydroxide or by adding an insoluble base such as copper(II) oxide.

(i) Name the salt formed when sodium hydroxide reacts with sulphuric acid.

_____ [1]

(ii) Write a balanced symbol equation for the reaction between copper(II) oxide and sulphuric acid.

_____ [2]

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(c) In the preparation of copper(II) sulphate crystals, an excess of copper(II) oxide was added to warm dilute sulphuric acid. The excess copper(II) oxide was removed by filtration. Describe how you would obtain pure dry crystals of copper(II) sulphate from the filtrate collected.

_____

_____

_____

_____

_____

_____ [3]

Quality of written communication [2]

(d) (i) To prove that the **copper(II) sulphate** salt produced in **(c)** contained copper(II) ions, Cu^{2+}, two different tests were carried out on a sample of the salt.
Test 1 used a solid sample of the salt and Test 2 used a solution of the salt.
Complete the table by stating what you would observe for Test 1, Test 2(a) and Test 2(b).

Test	Observations
1 Flame test	
2 (a) Add a few drops of ammonia solution to the salt solution (b) Add excess ammonia solution to the result of Test 2(a)	

[5]

Examiner Only
Marks Remark

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Examiner Only
Marks Remark

(ii) Name the reagent used to test for the presence of the sulphate ion in a solution of copper(II) sulphate and state the result for a positive test.

Reagent: _____

Result: _____

_____

_____ [3]

(iii) To identify the ions present in an unknown salt **A** the following tests were carried out and the observations are recorded in the table below.

Use these results to complete the table by giving the identity of the ions present and suggest the formula for salt **A**.

Test	Observations	Ion present
1. Flame test	lilac flame	
2. Dissolve half a spatula-measure of **A** in 2 cm^3 of dilute nitric acid. Add2 cm^3 of silver nitrate solution.	yellow precipitate	

Formula of salt **A** _____ [3]

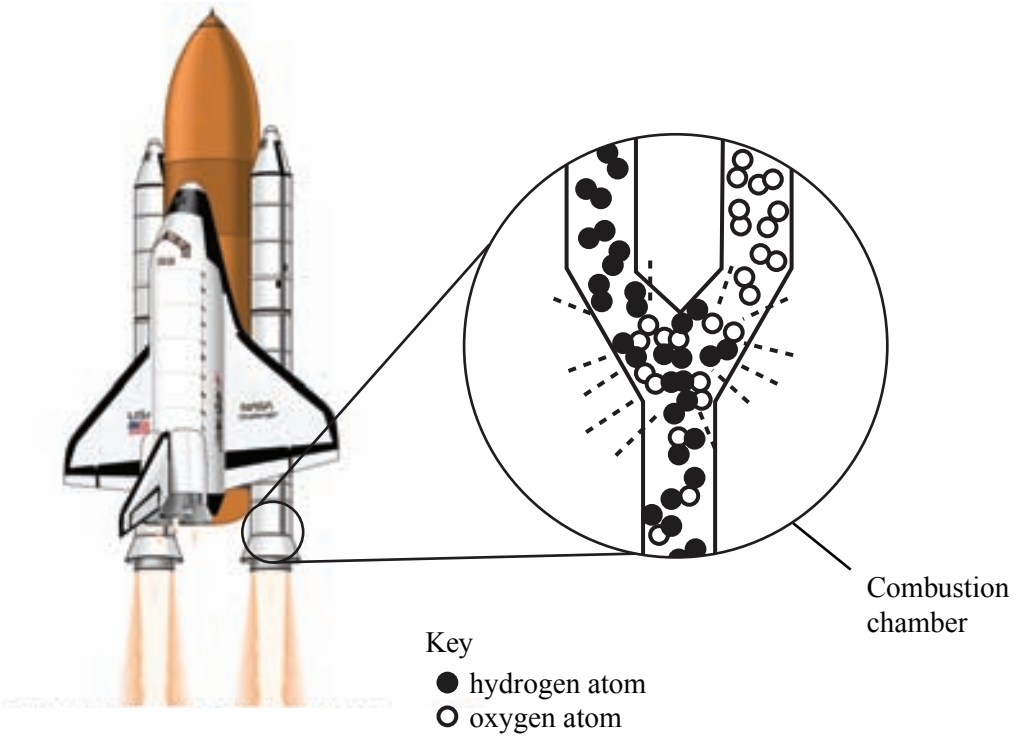
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(Questions continue overleaf)

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2 (a) Hydrogen is a powerful rocket fuel. The diagram shows the reaction which occurs in the combustion chamber of a rocket.



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(i) Explain what you understand by the term combustion.

_____

_____

_____ [3]

(ii) Explain why hydrogen is considered to be a 'clean' fuel.

_____

_____ [1]

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Marks Remark

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(iii) The equation for the reaction which occurs in the combustion chamber is:

$$2H_2 + O_2 \rightarrow 2H_2O$$

Explain, in terms of bonds, why the reaction in the combustion chamber is exothermic.

_____

_____

_____

_____

_____

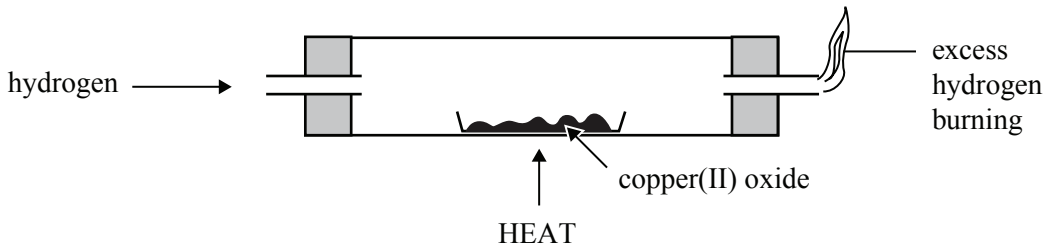
_____

_____ [5]

Examiner Only
Marks Remark

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(b) Hydrogen is also a powerful reducing agent. The diagram shows the apparatus which could be used in the laboratory to reduce copper(II) oxide using hydrogen.



(i) State two observations made during this reaction.

1. _____

2. _____ [2]

(ii) Write a balanced symbol equation for the reduction of copper(II) oxide using hydrogen.

_____ [2]

(iii) Explain why this reaction is described as reduction.

_____

_____

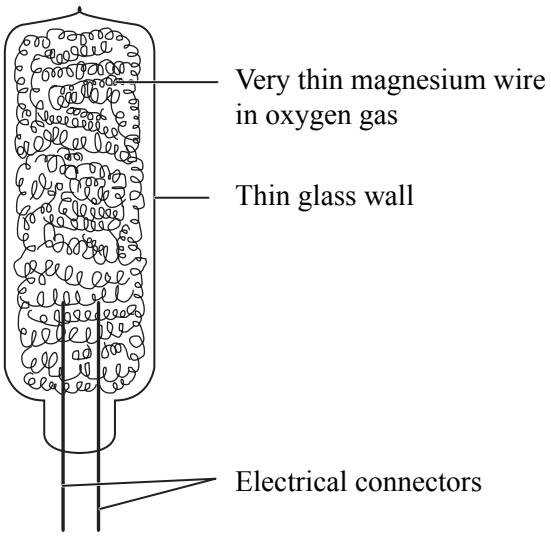
_____ [2]

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Marks Remark

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Examiner Only
Marks Remark

(c) Before the use of electronic built-in flashes, most cameras needed flash bulbs to create a flash of artificial light. The diagram below represents a flash bulb which works by the reaction of very thin magnesium wires with oxygen.



(i) Explain why very thin magnesium wires are used instead of magnesium ribbon.

_____

_____ [2]

(ii) Write a balanced symbol equation for the reaction which occurs inside the flash bulb.

_____ [3]

(iii) State one observation made during this reaction.

_____ [1]

(iv) Complete the ionic half equation below and use it to explain, in terms of electrons, why this reaction is described as oxidation.

$$Mg \longrightarrow Mg^{2+}$$

_____

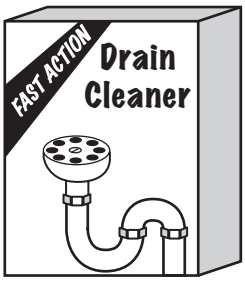
_____

_____ [3]

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3 Barium hydroxide is a Group II metal hydroxide which is often found in drain cleaners.

Examiner Only
Marks Remark



To determine the concentration of a solution of barium hydroxide $Ba(OH)_2$ 25.0 cm^3 of the solution was placed in a conical flask with a few drops of phenolphthalein indicator and titrated with a solution of hydrochloric acid of concentration 0.2 mol/dm^3 (moles per litre).

The balanced symbol equation for the reaction is:

$$Ba(OH)_2 + 2HCl \rightarrow BaCl_2 + 2H_2O$$

(a) (i) Describe in detail, stating precautions to ensure safety and accuracy, how you would place 25.0 cm^3 of barium hydroxide solution into the conical flask.

_____

_____

_____

_____

_____

_____

_____ [4]

(ii) State the colour change of the phenolphthalein indicator at the end point.

From _____ to _____ [2]

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(b) The results of the titration are shown in the table below .

	Initial burette reading (cm^3)	**Final burette reading (cm^3)**	**Volume of hydrochloric acid used (titre) (cm^3)**
Rough titration	0.0	22.8	22.8
1st accurate titration	0.0	22.4	22.4
2nd accurate titration	0.0	22.5	22.5

(i) Calculate the average titre.

Examiner Only
Marks Remark

[2]

(ii) Calculate the number of moles of hydrochloric acid used in this titration.

[2]

(iii) Use the balanced symbol equation to deduce the number of moles of barium hydroxide which reacted with the hydrochloric acid.

[2]

(iv) Calculate the concentration of the barium hydroxide solution in mol/dm^3 (moles per litre).

[2]

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(c) Calcium is a Group II metal which reacts with nitric acid according to the balanced symbol equation:

$$Ca + 2HNO_3 \rightarrow Ca(NO_3)_2 + H_2$$

(Relative atomic masses: H = 1; N = 14; O = 16; Ca = 40)

(i) 0.2 g of calcium metal was reacted with excess nitric acid. Calculate the volume of hydrogen gas which was produced in this reaction. (1 mole of any gas occupies 24 dm^3).

_____ dm^3 [5]

(ii) If the concentration of the nitric acid was 2.0 mol/dm^3 (moles per litre) calculate the volume of nitric acid needed to completely react with the 0.2 g of calcium.

[4]

(iii) The calcium nitrate produced in this reaction is often used in fertilisers. Calculate the percentage of nitrogen, by mass, present in calcium nitrate.

[3]

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Marks Remark

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Examiner Only
Marks Remark

4 **(a)** Calcium carbonate thermally decomposes to form calcium oxide. Calcium oxide (lime) has a high melting point and can be heated to a high temperature without melting so that it emits white light, called limelight.



© Adam Hart-Davis/Science Photo Library

(i) Explain what is meant by thermal decomposition.

_____

_____ [2]

(ii) Write a balanced symbol equation for the thermal decomposition of calcium carbonate.

_____ [2]

(iii) Explain why calcium oxide has a high melting point.

_____

_____

_____ [2]

(iv) Calcium oxide must be kept dry because when it comes into contact with even the slightest amount of moisture, it rapidly becomes hot and hisses, releasing a large amount of steam.

Write a balanced symbol equation for the reaction of calcium oxide with water.

_____ [2]

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(b) Calcium carbonate reacts with acids such as hydrochloric acid and sulphuric acid. It is used in many antacid tablets, where it reacts with excess acid in the stomach, reducing acidity and relieving 'heartburn'.

Examiner Only
Marks Remark



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(i) Write a balanced symbol equation for the reaction between calcium carbonate and hydrochloric acid.

_____ [3]

(ii) State two observations for this reaction.

1. _____

2. _____ [2]

(iii) Write a balanced symbol equation for the reaction between calcium carbonate and sulphuric acid.

_____ [2]

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(c) Another compound used in antacid tablets is aluminium hydroxide.

Examiner Only
Marks Remark

(i) Write a balanced symbol equation for the reaction between aluminium hydroxide and hydrochloric acid.

_____ [3]

(ii) Aluminium hydroxide is amphoteric. Explain what you understand by the term amphoteric.

_____

_____ [1]

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5 (a) Compounds are formed when two or more different elements chemically bond together.

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Marks Remark

(i) Explain what you understand by the term element.

_____

_____

_____ [2]

(ii) Using **full** electronic configurations, **draw diagrams** to show how atoms of magnesium combine with atoms of oxygen to form magnesium oxide.

[6]

(iii) State the type of bonding which is present in magnesium oxide.

_____ [1]

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(b) Substances containing covalent bonds can have very different physical properties. Graphite, which is an allotrope of the element carbon, contains covalent bonds.

Examiner Only
Marks Remark

(i) Explain what you understand by the term allotrope.

_____

_____ [2]

(ii) Draw a labelled diagram to show the structure and bonding in graphite.

[4]

(iii) Diamond is another allotrope of carbon and it is the hardest naturally occurring substance on Earth. Explain why diamond is so hard.

_____

_____

_____

_____ [2]

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(c) Carbon dioxide also contains covalent bonds. The melting point of carbon dioxide is –78 °C.

Examiner Only
Marks Remark

(i) Explain what you understand by the term covalent bond.

_____

_____

_____[3]

(ii) Explain why the melting point of carbon dioxide is very low .

_____

_____

_____

_____

_____

_____[3]

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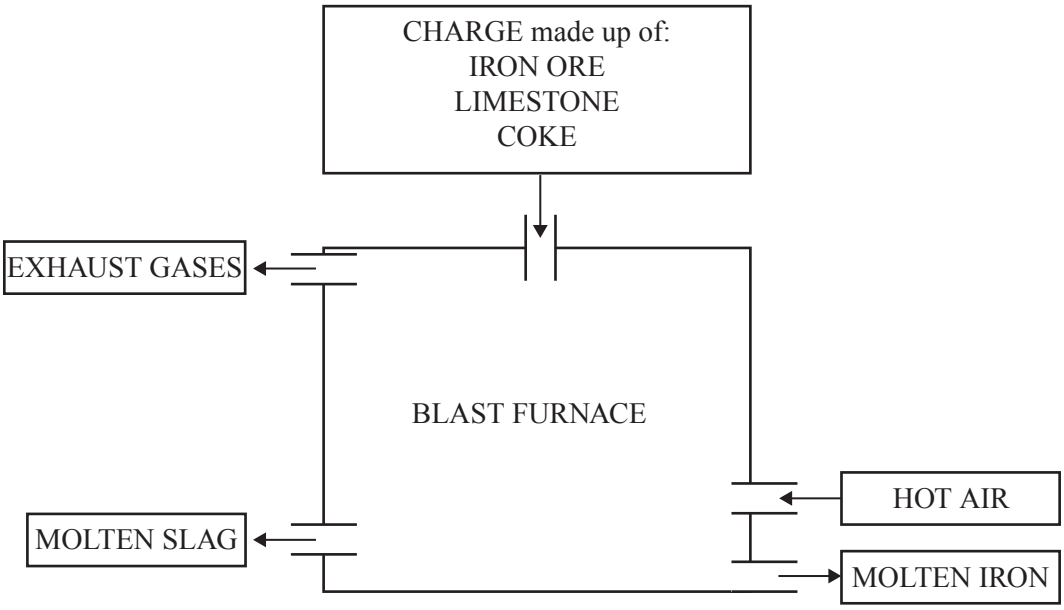
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Marks Remark

6 The blast furnace is used to produce iron from its ore. The diagram below represents the materials added to, and removed from, the blast furnace.



(a) Iron ore is reduced to iron. The reducing agent is carbon monoxide. Carbon monoxide is formed from carbon in two reactions which are shown as word equations below.

Reaction 1: carbon + oxygen → carbon dioxide

Reaction 2: carbon dioxide + carbon → carbon monoxide

(i) Name the material added to the blast furnace which is composed mainly of carbon.

_____ [1]

(ii) What is the source of oxygen in the blast furnace?

_____ [1]

(iii) Write balanced symbol equations for reactions 1 and 2 which are given above.

Reaction 1: _____ [2]

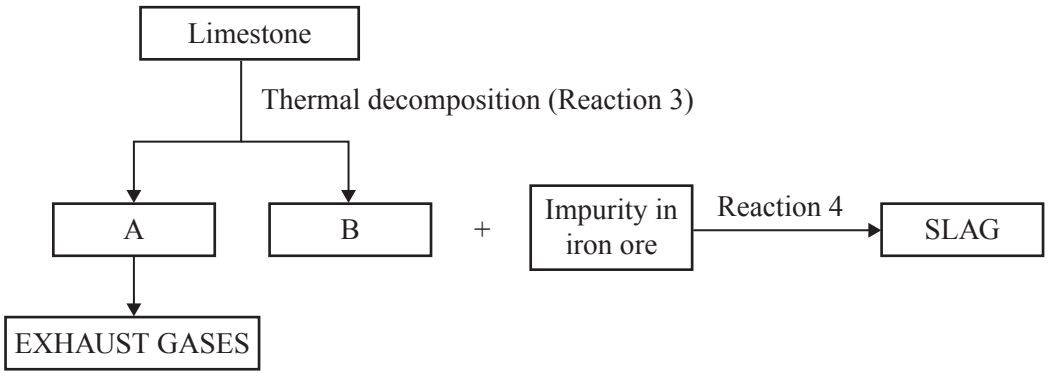
Reaction 2: _____ [3]

(iv) Write a balanced symbol equation for the reduction of iron ore to iron in the blast furnace.

_____ [3]

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(b) The flow diagram below represents the formation of slag in the blast furnace. Substances A and B are formed by the thermal decomposition of limestone (Reaction 3) and then substance B reacts with an impurity in the iron ore to form slag. Substance A is one of the exhaust gases.



(i) Name A and B.

A _____

B _____ [2]

(ii) Name the impurity in the iron ore which reacts with B to form slag.

_____ [1]

(iii) Write a balanced symbol equation for reaction 4.

_____ [2]

(iv) Suggest the name of one other gas which could be present in the exhaust gases.

_____ [1]

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Marks Remark

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Examiner Only
Marks Remark

7 Many chemical reactions produce gases. For a reaction which produces a gas, the rate of the reaction can be measured by two main methods.

(a) The following three reactions produce a gas.

Reaction A: $Mg + 2HCl \rightarrow MgCl_2 + H_2$

Reaction B: $2H2O2 \rightarrow 2H2O + O2$

Reaction C: $Na2S2O3 + 2HCl \rightarrow 2NaCl + SO2 + S + H2O$

(i) Circle the **gaseous product** in each reaction. [3]

(ii) H_2O_2 undergoes catalytic decomposition in reaction B. What is the chemical name of H_2O_2?

_____ [1]

(iii) A catalyst is required for reaction B. What is meant by the term catalyst?

_____

_____

_____ [3]

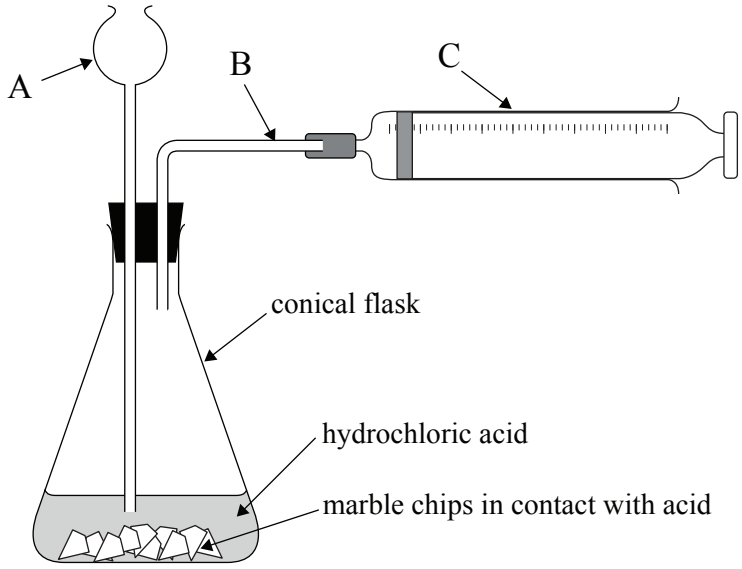
(iv) Name the catalyst required for reaction B.

_____ [1]

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(b) One method of measuring the rate of a reaction in which a gas is produced is to monitor the volume of gas. The apparatus shown below is often used for this purpose.

Examiner Only
Marks Remark



(i) Name the pieces of apparatus labelled A, B and C

A _____

B _____

C _____[3]

(ii) Apart from safety equipment, what other piece of apparatus would be required to carry out this experiment?

_____[1]

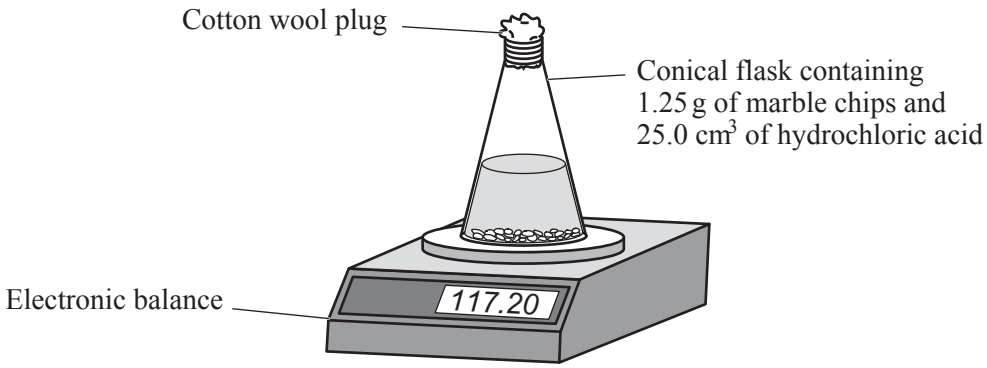
(iii) Why must A be below the level of the hydrochloric acid in the conical flask during the experiment?

_____

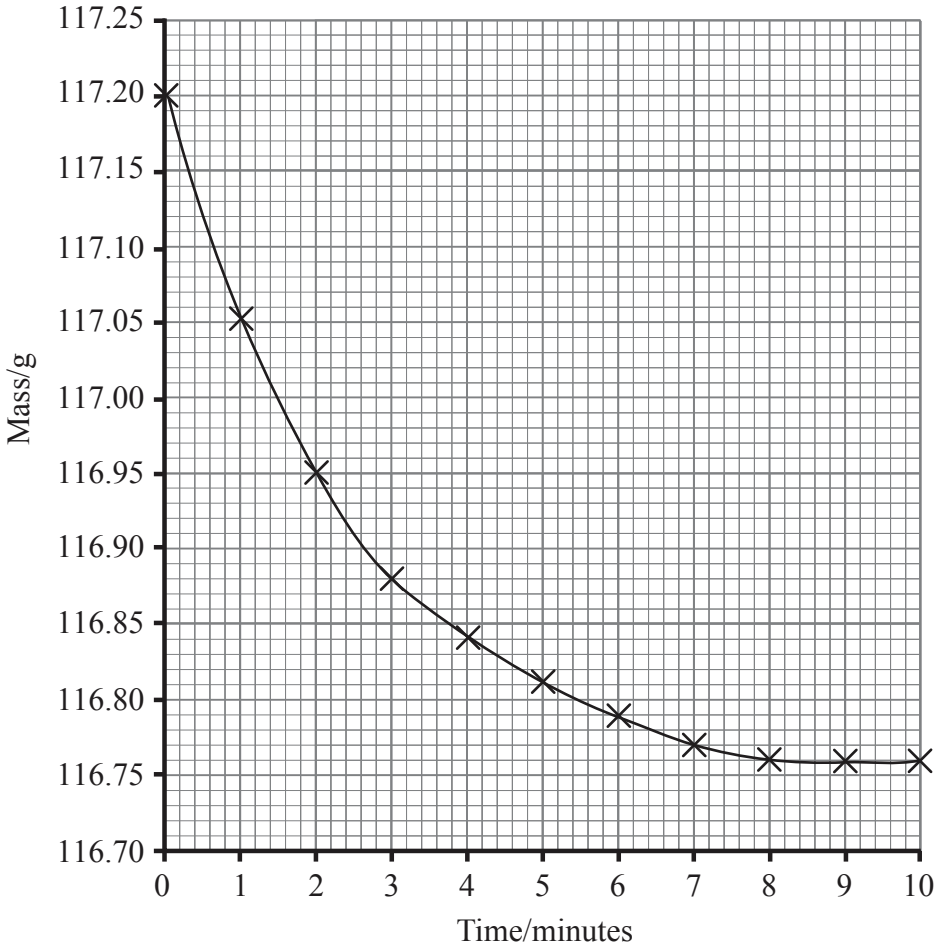
_____[1]

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(c) The apparatus below also shows how the rate of the reaction between 1.25 g of marble chips (calcium carbonate) and 25.0 cm^3 of hydrochloric acid (an excess) may be measured. This was carried out at room temperature (20 °C).



The mass of the flask containing the marble chips and the acid is measured against time. The results obtained were plotted on the graph shown below.



(i) Calculate the total mass lost during the experiment.

_____

_____ [2]

Examiner Only
Marks Remark

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

Examiner Only
Marks Remark

_____

_____[1]

(iii) The experiment was repeated at 40 °C and the rate of reaction increased. Sketch on the graph the curve you would expect to obtain if all other factors were kept the same. [2]

(iv) Explain, in terms of particles, how increasing the temperature would increase the rate of this reaction.

_____

_____

_____

_____[3]

(v) State clearly two other factors which you could change to **increase** the rate of this chemical reaction.

1. _____

2. _____[2]

(d) Catalysts are used in many industrial processes. Complete the blanks in the table below.

Industrial Process	**Equation for the reaction**	**Name of catalyst**
Catalytic oxidation of ammonia	$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$	
Haber Process		iron

[4]

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GCSE

Science: Chemistry

Summer 2010

Mark Schemes

Issued: October 2010

Rewarding Learning

General Certificate of Secondary Education
2010

Science: Chemistry

Paper 2
Higher Tier

[G1404]

WEDNESDAY 9 JUNE, AFTERNOON

MARK SCHEME

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AVAILABLE MARKS

1 (a) (i)

	Name	Formula
Ion present in all acids	hydrogen [1]	H^+ [1]
Ion present in all alkalis	hydroxide [1]	OH^- [1]

[4]

(ii) $H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$ [1] for state symbols [2]

(b) (i) sodium sulphate [1]

(ii) $CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$ [2]

(c) evaporate off half/$\frac{2}{3}$ of the water/heat to concentrate/idea of reduced volume by heating [1]
allow to cool [1] and crystallise [1]
filter [1]
dry between sheets of filter paper/in a low temperature oven/in a desiccator [1] max [3]

Quality of written communication max [2] if [2]–[3] in **(c)**
max [1] if [1] in **(c)**
max [0] if [0] in **(c)** [2]

(d) (i)

	blue/green (flame) [1]
	blue [1] ppt [1] deep/dark blue [1] solution/ppt redissolves [1]

[5]

(ii) add barium nitrate/barium chloride (solution) [1]
ppt [1]
white [1] award mark for "white" if one of the other statements is given correctly [3]

(iii)

		potassium/K^+ [1]
		iodide/I^- [1] (**not** iodine)

Formula of salt **A** KI [1] [3]

25

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AVAILABLE MARKS

2 **(a)** **(i)** reaction [1] (of fuels) with oxygen [1] **not** with **air**
producing oxides [1]
releasing energy [1] max [3]

(ii) (combustion) **product** is water
or
(combustion) **product(s)** does not cause pollution
or
no solid residue in (combustion) **product(s)** [1]

(iii) bonds broken in the hydrogen and oxygen [1]
bond breaking takes in energy [1]
bonds made in water [1]
bond making gives out energy [1]
more energy given out in bond making than taken in in bond breaking [1] [5]
Example: There is more energy given out when the bonds are made in water than taken in when the bonds are broken in the hydrogen and oxygen molecules.

(b) **(i)** black [1] copper oxide
red-brown [1] copper
condensation/droplets/of a colourless liquid [1] max [2]

(ii) $CuO + H_2 \rightarrow Cu + H_2O$ [2]

(iii) **copper oxide** loses oxygen [1] reduction is loss of oxygen [1]
or
copper ions gain electrons [1] reduction is gain of electrons [1] [2]

(c) **(i)** larger surface area [1]
react faster [1] [2]

(ii) $2Mg + O_2 \rightarrow 2MgO$ [3]

(iii) white light/bright light [1]
changes from grey to white powder [1]
idea of heat evolved [1] max [1]

(iv) $2e^-$ [1] accept $Mg - 2e^- \rightarrow Mg^{2+}$ / $Mg \rightarrow Mg^{2+} + 2e^-$
magnesium has lost electrons [1]
oxidation is loss of electrons [1] [3] 24

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				AVAILABLE MARKS
3	(a)	(i)	pipette [1]* use safety pipette filler [1] rinse with distilled water [1] rinse with barium hydroxide solution [1] draw up liquid until (bottom of) meniscus on line [1] release [1] into conical flask touch tip of pipette on to surface of solution [1] max [4] * essential	
		(ii)	pink [1] to colourless [1] (wrong way round = [1]) [2]	
	(b)	(i)	average titre = 22.45 (cm^3) use of rough titre max [1] (22.57 cm^3) [2]	
		(ii)	moles = $\frac{22.45 \times 0.2}{1000}$ [1] = 0.00449 [1] [2]	
		(iii)	ratio 1 $Ba(OH)_2$: 2HCl or division by 2 [1] = 0.002245 [1] [2]	
		(iv)	$\frac{0.002245 \times 1000}{25.0}$ [1] = 0.0898 [1] [2]	
	(c)	(i)	moles Ca = $\frac{0.2}{40}$ [1] = 0.005 [1] ratio 1 Ca:1 H_2/0.005 : 0.005 [1] 0.005 × 24 [1] volume = 0.12 [1] dm^3 [5]	
		(ii)	ratio 1 Ca: 2HNO_3/multiplication by 2 [1] = 0.005 × 2 = 0.01 [1] $\frac{0.01 \times 1000}{2}$ [1] = 5 [1] cm^3 [4]	
		(iii)	% N $\frac{28\ [1]}{164\ [1]} \times 100$ = 17.1% [1] [3]	26

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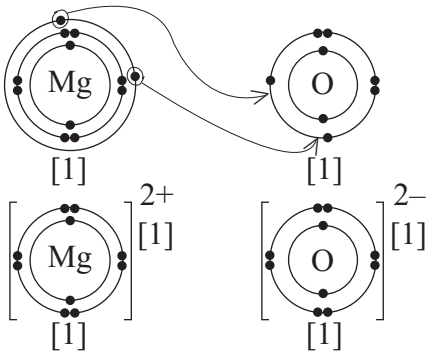
					AVAILABLE MARKS
4	(a)	(i)	break down [1] using heat [1]	[2]	
		(ii)	$CaCO_3 \rightarrow CaO + CO_2$	[2]	
		(iii)	breaking strong/ionic bonds [1] requires a lot of energy [1]	[2]	
		(iv)	$CaO + H_2O \rightarrow Ca(OH)_2$	[2]	
	(b)	(i)	$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$	[3]	
		(ii)	bubbles/effervescence/gas produced [1] idea of solid/calcium carbonate disappears [1] **not** dissolving idea of heat (released/given out) [1] idea that solution remains colourless	max [2]	
		(iii)	$CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + H_2O + CO_2$	[2]	
	(c)	(i)	$Al(OH)_3 + 3HCl \rightarrow AlCl_3 + 3H_2O$	[3]	
		(ii)	reacts/acts/behaves as an acid and a base	[1]	19

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AVAILABLE MARKS

5 **(a)** **(i)** A substance made up of (only) one type of atom [2] (a substance made up of one atom = [1])
or substance which cannot be broken down into anything simpler [1]
by chemical means [1] [2]

(ii) diagrams drawn to show full electronic configuration.
magnesium atom 2,8,2 [1]
oxygen atom 2,6 [1]
transfer of 2 electrons from Mg to O [1]



magnesium ion 2,8 [1]
oxide ion 2,8 [1]

charge on magnesium ion 2^+ [1]
charge on oxide ion 2^- [1]

attraction between oppositely charged ions/electrostatic attraction [1]

max [6]

(iii) ionic/electrostatic [1]

(b) **(i)** different { structure / forms } of the same element [1]
in the same (physical) state [1] [2]

(ii)
- correct bonding in **all** layers shown [1]
- diagram of at least 2 layers [1] max [2] for drawing

labels
- (carbon) atoms
- delocalised electrons
- covalent bond (between carbon atoms)
- weak bonds (between layers) or Van der Waals forces max [4]

(iii) strong **bonds**/covalent **bonds** [1]
tetrahedral [1]
3D/rigid structure/regular structure/giant structure/macromolecular [1]
max [2]

(c) **(i)** shared [1] electrons [1]
idea of pair [1] [3]

(ii) carbon dioxide – simple/molecular (structure) [1]
van der Waals forces/with weak forces/bonds [1]
between molecules [1]
little energy required to break [1] max [3] 23

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					AVAILABLE MARKS
6	(a)	(i)	coke	[1]	
		(ii)	(hot) air	[1]	
		(iii)	Reaction 1: $C + O_2 \rightarrow CO_2$ Reaction 2: $CO_2 + C \rightarrow 2CO$	[2] [3]	
		(iv)	$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$	[3]	
	(b)	(i)	A = carbon dioxide [1] CO_2 B = calcium oxide [1] CaO/quicklime	[2]	
		(ii)	silicon dioxide/sand	[1]	
		(iii)	Reaction 4: $CaO + SiO_2 \rightarrow CaSiO_3$	[2]	
		(iv)	carbon monoxide/nitrogen/argon/any other noble gas	[1]	16

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		AVAILABLE MARKS
7 **(a)** **(i)**	Reaction A: $Mg + HCl \rightarrow MgCl_2 + (H_2)$	
	Reaction B: $2H_2O_2 \rightarrow 2H_2O + (O_2)$	
	Reaction C: $Na_2S_2O_3 + 2HCl \rightarrow 2NaCl + (SO_2) + S + H_2O$	
	[1] for each correct circle [3]	
(ii)	hydrogen peroxide [1]	
(iii)	(substance which) increases rate/speeds up [1] reaction [1] idea of without being used up [1] [3] **not** does not take part in the reaction	
(iv)	manganese(IV) oxide/manganese dioxide [1]	
(b) **(i)**	A = **thistle** funnel [1] B = delivery tube/connecting tubing [1] C = (gas) syringe [1] [3]	
(ii)	(stop)clock/watch/timer [1]	
(iii)	idea of prevent gas escaping [1]	
(c) **(i)**	117.2 – 116.76 [1] = 0.44 [1] g [2]	
(ii)	idea of prevent loss of liquid/spray **not** loss of gas [1]	
(iii)	starts at 117.20 **and** stays lower [1] ends at same mass [1] [2]	
(iv)	more energy/move faster [1] more collisions [1] more successful collision [1] } max [2]/[3] * in a given period of time [1] **essential** max [3]	
(v)	stir/shaking [1] increase concentration of (hydrochloric) acid [1] crush marble chips/increase surface area of solid/marble chips [1] any [2]	
(d)		

		platinum/(rhodium) [1]
	$N_2 + 3H_2 \rightarrow 2NH_3$ [3]	

[4] 27

Total **160**

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Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2009

Science: Chemistry

Paper 2
Higher Tier

G1404

[G1404]

WEDNESDAY 17 JUNE, MORNING

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	

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Examiner Only	
Marks	Remark

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]

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

Examiner Only	
Marks	Remark

(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]

(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]

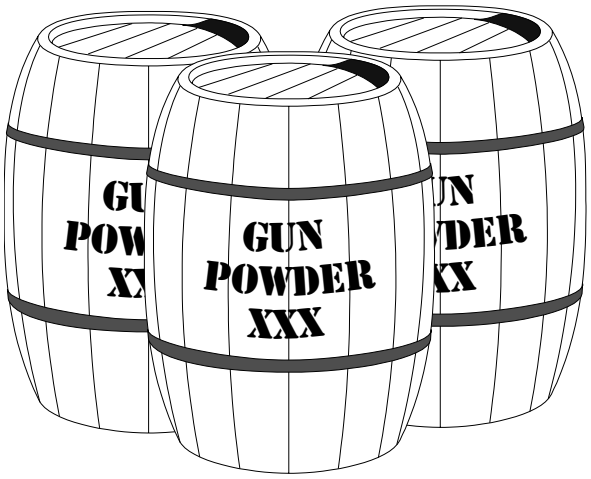
Examiner Only

Marks	Remark

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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]

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

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Marks	Remark

(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.

_____

_____

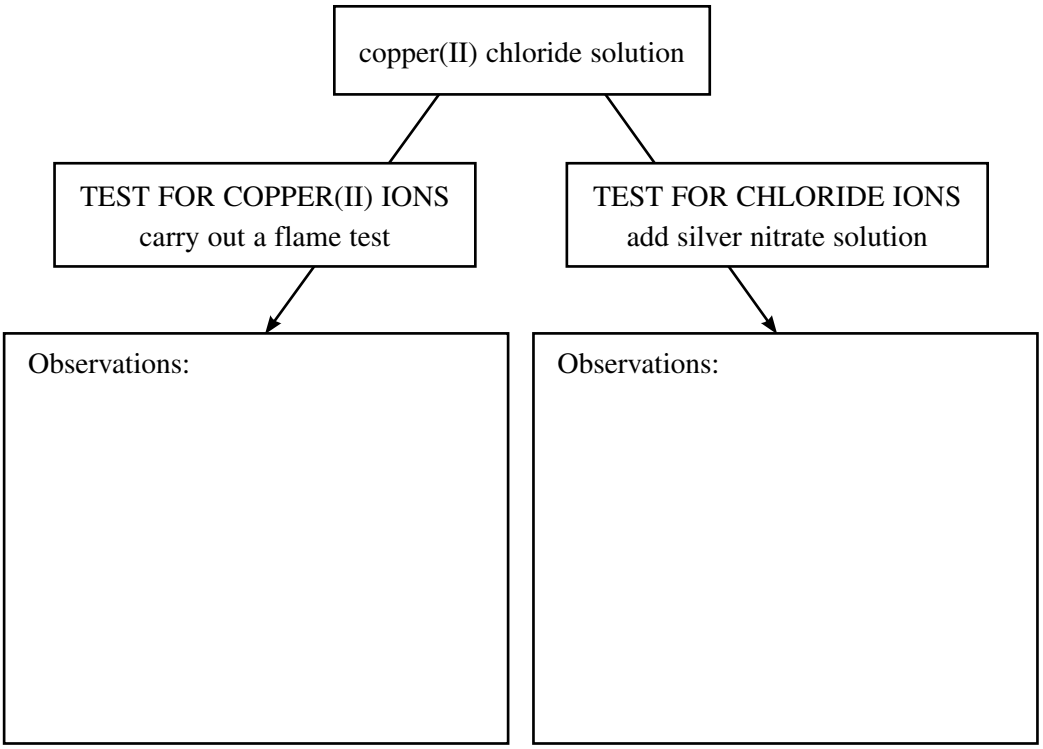
_____

_____

_____ [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.



[3]

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

_____

_____

_____

_____ [4]

Quality of written communication [2]

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(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

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]

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(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.

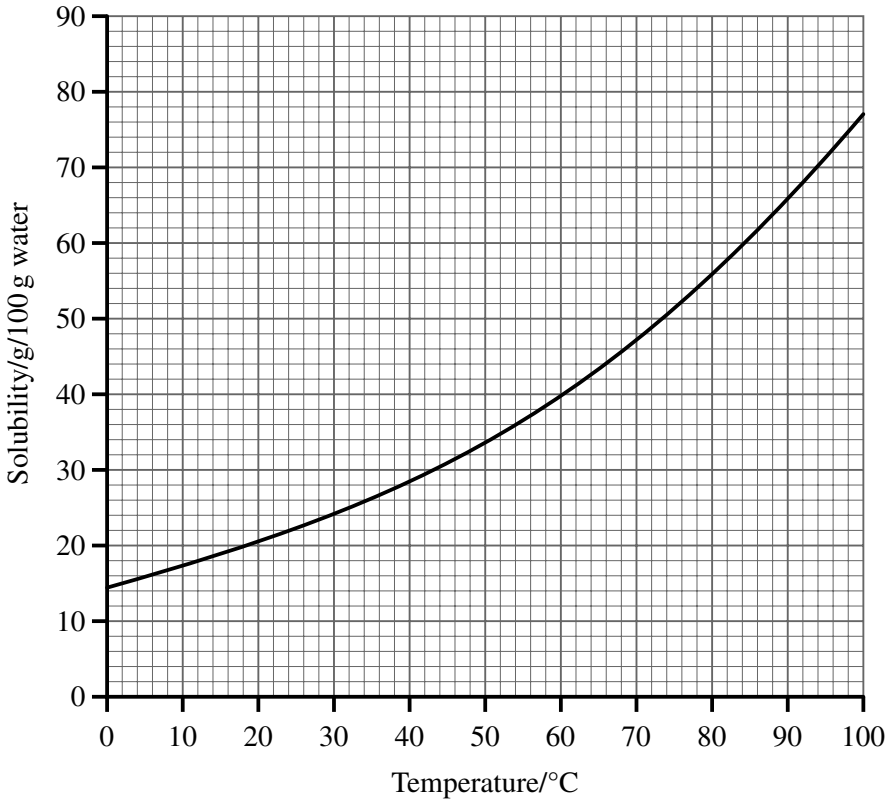
_____ g/100 g water [2]

Examiner Only

Marks	Remark

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

Examiner Only	
Marks	Remark



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]

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(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?

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Marks	Remark

_____ 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]

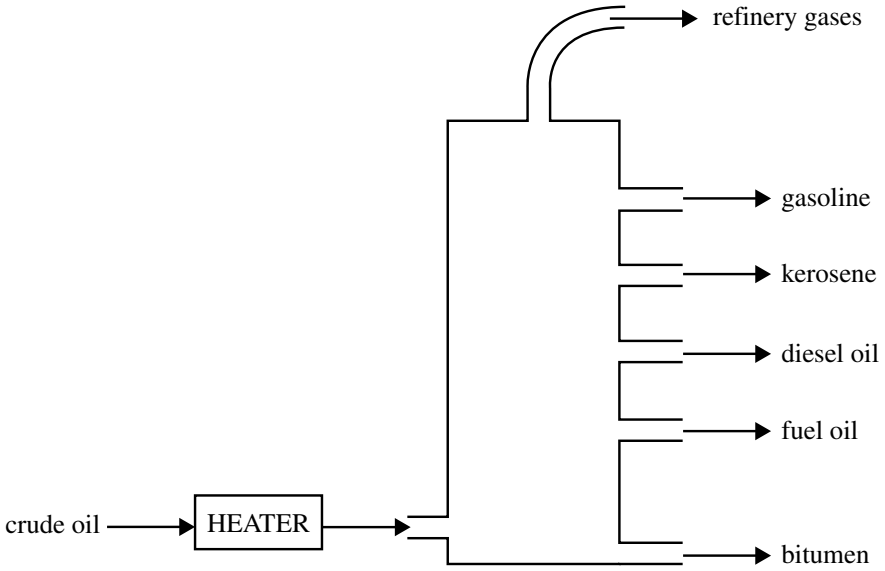
(ii) State one other use for sulphur dioxide.

_____ [1]

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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]

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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]

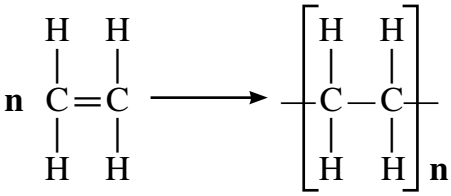
(iv) If a heating system is not serviced the methane may burn in a limited supply of air. Explain why this is dangerous.

_____

_____ [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]

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

Examiner Only	
Marks	Remark

(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.

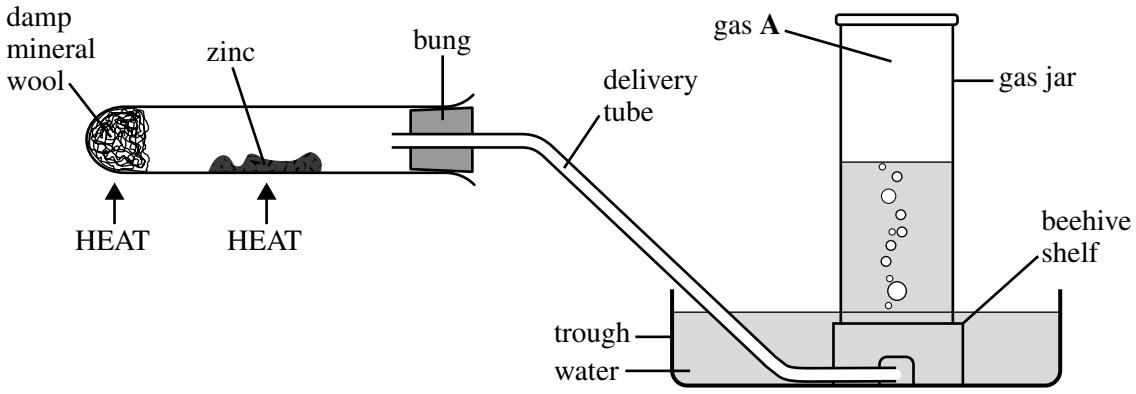
potassium and water	
observations	[4]
balanced symbol equation	[3]

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

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(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

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]

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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.

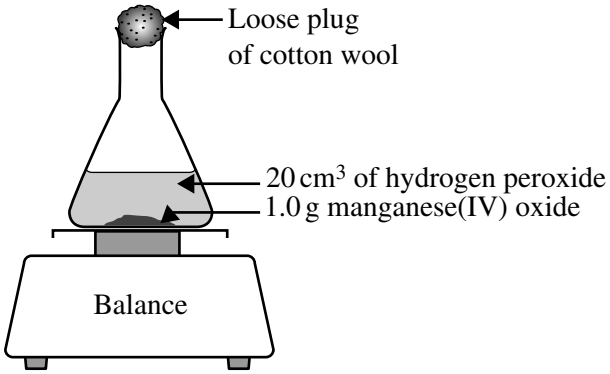
_____ [1]

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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 cm^3 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.

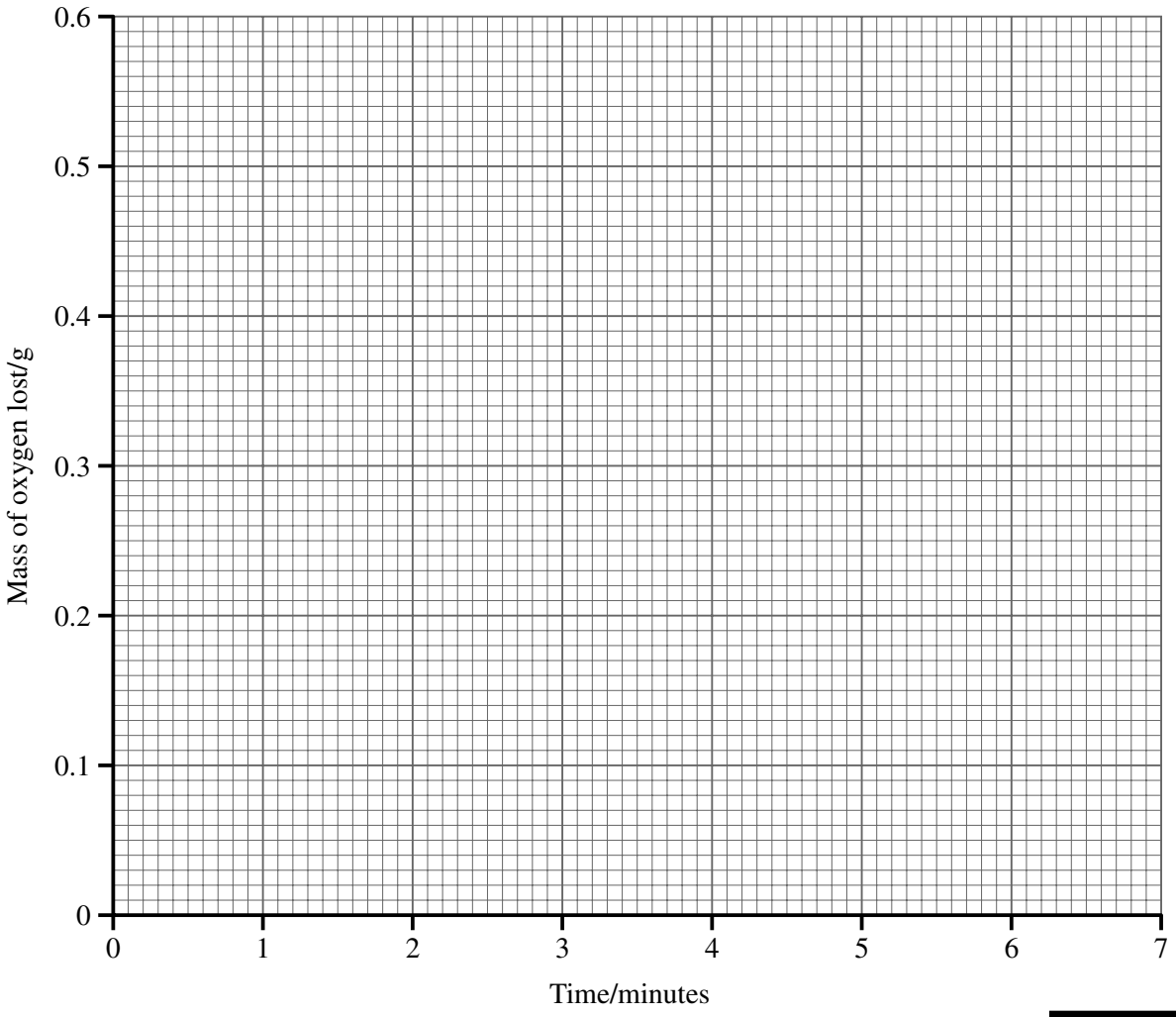
_____ [3]

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

_____ [1]

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(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

Examiner Only	
Marks	Remark

(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]

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(c) To investigate the effect of temperature on this reaction, 20 cm^3 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]

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Marks	Remark

THIS IS THE END OF THE QUESTION PAPER

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GCSE

Science: Chemistry

Summer 2009

Mark Schemes

Issued: October 2009

Rewarding Learning

General Certificate of Secondary Education
2009

Science: Chemistry

Paper 2
Higher Tier

[G1404]

WEDNESDAY 17 JUNE, MORNING

MARK SCHEME

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					AVAILABLE MARKS
1	(a)	(i)	Mendeleev	[1]	
		(ii)	number [1] mass [1]	[2]	
		(iii)	Mendeleev's table had gaps for undiscovered elements **or** any suitable	[1]	
		(iv)	Newlands	[1]	
	(b)	(i)	8	[1]	
		(ii)	Group I/alkali metals	[1]	
		(iii)	noble gases/Group VIII or 0	[1]	
		(iv)	more reactive/increased reactivity	[1]	
	(c)	(i)	Periods	[1]	
		(ii)	number of electrons in outer shell equals group number/as the Periodic Table is crossed from left to right the number of electrons increases	[1]	
		(iii)	decreases	[1]	
		(iv)	silicon/germanium [1] has properties of metals and non-metals [1]	[2]	
	(d)	(i)	**C** [1] **D** [1]	[2]	
		(ii)	**A**	[1]	
		(iii)	copper oxide/magnesium oxide or any other suitable insoluble base	[1]	
	(e)		Hydrogen [1] H_2O [1] **or** Carbon [1] CO [1] **or** Nitrogen [1] NO [1]	[2]	20

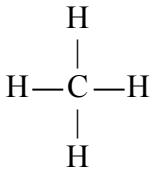
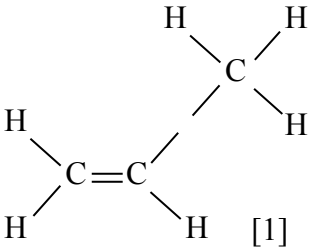
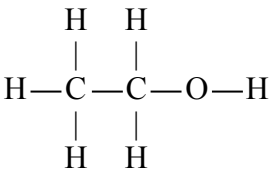
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				AVAILABLE MARKS
2	**(a)**	**(i)**	a compound [1] formed when an acid reacts with/neutralises **or** when acid hydrogen replaced [1] a base/alkali/metal/carbonate [1] **or** with a metal [1] maximum [2] [2]	
		(ii)	KNO_3 [1]	
		(iii)	potassium oxide/hydroxide/carbonate/hydrogen carbonate [1] nitric acid [1] [2]	
	(b)	**(i)**	green [1] (solid) disappears [1] bubbles [1] colourless [1] to blue [1] heat released [1] maximum [3] [3]	
		(ii)	$CuCO_3 + 2HCl \rightarrow CuCl_2 + CO_2 + H_2O$ [3]	
		(iii)	filter [1]	
		(iv)	$CuCl_2.2H_2O$ [1]	
		(v)	heat [1] appropriate test for water [1] relevant colour change [2] [4]	
	(c)	**(i)**	blue/green [1] white [1] ppt [1] [3]	
		(ii)	flame test rod/nichrome wire [1] dip into deionised water/conc hydrochloric acid [1] place in sample [1] heat in flame and observe colour [1] [4]	
			Quality of written communication [2]	
	(d)	**(i)**	amphoteric [1]	
		(ii)	$Zn(OH)_2 + 2HCl \rightarrow ZnCl_2 + 2H_2O$ [3]	
		(iii)	sodium zincate [1]	
		(iv)	zinc oxide/aluminium oxide/aluminium hydroxide [1]	32

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					AVAILABLE MARKS
3	(a)	(i)	blue	[1]	
		(ii)	colourless	[1]	
		(iii)	limewater	[1]	
		(iv)	carbon dioxide	[1]	
	(b)	(i)	individual marks are given for correctly **labelled** and recognisable drawing no labels = no marks water and copper sulphate in boiling tube [1] boiling tube in water bath [1] thermometer in boiling tube [1] tripod [1] gauze [1] Bunsen burner/heat [1] maximum [4]	[4]	
		(ii)	no more solid will dissolve/maximum mass dissolved [1] at a particular temperature [1]	[2]	
		(iii)	6.8 × 5 [1] = 34 g/100 g [1]	[2]	
	(c)	(i)	water boils at 100 °C	[1]	
		(ii)	47 ±1	[1]	
		(iii)	60 °C	[1]	
		(iv)	40 [1] g/100 g at 60 °C 24 [1] g/100 g at 30 °C 40 – 24 [1] = 16 16/2 = 8 [1] g	[4]	
	(d)	(i)	decreases	[1]	
		(ii)	preservative/bleach	[1]	21

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				AVAILABLE MARKS
4	**(a)**	**(i)**	fractional [1] distillation [1]	[2]
		(ii)	carbon [1] hydrogen [1]	[2]
	(b)	**(i)**	cracking	[1]
		(ii)	heat/catalyst	[1]
	(c)	**(i)**	 [1]  [1]	[2]
		(ii)	(bubble into) red-brown [1] bromine water [1] changes to colourless for propene [1] no change for methane [1]	[4]
		(iii)	$CH_4 + 2O_2 \rightarrow 2H_2O + CO_2$	[3]
		(iv)	carbon monoxide produced [1] toxic [1]	[2]
	(d)	**(i)**	addition [1] polymerisation [1]	[2]
		(ii)	polythene	[1]
		(iii)	plastic bags/plastic bottles	[1]
		(iv)	repetition of structure/number of monomers/number of ethene molecules	[1]
	(e)	**(i)**	$C_2H_4 + H_2O \rightarrow C_2H_5OH$	[2]
		(ii)		[2]
		(iii)	low bpt./evaporates easily	[1]
	(f)	**(i)**	yeast	[1]
		(ii)	warm conditions [1] anaerobic/no air [1]	[2]

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AVAILABLE MARKS

5 **(a)** **(i)**

Physical Property	Meaning
ductile [1]	can be drawn out into wires
lustrous	shiny [1]

[2]

(ii) layers [1]
can slide over each other [1] [2]

(b)

potassium and water	
observations	floats [1] moves [1] hisses/gas produced [1] heat released [1] lilac [1] flame [1] eventually disappears [1] colourless solution [1] cracks/explodes [1] maximum [4]
balanced symbol equation	$2K + 2H_2O \rightarrow 2KOH + H_2$

[4]

[3]

calcium and water	
observations	Ca sinks/Ca sinks and rises [1] bubbles/gas produced [1] heat released [1] eventually disappears [1] colourless solution [1] maximum [3]
balanced symbol equation	$Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$

[3]

[3]

(c) **(i)** to generate/produce steam [1]

(ii) hydrogen [1]

(iii) $Zn + H_2O \rightarrow ZnO + H_2$ [2]

(iv) aluminium/iron [1]

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					AVAILABLE MARKS
6	(a)	(i)	haematite	[1]	
		(ii)	thermal [1] decomposition [1]	[2]	
		(iii)	$CaCO_3 \rightarrow CaO + CO_2$	[2]	
		(iv)	to remove impurities/form slag	[1]	
		(v)	greenhouse effect/global warming	[1]	
	(b)	(i)	Al_2O_3	[1]	
		(ii)	900–1000 °C	[1]	
		(iii)	lower melting point [1] act as solvent [1] increase conductivity [1] maximum [2]	[2]	
		(iv)	energy/electricity costs [1] replacement of anodes [1] raw materials not as readily available [1] raw materials must be purified [1] **or** other suitable maximum [2]	[2]	
		(v)	eyesore [1] noise pollution [1] dust pollution [1] traffic pollution [1] destroys habitats [1] **or** other suitable, e.g. exhausts natural resources maximum [2]	[2]	
		(vi)	electrical power lines/drinks cans/saucepans **or** other suitable	[1]	16

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					AVAILABLE MARKS
7	**(a)**	**(i)**	$2H_2O_2 \rightarrow 2H_2O + O_2$	[3]	
		(ii)	prevent loss of liquid spray	[1]	
		(iii)	plot points [2] smooth curve [1]	[3]	
		(iv)	0.40 (take value from 3 minutes on graph)	[1]	
		(v)	measure volume of oxygen produced/use a gas syringe/measure time taken for reaction to complete	[1]	
	(b)	**(i)**	individual marks are given for correctly labelled and recognisable drawing No labels = no marks filter funnel [1] filter paper [1] conical flask/beaker/suitable container [1] manganese(IV) oxide/residue [1] **or** evaporating basin [1] heat [1] tripod [1] gauze [1] any **three**	[3]	
		(ii)	dry [1] weigh – should be 1.0 g [1] **or** weigh before **and** after [1] compare [1]	[2]	
		(iii)	catalyst	[1]	
	(c)		Effect: rate increases	[1]	
			Explanation: particles move faster/have more energy [1] more collisions [1] more successful collisions [1] in unit time/per sec/min/more frequent [1] (essential mark) maximum [3]	[3]	19
				Total	**160**

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