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Surname

Other names

**Pearson Edexcel
International GCSE**

Centre Number

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Candidate Number

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Chemistry

Unit: 4CH0**Science (Double Award) 4SC0****Paper: 1C**

Thursday 17 May 2018 – Morning

Time: 2 hours

Paper Reference

**4CH0/1C
4SC0/1C****You must have:**

Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Show all the steps in any calculations and state the units.
- Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Information

- The total mark for this paper is 120.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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P 5 2 3 2 2 R A 0 1 3 6



Pearson



THE PERIODIC TABLE

Period 1 2 3 4 5 6 7 0

1	1	2	3	4	5	6	7	0													
1	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹ H Hydrogen 1 </div>								<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ⁴ He Helium 2 </div>												
2	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ⁹ Li Lithium 3 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ⁴ Be Beryllium 4 </div>						<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹⁹ F Fluorine 9 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ²⁰ Ne Neon 10 </div>												
3	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ²³ Na Sodium 11 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ²⁴ Mg Magnesium 12 </div>						<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ^{35.5} Cl Chlorine 17 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ⁴⁰ Ar Argon 18 </div>												
4	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ³⁹ K Potassium 19 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ⁴⁰ Ca Calcium 20 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ⁵¹ V Vanadium 23 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ⁵² Cr Chromium 24 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ⁵⁵ Mn Manganese 25 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ⁵⁶ Fe Iron 26 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ⁵⁹ Co Cobalt 27 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ^{63.5} Cu Copper 29 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ⁷⁰ Zn Zinc 30 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ⁷³ Ga Gallium 31 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ⁷⁵ As Arsenic 33 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ⁷⁹ Se Selenium 34 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ⁸⁰ Br Bromine 35 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ⁸⁴ Kr Krypton 36 </div>							
5	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ⁸⁶ Rb Rubidium 37 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ⁸⁸ Sr Strontium 38 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ⁹¹ Ti Titanium 22 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ⁹³ Nb Niobium 41 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ⁹⁶ Mo Molybdenum 42 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ⁹⁹ Tc Technetium 43 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹⁰¹ Ru Ruthenium 44 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹⁰³ Rh Rhodium 45 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹⁰⁶ Pd Palladium 46 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹¹² Cd Cadmium 48 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹¹⁵ In Indium 49 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹¹⁹ Sn Tin 50 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹²² Sb Antimony 51 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹²⁷ I Iodine 53 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹³¹ Xe Xenon 54 </div>						
6	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹³³ Cs Caesium 55 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹³⁷ Ba Barium 56 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹⁷⁹ Hf Hafnium 72 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹⁸¹ Ta Tantalum 73 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹⁸⁴ W Tungsten 74 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹⁸⁶ Re Rhenium 75 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹⁹⁰ Os Osmium 76 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹⁹² Ir Iridium 77 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹⁹⁵ Pt Platinum 78 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹⁹⁷ Au Gold 79 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ²⁰¹ Hg Mercury 80 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ²⁰⁴ Tl Thallium 81 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ²⁰⁷ Pb Lead 82 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ²⁰⁹ Bi Bismuth 83 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ²¹⁰ Po Polonium 84 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ²¹⁰ At Astatine 85 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ²²² Rn Radon 86 </div>				
7	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ²²³ Fr Francium 87 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ²²⁶ Ra Radium 88 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹³⁹ La Lanthanum 57 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹⁷³ Lu Lutetium 71 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹⁸⁷ Yb Ytterbium 80 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹⁹¹ Tm Thulium 81 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹⁹³ Er Erbium 82 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹⁹⁵ Ho Holmium 83 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹⁹⁷ Dy Dysprosium 84 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ¹⁹⁹ Ho Holmium 85 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ²⁰¹ Er Erbium 86 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ²⁰³ Tm Thulium 87 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ²⁰⁵ Yb Ytterbium 88 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ²⁰⁷ Lu Lutetium 89 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ²⁰⁹ Tm Thulium 89 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ²¹¹ Bi Bismuth 89 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ²¹⁵ Po Polonium 89 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ²¹⁷ At Astatine 89 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ²²³ Fr Francium 89 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ²²⁷ Ra Radium 89 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> ²³¹ Ac Actinium 89 </div>

Key

Relative atomic mass
Symbol
Name
Atomic number

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Answer ALL questions.

1 Chromatography can be used to separate the substances in a mixture.

(a) Diagram 1 shows the apparatus used to separate the different dyes in a food colouring.

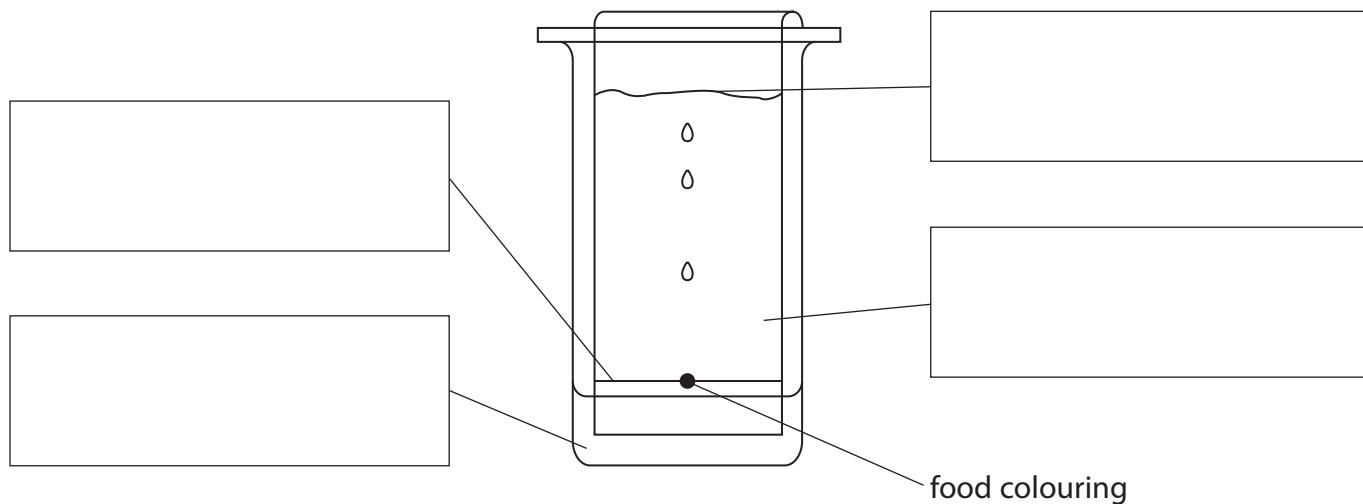


Diagram 1

The box lists some terms used in chromatography.

- | | |
|----------|----------------------|
| baseline | chromatography paper |
| solvent | solvent front |

Use the terms from the box to label diagram 1.

(3)

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(b) Diagram 2 shows a chromatogram produced using four different food colourings, P, Q, R and S.

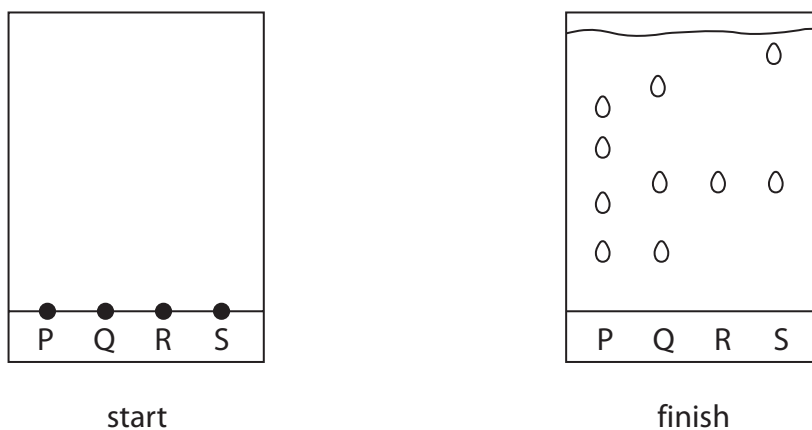


Diagram 2

(i) Which food colouring contains only one dye? (1)

- A P
- B Q
- C R
- D S

(ii) Which food colourings have one dye in common? (1)

- A P, Q and R
- B P, R and S
- C Q, R and S
- D P, Q, R and S

(iii) Explain which food colouring contains the largest number of dyes. (2)

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(Total for Question 1 = 7 marks)

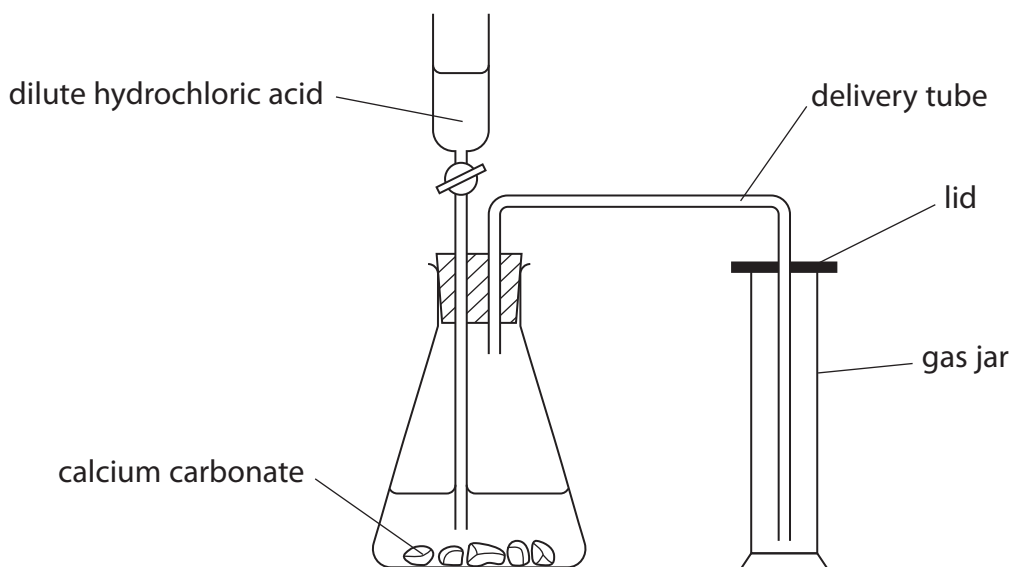
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2 The diagram shows the apparatus used to prepare carbon dioxide in the laboratory.



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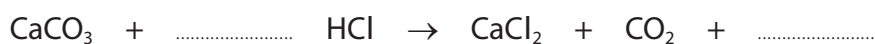
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(a) What is the name of the piece of apparatus containing the dilute hydrochloric acid? (1)

- A burette
- B pipette
- C tap funnel
- D thistle funnel

(b) Complete the chemical equation for this reaction. (2)



(c) Which of these is a true statement about carbon dioxide? (1)

- A it turns red litmus blue
- B it turns limewater milky
- C it relights a glowing spill
- D it burns with a squeaky pop



(d) The diagram shows how carbon dioxide is collected by downward delivery in air.

(i) Give a reason why carbon dioxide can be collected by downward delivery in air.

(1)

(ii) Give another method of collecting carbon dioxide.

(1)

(e) When carbon dioxide dissolves in water, a weakly acidic solution forms.

Suggest a pH value for this solution.

(1)

(f) Carbon dioxide also forms when copper(II) carbonate is decomposed by heating.

The equation for this reaction is



State the change in colour of the solid when copper(II) carbonate decomposes.

(2)

from to

(g) Suggest two properties of carbon dioxide that make it suitable for use in fire extinguishers.

(2)

1

2

(Total for Question 2 = 11 marks)

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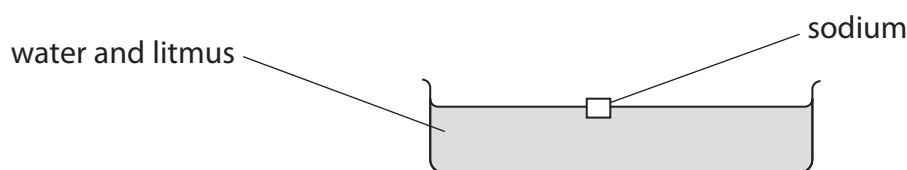
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3 A teacher investigates the reaction between sodium and water.

The teacher fills a trough with water.

She adds a few drops of litmus solution to the water, and then adds a piece of sodium.



(a) The sodium floats on the water. It reacts with the water and produces bubbles of hydrogen gas.

(i) State two other observations that are made during the reaction.

(2)

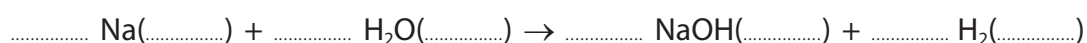
1

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(ii) Balance the equation for the reaction between sodium and water.

Include the state symbols.

(2)



(b) Lithium and potassium react in a similar way to sodium when added to water.

(i) State why they have a similar reaction in terms of the electronic configurations of their atoms.

(1)

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.....

(ii) Place the elements lithium, potassium and sodium in order of reactivity.

(1)

most reactive

.....

least reactive

(Total for Question 3 = 6 marks)

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4 Use the Periodic Table on page 2 to help you answer this question.

(a) Which word correctly describes substances found in the Periodic Table?

(1)

- A alloys
- B compounds
- C elements
- D mixtures

(b) The substances in the Periodic Table are arranged in order of increasing

(1)

- A atomic number
- B mass number
- C nucleon number
- D relative atomic mass

(c) The table lists properties of some of the gases in Group 0 of the Periodic Table.

Gas	Symbol	Boiling point in K	Reaction with metals
helium	He	4	no reaction
neon		27	no reaction
argon	Ar		no reaction
krypton	Kr	121	no reaction
xenon	Xe	165	

Complete the table by giving

- the symbol for neon
- an estimate for the boiling point of argon
- the reaction of xenon with metals

(3)

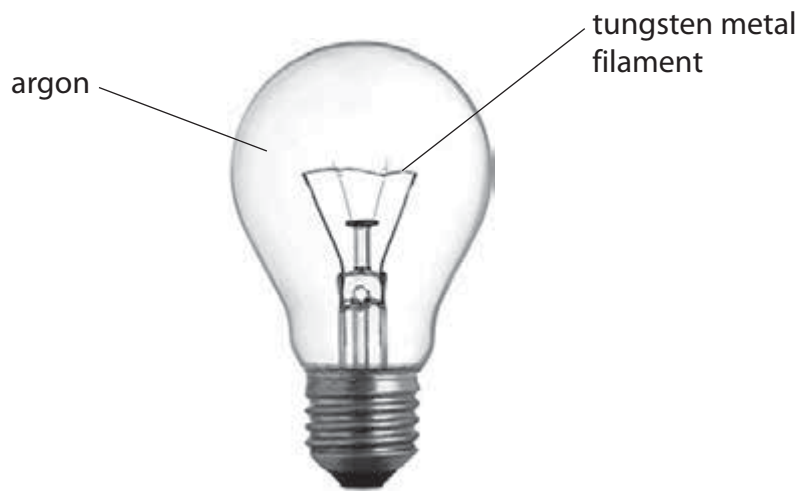
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(d) The photograph shows an electric light bulb.



The tungsten filament becomes very hot when the light bulb is switched on.

Suggest why argon is a more suitable gas than air to use in the light bulb.

(2)

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(Total for Question 4 = 7 marks)

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- 5 A student tries to make a pure, dry sample of hydrated cobalt(II) chloride crystals. He uses dilute hydrochloric acid and solid cobalt(II) oxide.

This is the student's method.

- Step 1 pour about 50 cm^3 of dilute hydrochloric acid into a beaker
- Step 2 warm the acid using a Bunsen burner
- Step 3 add a small amount of cobalt(II) oxide and stir the mixture with a glass rod
- Step 4 add further small amounts of cobalt(II) oxide until it stops reacting
- Step 5 filter the final mixture and collect the filtrate in an evaporating basin
- Step 6 leave the filtrate until all of the water has evaporated

His sample of cobalt(II) oxide contains a small amount of a solid impurity that dissolves in water, but does not react with the acid.

- (a) State why it is not necessary to have a precise measurement of the volume of hydrochloric acid in step 1.

(1)

- (b) State why the acid is warmed in step 2.

(1)

- (c) Suggest why a glass rod, rather than a metal spatula, is used to stir the mixture in step 3.

(1)

- (d) State how the student will know when the cobalt(II) oxide stops reacting in step 4.

(1)

- (e) State why the method used in step 6 will not produce a pure sample of hydrated cobalt(II) chloride crystals.

(1)

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(f) Describe how the student could produce a pure, dry sample of crystals from the filtrate in step 5.

(5)

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(g) The table shows the formula and colour of three different types of cobalt(II) chloride.

Formula	Colour
CoCl_2	blue
$\text{CoCl}_2 \cdot 2\text{H}_2\text{O}$	purple
$\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$	pink

When water is added very slowly to solid CoCl_2 , the colour of CoCl_2 changes from blue to purple and then to pink.

(i) Write a chemical equation for the change from the purple solid to the pink solid. (1)

(ii) Which of these words describes the change taking place when the pink solid is heated to form the blue solid? (1)

- A crystallisation
- B dehydration
- C hydration
- D redox

(Total for Question 5 = 12 marks)



6 Tests are done on a sample of a solid, X.

Solid X contains the ammonium ion, NH_4^+ , one other cation and one anion.

The table lists details of the tests done on solid X and the observations made for each test.

	Test	Observation
1	Add dilute sodium hydroxide and warm	gas given off, gas turns damp litmus paper from red to blue
2	Flame test	lilac coloured flame
3	A sample of solid X is dissolved in deionised water. The solution is divided into three test tubes and the following tests are done: A to the first test tube, add dilute hydrochloric acid B to the second test tube, add dilute nitric acid and a few drops of silver nitrate solution C to the third test tube, add dilute hydrochloric acid and a few drops of barium chloride solution	no observable change no observable change white precipitate forms

(a) Identify the gas given off in test 1.

(1)

(b) Give the formula of the other cation present in solid X.

(1)

(c) (i) State what test 3A and test 3B tell you about solid X.

(2)

test 3A

test 3B

(ii) Identify the anion in solid X.

(1)

(Total for Question 6 = 5 marks)

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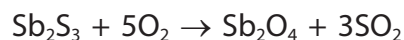


7 Antimony, Sb, is an element in Group 5 of the Periodic Table.

The mineral, stibnite, contains antimony sulfide, Sb_2S_3

Antimony can be obtained from stibnite in a two-stage process.

Stage 1 stibnite is roasted in air



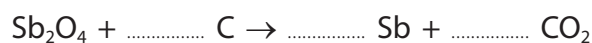
Stage 2 the oxide produced is heated with carbon to form antimony and carbon dioxide

(a) (i) State why the sulfur in stage 1 is said to be oxidised.

(1)

(ii) Complete the equation for the reaction in stage 2.

(1)



(b) Bismuth is another element in Group 5 of the Periodic Table.

Bismuth forms an oxide, Bi_2O_3 , which has a giant ionic structure.

(i) Give the formula of the bismuth ion in bismuth oxide.

(1)

(ii) Explain why bismuth oxide has a high melting point.

(2)

(iii) Bismuth oxide reacts with dilute hydrochloric acid to form bismuth chloride.

Write a chemical equation for this reaction.

(2)

(Total for Question 7 = 7 marks)

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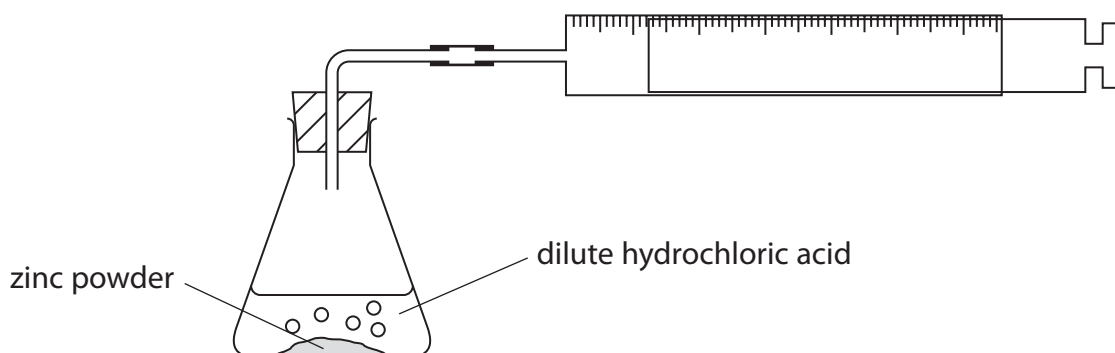
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- 8 A student investigates the rate of reaction between zinc and hydrochloric acid, using an excess of zinc powder.

She uses this apparatus.



The student measures the volume of gas in the syringe every minute for ten minutes.

The table shows her results.

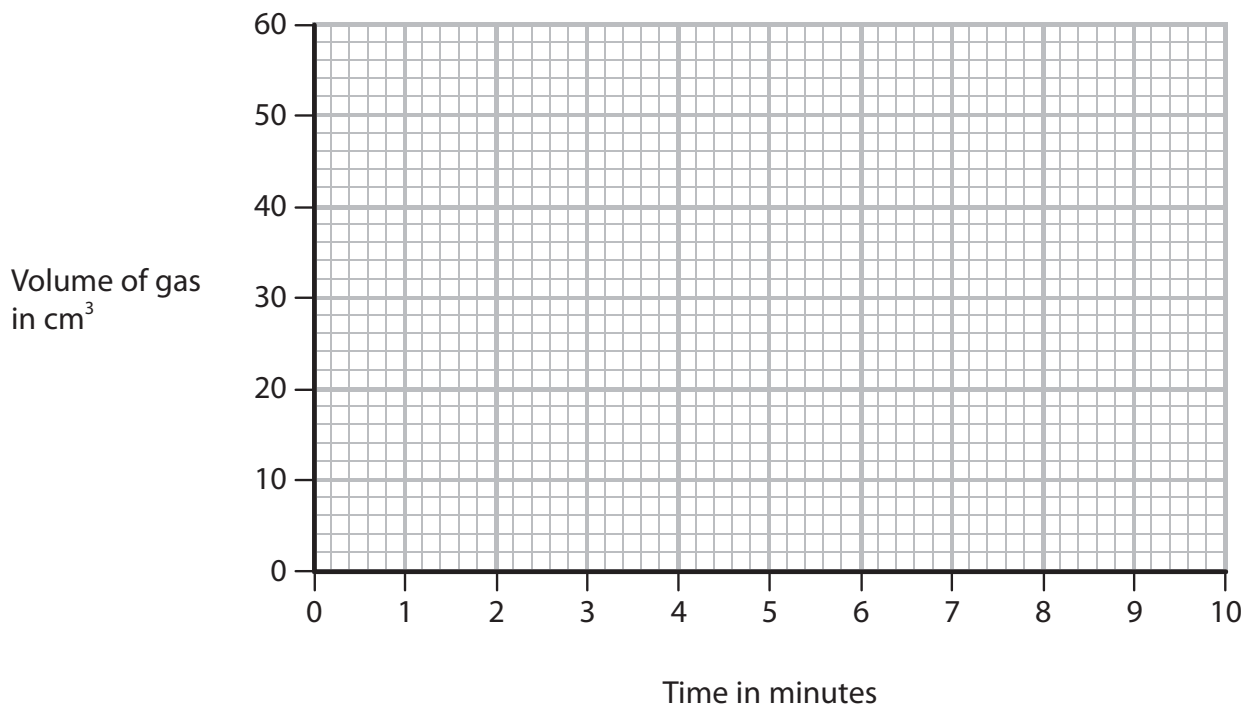
Time in minutes	0	1	2	3	4	5	6	7	8	9	10
Volume of gas in cm³	0	14	37	40	49	54	58	60	60	60	60

- (a) (i) Plot the student's results on the grid.

(2)

- (ii) Draw a curve of best fit.

(1)



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(b) The result at two minutes is anomalous.

- (i) Suggest a mistake that the student could have made to produce this anomalous result.

(1)

- (ii) Use your graph to estimate the volume of gas that was given off at two minutes.

Show clearly on your graph how you obtain your answer.

(2)

volume of gas = cm³

- (c) Explain why the last four readings for the volume of gas are the same.

(2)

- (d) (i) State how the graph shows that the rate of reaction decreases during the first seven minutes.

(1)

- (ii) Explain, in terms of the particle collision theory, why the rate of reaction decreases during the first seven minutes.

(2)

(Total for Question 8 = 11 marks)

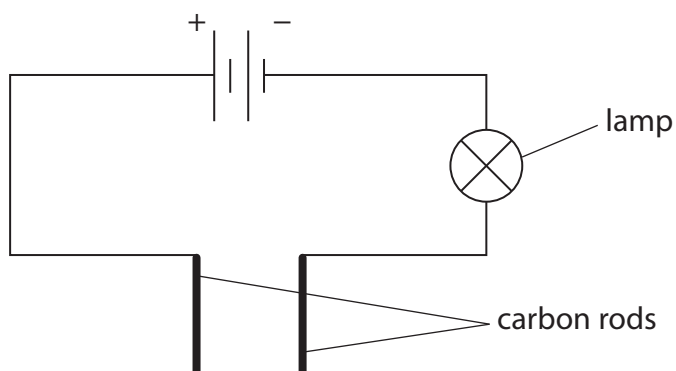
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- 9 This apparatus is used to test whether magnesium, solid magnesium chloride and an aqueous solution of magnesium chloride conduct electricity.



The table shows the results.

Substance	Conducts electricity
magnesium	yes
solid magnesium chloride	no
aqueous solution of magnesium chloride	yes

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Explain these results, with reference to the type of particles in each substance.

(6)

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(Total for Question 9 = 6 marks)



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10 Bromine is a red-brown liquid at room temperature.

Liquid bromine forms a brown gas when warmed.

- (a) Explain what happens to the bromine molecules when liquid bromine is warmed to form a gas.

(2)

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- (b) Bromine reacts with water to form a mixture of hydrobromic acid, HBr, and hypobromous acid, HBrO.

Write a chemical equation for this reaction.

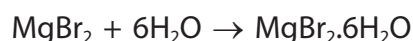
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- (c) Hydrobromic acid reacts with magnesium carbonate to form a solution containing magnesium bromide.



Crystals of hydrated magnesium bromide, $\text{MgBr}_2 \cdot 6\text{H}_2\text{O}$, can be obtained from this solution.



- (i) An excess of hydrobromic acid is reacted with 0.125 mol of magnesium carbonate.

Show, by calculation, that the maximum theoretical mass of hydrated magnesium bromide that can be made is 36.5 g.

[M_r of $\text{MgBr}_2 \cdot 6\text{H}_2\text{O} = 292$]

(3)

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(ii) In an experiment using 0.125 mol of magnesium carbonate, with an excess of hydrobromic acid, the mass of hydrated magnesium bromide obtained is 26.4 g.

Suggest two reasons why the actual mass obtained is less than the maximum theoretical mass.

(2)

1

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2

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(Total for Question 10 = 8 marks)

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- 11 Malachite is an ore of copper containing copper(II) carbonate and several other compounds that are insoluble in water.

You are supplied with several pieces of malachite, these chemicals and items of apparatus.

Chemicals: dilute sulfuric acid magnesium powder

Apparatus: beakers filter funnel and paper pestle and mortar

Describe how you would use the chemicals and the apparatus to obtain a sample of copper from the malachite.

(6)

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(Total for Question 11 = 6 marks)



12 Crude oil is a mixture of hydrocarbons.

Fractional distillation of crude oil and cracking of hydrocarbon fractions are two of the processes used in an oil refinery.

(a) Which property of hydrocarbons is used to separate crude oil into fractions? (1)

- A boiling point
- B chemical reactivity
- C density
- D melting point

(b) These are the main fractions obtained from crude oil.

- bitumen
- diesel
- fuel oil
- gasoline
- kerosene
- refinery gases

(i) Give one use for the refinery gases. (1)

(ii) Give one use for kerosene. (1)

(iii) State which fraction is the most viscous. (1)

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(c) Catalytic cracking is used to break down long-chain alkanes into shorter-chain alkanes and alkenes.

(i) Name the catalyst used in industrial cracking. (1)

(ii) State the temperature used in industrial cracking. (1)

(iii) Tetradecane ($C_{14}H_{30}$) can be cracked to make ethene (C_2H_4) and only one other hydrocarbon.

Write a chemical equation for this reaction. (1)

(iv) Draw the displayed formula of ethene. (1)

(v) Name the polymer formed from ethene. (1)

(vi) Explain why this polymer is difficult to dispose of. (2)

(Total for Question 12 = 11 marks)

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13 A student investigates the reaction between zinc and dilute sulfuric acid.

She uses this method.

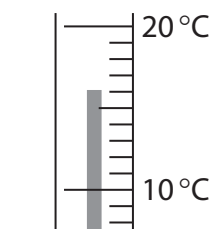
- put 50 cm³ of dilute sulfuric acid into a polystyrene cup
- measure the initial temperature of the acid
- add 2.0 g of zinc to the acid and stir the mixture
- measure the temperature of the mixture after one minute

The student does the experiment three times. For each experiment, she uses the same size pieces of zinc but different concentrations of sulfuric acid.

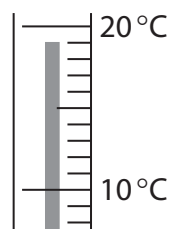
The diagram shows the temperatures for each experiment.

Experiment 1

1.0 mol/dm³ H₂SO₄



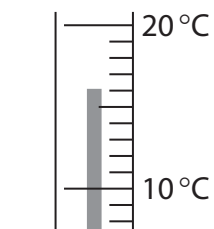
initial
temperature



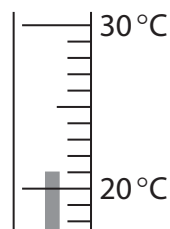
temperature after
one minute

Experiment 2

1.5 mol/dm³ H₂SO₄



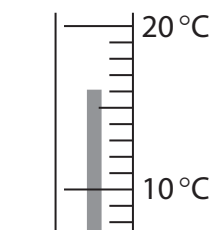
initial
temperature



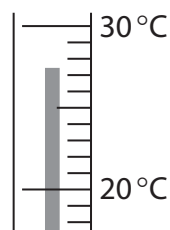
temperature after
one minute

Experiment 3

2.0 mol/dm³ H₂SO₄



initial
temperature



temperature after
one minute

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- (a) Record the temperature readings in the table and calculate the temperature increase for each experiment.

Give all values to the nearest 0.5°C.

(3)

	Initial temperature in °C	Temperature after one minute in °C	Temperature increase in °C
experiment 1			
experiment 2			
experiment 3			

- (b) Explain why the temperature increase changes as the concentration of the sulfuric acid increases.

(2)

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(c) The student does another experiment at the same initial temperature as experiment 3.
She uses the same size pieces of zinc but uses 25 cm³ of dilute sulfuric acid.
The acid is in excess in both reactions.

(i) Explain the effect, if any, of this change on the initial rate of reaction when compared to experiment 3.

(2)

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(ii) Explain the effect, if any, of this change on the temperature increase when compared to experiment 3.

(3)

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(Total for Question 13 = 10 marks)





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14 Iron deficiency anaemia occurs when the body does not have enough iron(II) ions. Iron deficiency can be overcome by taking iron tablets.

A chemist wants to find out the percentage of iron(II) ion (Fe^{2+}) in an iron tablet.

She uses this method.

- weigh an iron tablet
- dissolve the tablet in an excess of dilute sulfuric acid
- titrate the solution with potassium permanganate solution, KMnO_4

The table shows her results.

mass of iron tablet	0.298 g
concentration of KMnO_4 solution	0.0200 mol/dm^3
volume of KMnO_4 solution added	17.40 cm^3

(a) Calculate the amount, in moles, of KMnO_4 in 17.40 cm^3 of 0.0200 mol/dm^3 potassium permanganate solution.

(2)

amount of $\text{KMnO}_4 = \dots\dots\dots \text{ mol}$

(b) In the titration, 1 mol of KMnO_4 reacts with 5 mol of Fe^{2+} .

Calculate the amount, in moles, of Fe^{2+} in the iron tablet.

(1)

amount of $\text{Fe}^{2+} = \dots\dots\dots \text{ mol}$

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- (c) Calculate the mass, in grams, of Fe^{2+} in the iron tablet.
[A_r of $\text{Fe}^{2+} = 56.0$]

(1)

mass of $\text{Fe}^{2+} = \dots\dots\dots$ g

- (d) Calculate the percentage by mass of Fe^{2+} in the iron tablet.

(1)

percentage of $\text{Fe}^{2+} = \dots\dots\dots$ %**(Total for Question 14 = 5 marks)**

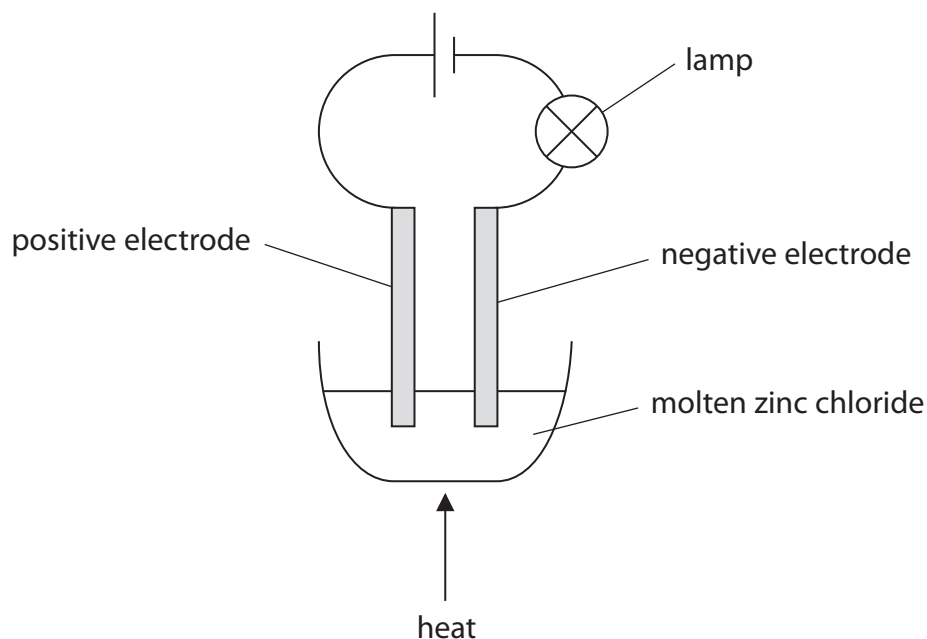
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15 A teacher uses this apparatus to demonstrate the electrolysis of molten zinc chloride.



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A student records these observations.

- crystals of a shiny, grey solid form at one of the electrodes
- a pale green substance forms at the other electrode
- the lamp goes out after the teacher stops heating the zinc chloride

(a) State what is meant by the term **electrolysis**.

(2)

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(b) State why graphite is more suitable to use for the electrodes than magnesium in this electrolysis.

(1)

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(c) Which of these is a correct statement for this electrolysis?

(1)

- A the pale green substance is chloride
- B both products are elements
- C the pale green substance forms at the negative electrode
- D the shiny grey solid is zinc chloride

(d) The student writes this ionic half-equation for the reaction that forms the pale green substance.



(2)

Identify the two mistakes in her ionic half-equation.

1

2

(e) The lamp goes out after the teacher stops heating the zinc chloride, because electrons are no longer flowing through the wires.

Explain why electrons are no longer flowing through the wires.

(2)

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(Total for Question 15 = 8 marks)

TOTAL MARKS FOR PAPER = 120 MARKS

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