Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International GCSE (9–1)

Time 2 hours

Paper reference 4CH1/1CR 4SD0/1CR

Chemistry

UNIT: 4CH1

Science (Double Award) 4SD0

PAPER: 1CR

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.

Information

- The total mark for this paper is 110.
- 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 ▶

P70946A

Q:1/1/1/ 1CR-JU-22

Pearson

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112–116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58–71) and the actinoids (atomic numbers 90–103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

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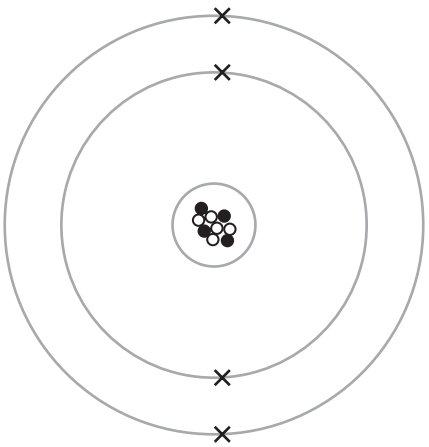
Answer ALL questions.

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 ☒.

1 (a) The diagram represents an atom of an element.



● proton
○ neutron
× electron

Use numbers from the box to complete the table.

You may use each number once, more than once or not at all.

2	4	5	9	10

(4)

Atomic number of this atom	
Mass number of this atom	
Period number of this element	
Number of electrons in the 2+ ion formed from this atom	

(b) In terms of sub-atomic particles, state a similarity and a difference for isotopes of the same element.

(2)

similarity

.....

.....

difference

.....

.....

(Total for Question 1 = 6 marks)

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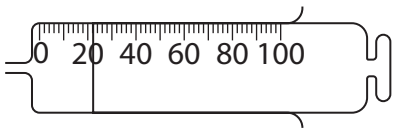
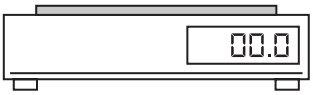
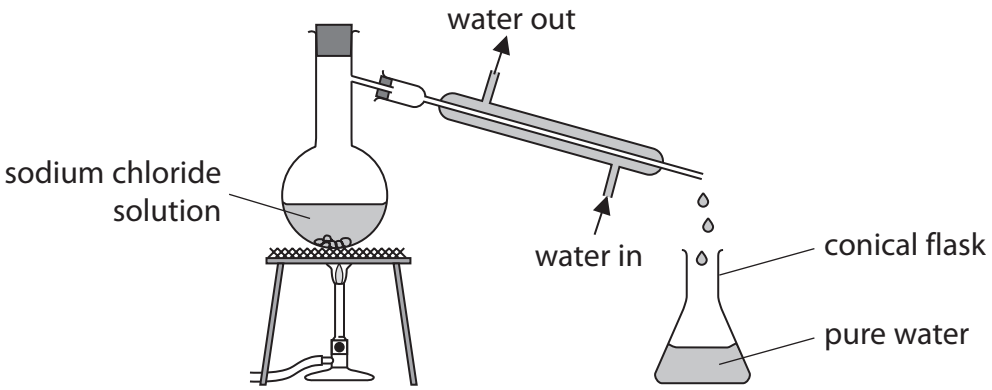
2 This question is about apparatus used in the laboratory.

(a) Complete the table by giving the name of each piece of apparatus and a unit used for the quantity it measures.

(2)

Apparatus	Name	Unit
		
		

(b) The diagram shows apparatus used to obtain pure water from sodium chloride solution by simple distillation.



(i) Explain why it is necessary for water to flow continuously in and out of the apparatus.

(2)

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(ii) Describe a chemical test to show that the sodium chloride solution contains chloride ions.

(2)

.....

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(iii) Describe a physical test to show that the liquid in the conical flask is pure water.

(2)

.....

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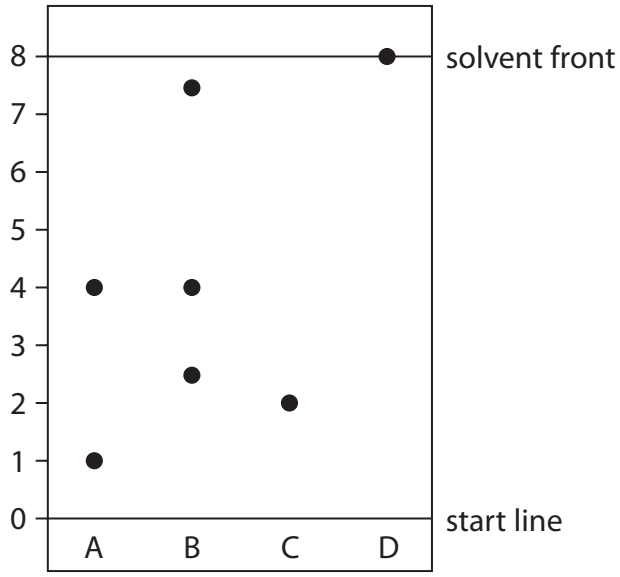
(Total for Question 2 = 8 marks)

3 The diagram shows a chromatogram of the food dyes in four different food colourings, A, B, C and D.



(a) (i) Give the letter of the food colouring that contains three different food dyes.

(1)

.....

(ii) Give the letters of the two food colourings that contain the same dye.

(1)

.....

(iii) Using the scale on the diagram, determine the R_f value of the dye in food colouring C.

(2)

R_f = ...

(iv) Give a reason why the dye in food colouring D moves the furthest from the start line.

(1)

.....

.....

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(b) Describe how a student could obtain a chromatogram similar to the one shown in the diagram.

(4)

(Total for Question 3 = 9 marks)

4 The diagram shows the positions of some elements in part of the Periodic Table.

Na												Al			S	Cl	
K																	Xe
												In					

(a) (i) Give the symbol of a metal from the diagram.

(1)

.....

(ii) Give the symbol of an element from the diagram that forms an acidic oxide.

(1)

.....

(b) Give a similarity in the electron configurations of Al and In.

(1)

.....

.....

(c) Explain which element in the diagram is unreactive.

(2)

.....

.....

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(d) A teacher adds a small piece of sodium to a glass trough containing water and universal indicator.

The universal indicator changes colour.

The equation for the reaction is

$$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$$

(i) Explain the final colour of the universal indicator.

(2)

.....

.....

.....

.....

(ii) The teacher repeats the experiment with potassium instead of sodium.

Give one similarity and one difference observed with potassium.

(2)

similarity

.....

.....

difference

.....

.....

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(iii) The reaction with sodium produces 0.036 g of hydrogen gas.

One mole of hydrogen gas contains 6.0×10^{23} molecules.

Calculate the number of molecules of hydrogen gas produced in the reaction with sodium.

Give your answer to two significant figures.

(3)

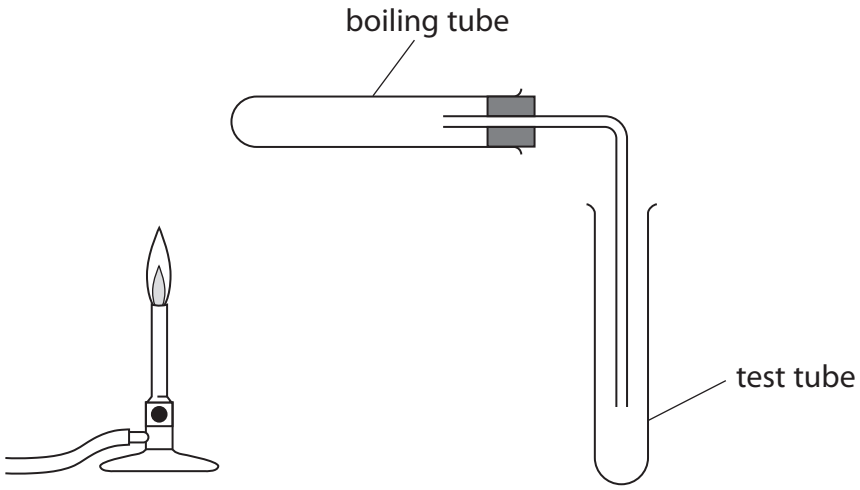
number of molecules of hydrogen gas = ...

(Total for Question 4 = 12 marks)

5 This question is about metal carbonates.

When heated, some metal carbonates decompose to form a metal oxide and carbon dioxide gas.

(a) A student is given three solid metal carbonates, a timer, some limewater and this apparatus.



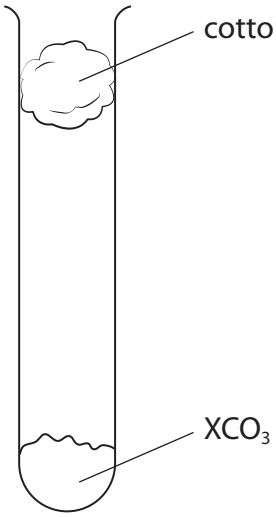
Describe a method the student can use to find out which metal carbonate decomposes fastest when heated.

(4)

(b) A student is given a solid metal carbonate with the formula XCO_3

X represents the symbol of a Group 2 metal.

A student uses this apparatus to heat a sample of XCO_3 until it all decomposes.



The equation for the decomposition of XCO_3 is

$$XCO_3 \rightarrow XO + CO_2$$

The student records the mass of XCO_3 and the mass of carbon dioxide that escapes through the cotton wool plug.

These are the student's results.

mass of XCO_3 = 7.40 g

mass of CO_2 = 2.20 g

(i) Give a reason why the student uses a cotton wool plug.

(1)

.....

.....

(ii) Calculate the amount, in mol, of carbon dioxide produced.

[for carbon dioxide $M_r = 44$]

(1)

amount of carbon dioxide = ... mol

(iii) Use the equation to determine the amount, in mol, of XCO_3 that decomposed.

(1)

amount of XCO_3 = ... mol

(iv) Use the mass of XCO_3 and your answer to (b)(iii) to calculate the relative formula mass (M_r) of XCO_3

(2)

M_r of XCO_3 = ...

(v) Use your answer to (b)(iv) and the Periodic Table on page 2 to determine the identity of the Group 2 metal X.

Show your working.

(2)

identity of X = ...

(Total for Question 5 = 11 marks)

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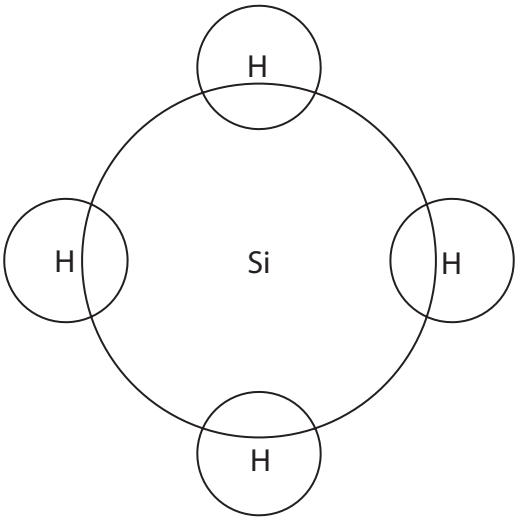
6 Silicon hydride (SiH_4) and silicon dioxide (SiO_2) both contain covalent bonds but they have different structures.

(a) Describe the forces of attraction in a covalent bond.

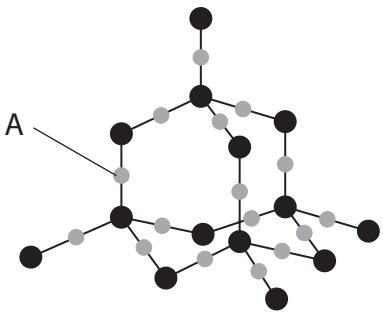
(2)

(b) Complete the diagram to show the outer shell electrons in a molecule of silicon hydride (SiH_4).

(1)



(c) The diagram represents part of the structure of silicon dioxide (SiO_2).



(i) State how the diagram shows that the atom labelled A is oxygen, not silicon.

(1)

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(ii) Silicon hydride has a simple molecular structure.

Silicon dioxide has the same type of structure as diamond.

Explain why silicon dioxide has a much higher melting point than silicon hydride.

Refer to structure and bonding in your answer.

(4)

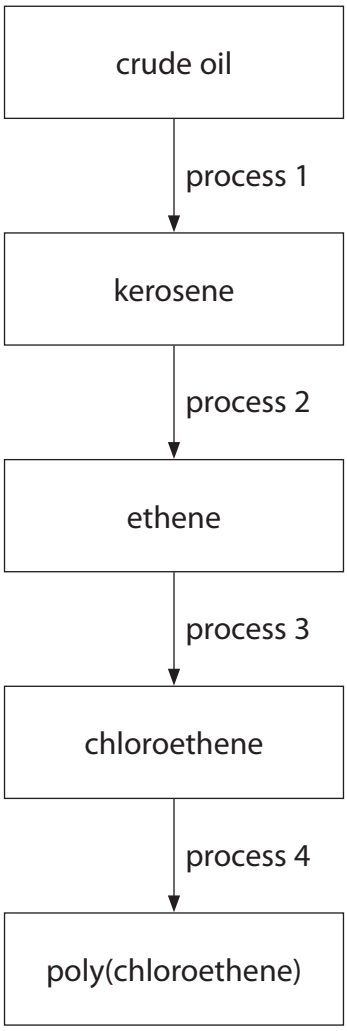
(d) Silicon hydride reacts with oxygen to form silicon dioxide and water.

Write a chemical equation for the reaction between silicon hydride and oxygen.

(1)

(Total for Question 6 = 9 marks)

7 The diagram shows some important conversion processes used in the oil industry.



(a) Describe how kerosene is produced from crude oil in process 1.

(5)

(b) $C_{12}H_{26}$ is present in kerosene.

In process 2, $C_{12}H_{26}$ is cracked to produce two molecules of ethene and one molecule of another hydrocarbon.

(i) Complete the equation for the cracking of $C_{12}H_{26}$

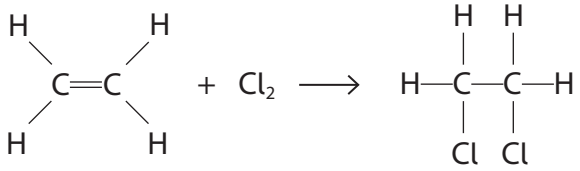
(1)

$$C_{12}H_{26} \rightarrow 2C_2H_4 + \text{.....}$$

(ii) Explain why cracking is a useful process in the oil industry.

(4)

(c) This is the equation for one of the reactions that may occur during process 3.



What is the name of this type of reaction?

(1)

- ☒ **A** addition
- ☒ **B** combustion
- ☒ **C** decomposition
- ☒ **D** substitution

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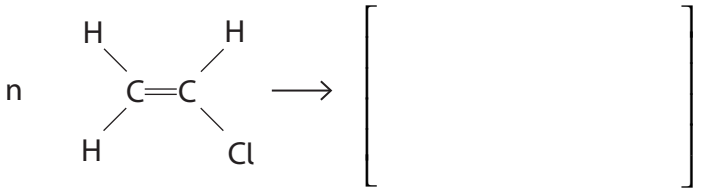
(d) (i) Complete the equation for the polymerisation of chloroethene in process 4.

(2)



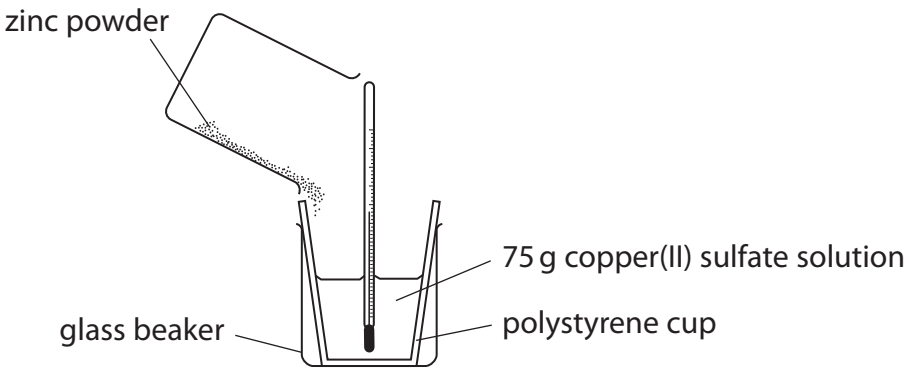
(ii) Explain why the disposal of polymers such as poly(chloroethene) is difficult.

(2)

(Total for Question 7 = 15 marks)

8 This question is about exothermic reactions.

(a) A student uses this apparatus to measure the temperature increase when an excess of zinc powder is added to copper(II) sulfate solution.



(i) Complete the word equation for the reaction.

(1)

zinc + copper(II) sulfate → ..... + ...

(ii) Give a reason why the student uses a polystyrene cup inside a glass beaker.

(1)

.....

.....

(iii) State why zinc reacts with copper(II) sulfate solution.

(1)

.....

.....

(iv) The temperature at the start of the reaction is 19.7 °C.

The temperature at the end of the reaction is 48.3 °C.

Calculate the heat energy change, in joules, for the reaction.

[for the mixture, c = 4.2 J/g/°C]

(2)

heat energy change = ... J

(b) (i) The reaction between zinc and silver nitrate solution is exothermic.

A mass of 0.65 g of zinc is added to excess silver nitrate solution.

The heat energy change is 800 J.

Calculate the molar enthalpy change, ΔH, in kJ/mol.

Include a sign in your answer.

(3)

ΔH = ... kJ/mol

(ii) This is the ionic equation for the reaction between zinc and silver nitrate solution.

$$Zn(s) + 2Ag^{+}(aq) \rightarrow Zn^{2+}(aq) + 2Ag(s)$$

Explain, in terms of electrons, why this is a redox reaction.

(2)

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(Total for Question 8 = 10 marks)

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9 This question is about rates of reaction.

(a) A student uses this method to investigate the rate of reaction between iron(III) nitrate solution and sodium thiosulfate solution.

- pour 50 cm^3 of iron(III) nitrate solution into a conical flask
- add one drop of catalyst solution
- add 50 cm^3 of sodium thiosulfate solution to the conical flask
- record the time for the mixture to become colourless

The student repeats the method using different catalysts and also with no catalyst.

The table shows the student's results.

Catalyst	Time for mixture to become colourless in s
no catalyst	55
cobalt(II) chloride solution	32
copper(II) sulfate solution	8
iron(II) sulfate solution	27
zinc nitrate solution	75

(i) Explain which is the best catalyst for the reaction.

(2)

.....

.....

.....

.....

(ii) Explain how a catalyst increases the rate of a reaction.

(2)

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(b) The rate of a reaction can also be altered by changing the temperature or by changing the concentration of solutions.

(i) Explain, using the particle collision theory, how increasing the temperature affects the rate of a reaction.

(4)

(ii) Explain why using a solution of a lower concentration decreases the rate of reaction.

(2)

(Total for Question 9 = 10 marks)

10 A student investigates how the electrical conductivity changes as dilute sulfuric acid is added to barium hydroxide solution.

This is the student's method.

Step 1 add 50.0 cm^3 of barium hydroxide solution to a beaker

Step 2 measure the electrical conductivity of the solution

Step 3 add 10.0 cm^3 of dilute sulfuric acid to the beaker

Step 4 stir the mixture

Step 5 measure the electrical conductivity of the mixture

Step 6 repeat steps 3 to 5 until a total of 100 cm^3 of dilute sulfuric acid has been added

The table shows the student's results.

Total volume of acid added in cm^3	Electrical conductivity in arbitrary units
0.0	10.0
10.0	8.0
20.0	7.2
30.0	4.0
40.0	2.0
50.0	0.0
60.0	1.4
70.0	2.8
80.0	4.2
90.0	5.6
100.0	7.0

(a) (i) Name a piece of apparatus the student could use to add 10.0 cm^3 of dilute sulfuric acid to the beaker.

(1)

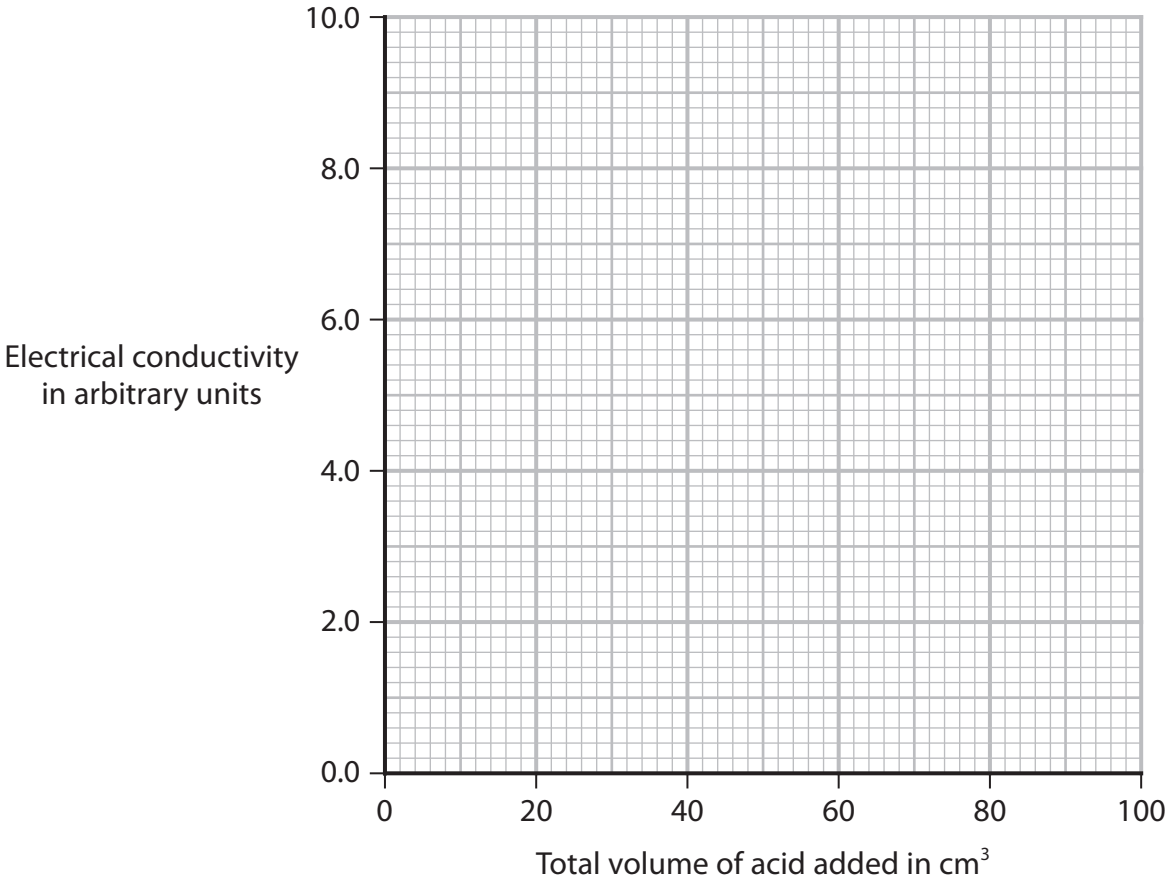
.....

(ii) Plot the student's results.

(2)

(iii) Ignoring the anomalous result, draw two lines of best fit, making sure that the two lines cross.

(1)



(iv) Give the trend shown on the graph for the first 50 cm^3 of acid added.

(1)

.....

.....

(v) Suggest a mistake the student could have made to cause the anomalous result.

(1)

.....

.....

(b) This is the equation for the reaction.

$$Ba(OH)_2(aq) + H_2SO_4(aq) \rightarrow BaSO_4(s) + 2H_2O(l)$$

(i) When 50 cm^3 of dilute sulfuric acid have been added, only barium sulfate and water are present in the mixture.

Explain why this mixture does not conduct electricity.
Refer to the type of bonding in barium sulfate and in water in your answer.

(3)

(ii) Name a technique the student could use to separate barium sulfate from the mixture after 100 cm^3 of dilute sulfuric acid has been added.

(1)

(Total for Question 10 = 10 marks)

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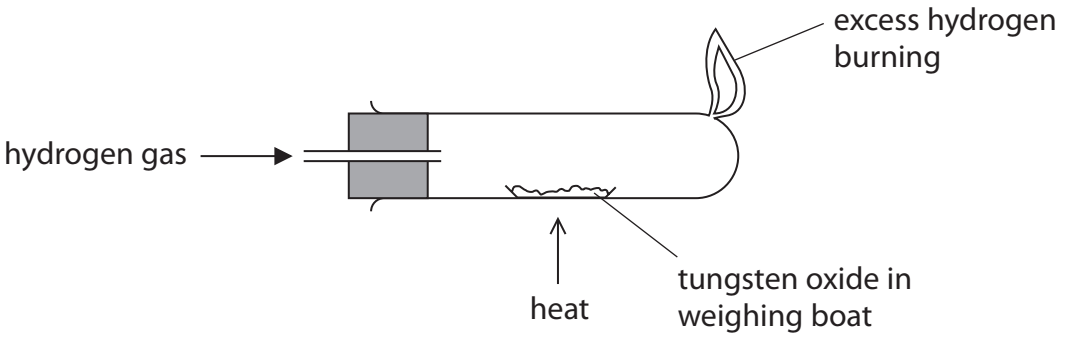
11 This question is about the reduction of tungsten oxide, WO_3

(a) A teacher uses this apparatus to reduce tungsten oxide.



This is the teacher's method.

- record the mass of a weighing boat
- add tungsten oxide and record the mass again
- heat the weighing boat and tungsten oxide strongly for two minutes and then allow to cool
- record the mass of the weighing boat and its contents

(i) Complete the equation by adding the state symbols.

(2)

$$WO_3(\ldots\ldots) + 3H_2(\ldots\ldots) \rightarrow W(\ldots\ldots) + 3H_2O(\ldots\ldots)$$

(ii) Give an addition to the method to check that the tungsten oxide has been completely reduced.

(1)

.....

.....

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(iii) The table shows the teacher's results.

	Mass in g
empty weighing boat	14.72
weighing boat and tungsten oxide	17.04
weighing boat and tungsten	16.56

Use the teacher's results to show that the empirical formula of tungsten oxide is WO_3

[for tungsten, $A_r = 184$ for oxygen, $A_r = 16$]

(3)

(iv) The teacher wears eye protection and a lab coat during the experiment.

Give one other safety precaution the teacher should take.

(1)

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(b) In industry, tungsten oxide is reduced on a large scale using hydrogen.

The percentage yield of tungsten is 73.5%

This is the equation for the reaction.

$$WO_3 + 3H_2 \rightarrow W + 3H_2O$$

Calculate the mass, in tonnes, of tungsten that is produced when 2784 tonnes of tungsten oxide are reacted with an excess of hydrogen.

[1 tonne = 1×10^6 g]

[for tungsten, $A_r = 184$ for oxygen, $A_r = 16$]

(3)

mass of tungsten = ... tonnes

(Total for Question 11 = 10 marks)

TOTAL FOR PAPER = 110 MARKS

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