Year 10 End-of-year (I)GCSE Examination
Chemistry
April 2021

Name:.....

Teacher:.....

Teaching Group: .....

Time allowed: 1hr 30mins

Total number of pages in the examination: 25

Instructions: Answer ALL questions in the spaces provided.

Additional Equipment: Calculator

Total Marks available	/85	Teacher comment:
	%	
(I)GCSE Grade		

Student reflection:

Time finished the exam (If you finish early note down when you finished)-

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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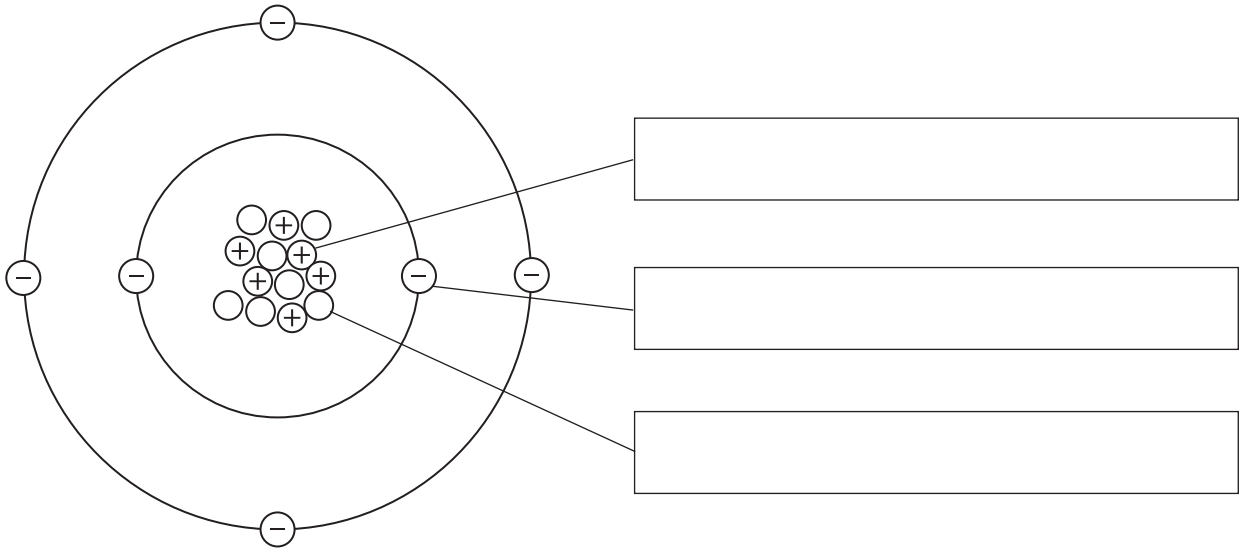
Answer ALL questions. Write your answers in the spaces provided.

1 The diagram shows the particles in an atom of an element.



(a) The box gives the names of some particles.

electron	ion	molecule	neutron	proton

Use words from the box to label the diagram.

(3)

(b) Give the mass number of this atom.

(1)

.....

(c) Complete the sentence about isotopes.

(2)

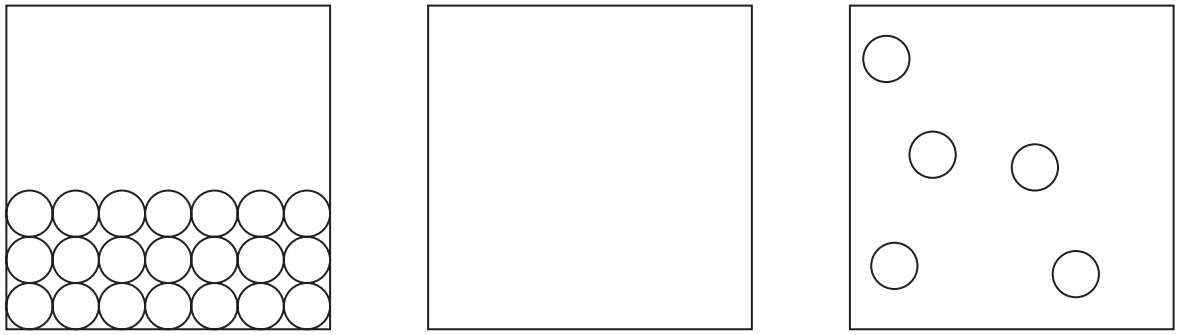
Isotopes are atoms that have the same number of .....

but have a different number of ..... .

(Total for Question 1 = 6 marks)

2 This question is about states of matter.

(a) The diagram shows how the particles of a substance are arranged in two different states.



solid liquid gas

(i) Complete the diagram to show how particles are arranged in the liquid state. **(1)**

(b) The state symbols (s), (l), (g) and (aq) are often used in chemistry.

The table shows some physical changes.

Complete the table by giving the state symbol before and after each change. **(3)**

	State symbol	
Physical change	**before change**	**after change**
water evaporates		
crystals of iodine sublime		
ice melts		

(c) Explain why hot water evaporates more quickly than cold water.

(2)

.....

.....

.....

.....

(Total for Question 2 = 6 marks)

3 The table gives some information about the halogens, chlorine, bromine and iodine.

Halogen	Physical state at room temperature	Colour
chlorine	gas	pale green
bromine		red-brown
iodine	solid	

(a) Complete the table.

(2)

(b) Chlorine has two isotopes of mass numbers 35 and 37

The relative percentage of each isotope in a sample of chlorine is

chlorine-35 77.78% chlorine-37 22.22%

Calculate the relative atomic mass of this sample of chlorine.

Give your answer to one decimal place.

(3)

relative atomic mass = ...

(c) A student is given an aqueous solution of chlorine and an aqueous solution of potassium bromide.

Explain how he can use these two solutions to compare the reactivity of chlorine with the reactivity of bromine.

(4)

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(Total for Question 3 = 9 marks)

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4 A student uses paper chromatography to investigate the dyes in five different inks, V, W, X, Y and Z.

This is what she uses.

- a beaker
- a piece of chromatography paper with a pencil line drawn near the bottom of the paper
- a solvent
- inks V, W, X, Y and Z

(a) Describe how the student should set up and carry out her experiment.

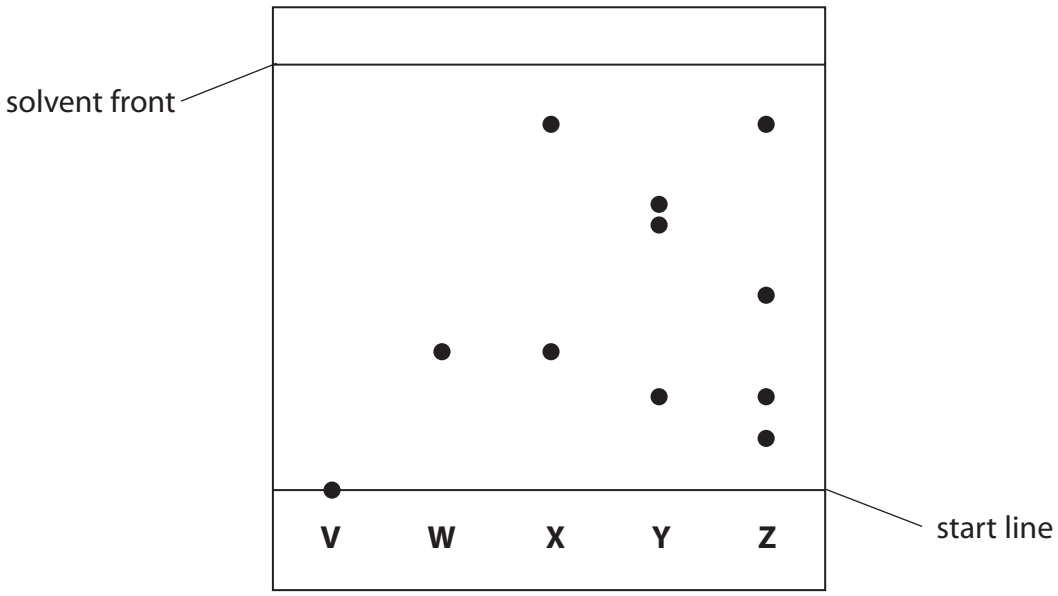
You may draw a diagram to help with your answer.

(4)

(b) Explain why the line on the paper is drawn in pencil rather than in ink.

(2)

(c) The chromatogram shows the results for inks V, W, X, Y and Z.



(i) Explain which ink contains a dye that is insoluble in the solvent.

(2)

(ii) Explain which two inks contain the dye that is likely to be the most soluble in the solvent.

(2)

(iii) Explain which two inks may contain only one dye.

(2)

.....

.....

(d) One dye in ink Y moves 4.3 cm when the solvent front moves 6.5 cm.

Calculate the R_f value for this dye.

Give your answer to 2 significant figures.

(3)

R_f value = ...

(Total for Question 4 = 15 marks)

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5 The order of reactivity of metals can be found using different methods.

(a) One method is to add the metals to cold water and to dilute hydrochloric acid.

The table shows the observations made when samples of four metals are added separately to cold water and to dilute hydrochloric acid.

Metal	Observation when added to cold water	Observation when added to dilute hydrochloric acid
magnesium	bubbles produced very slowly	bubbles produced very quickly
platinum		no change
sodium	bubbles produced very quickly	not done
zinc	no change	bubbles produced slowly

(i) State the observation that is made when platinum is added to cold water.

(1)

.....

(ii) Place the four metals in order of reactivity.

(1)

most reactive .....

.....

.....

least reactive .....

(iii) Describe a test to show that the bubbles contain hydrogen gas.

(1)

.....

.....

(iv) Write a word equation for the reaction between magnesium and dilute hydrochloric acid.

(1)

.....

(v) Suggest why the reaction between sodium and dilute hydrochloric acid is not done.

(1)

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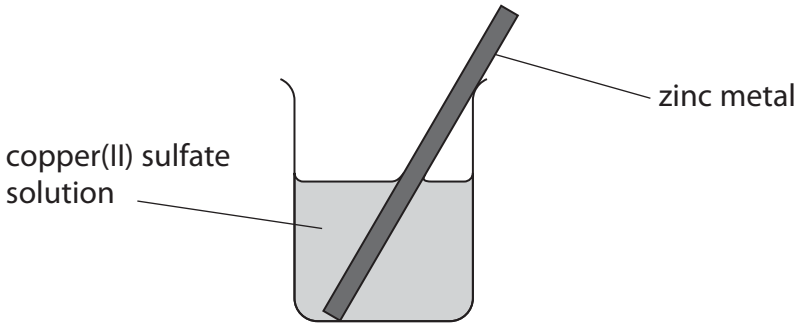
.....

(b) Displacement reactions are another method used to find the order of reactivity of metals.

In an experiment, a piece of zinc metal is placed in a beaker containing copper(II) sulfate solution.



(i) The reaction that occurs shows zinc is more reactive than copper.

State two observations that would be made as the reaction occurs.

(2)

1 .....

2 .....

(ii) In a second experiment, a piece of copper metal is placed in a beaker containing nickel sulfate solution.

No reaction occurs.

Explain why it is not possible to determine the complete order of reactivity for copper, nickel and zinc from these two experiments.

(2)

.....

.....

.....

.....

(c) The ionic equation for the reaction between zinc and copper(II) sulfate is

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

Explain why this is described as a redox reaction.

(3)

(Total for Question 5 = 12 marks)

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6 This question is about carbon and its compounds.

(a) (i) Draw a dot-and-cross diagram to show the outer shell electrons in a molecule of carbon dioxide, CO_2

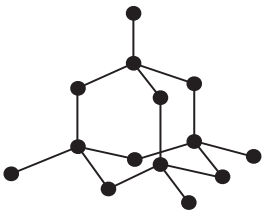
(2)

(ii) The atoms in carbon dioxide are held together by covalent bonds.

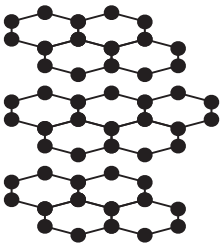
Describe the forces of attraction in a covalent bond.

(2)

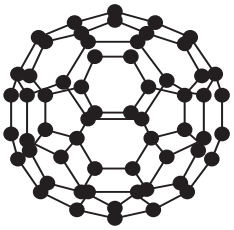
(b) The diagram shows three different structures of carbon.



diamond



graphite



C_{60} fullerene

(i) Explain why graphite conducts electricity.

(2)

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(ii) Explain why diamond has a much higher melting point than C_{60} fullerene.

Refer to structure and bonding in your answer.

(5)

(Total for Question 6 = 11 marks)

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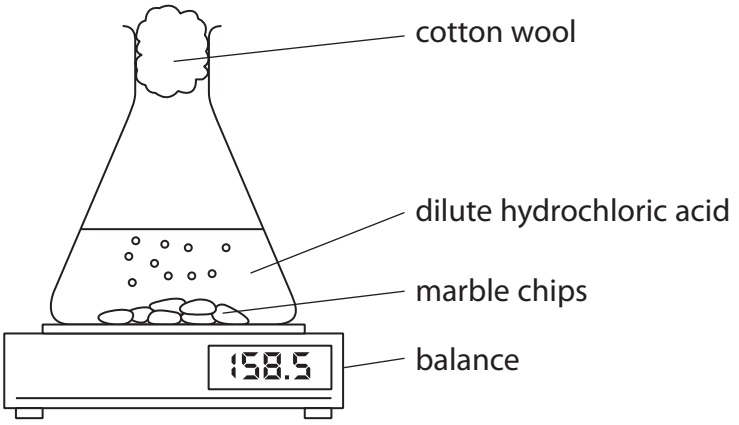
7 A student uses this apparatus to investigate the rate of reaction between marble chips and dilute hydrochloric acid.



(a) During the reaction, the reading on the balance decreases because mass is lost from the flask.

(i) Explain how using the cotton wool increases the accuracy of this investigation.

(2)

(ii) Why is mass lost from the flask?

(1)

☒ **A** acid particles are moving

☒ **B** gas is given off

☒ **C** heat energy is produced

☒ **D** marble chips are dissolving

(b) This is the equation for the reaction between marble chips and dilute hydrochloric acid.

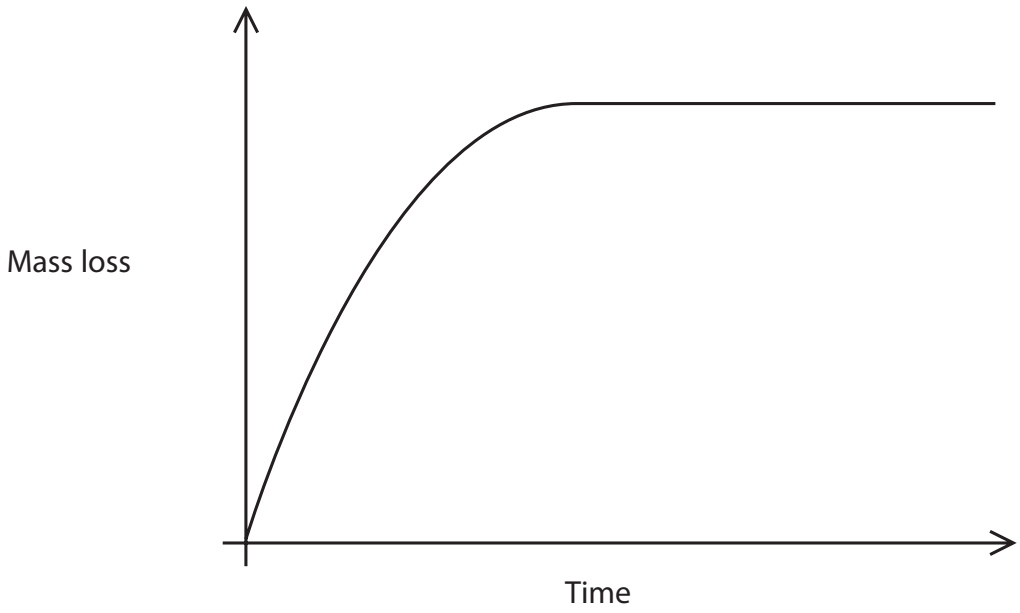
Complete the equation by adding the state symbols.

(2)

$CaCO_3$ (.....) + 2HCl (.....) → $CaCl_2$ (.....) + H_2O (.....) + CO_2 (.....)

(c) The student uses large marble chips in the investigation.

This is a graph of his results.



The student repeats the experiment using the same total mass of smaller marble chips.

On the graph, draw the curve that would be obtained.

[assume the marble chips are in excess]

(2)

(d) The rate of this reaction can be altered by increasing the temperature or by increasing the concentration of the hydrochloric acid.

(i) Explain, using the particle collision theory, how increasing the concentration of the hydrochloric acid would affect the rate of this reaction.

(3)

(ii) Explain, using the particle collision theory, how increasing the temperature would affect the rate of this reaction.

(3)

(Total for Question 7 = 13 marks)

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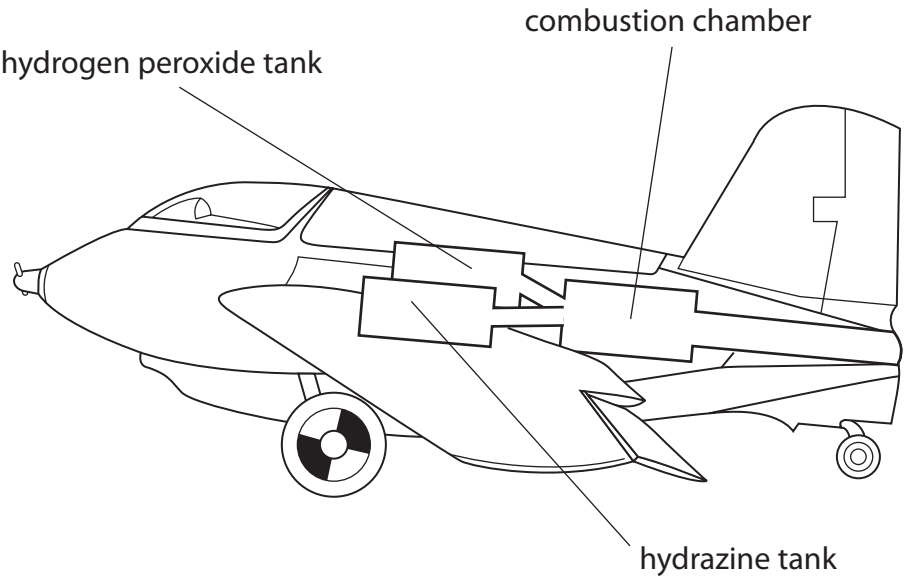
8 During the Second World War, engineers developed a rocket-powered aircraft.



The aircraft carried these two liquids

- hydrazine, N_2H_4
- hydrogen peroxide, H_2O_2

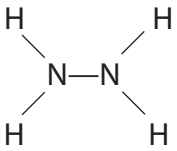
When these two liquids mix in the combustion chamber, they evaporate and then react rapidly to form nitrogen gas, N_2, and steam, H_2O

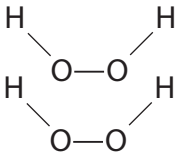
The reaction is exothermic.

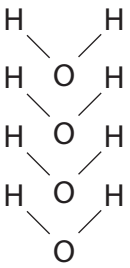
The equation for the reaction is

$$N_2H_4 \quad + \quad 2H_2O_2 \quad \rightarrow \quad N_2 \quad + \quad 4H_2O$$

The displayed formulae for the reactants and products are







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(a) The tables give the bond energies for the bonds broken in the reactants and the bonds made in the products.

Bonds broken	
bond	bond energy in kJ/mol
N—N	159
N—H	391
O—O	143
O—H	463

Bonds made	
bond	bond energy in kJ/mol
N≡N	945
O—H	463

(i) Use the data in the tables to calculate the total amount of energy required to break all of the bonds in the reactants.

(1)

energy required = ... kJ

(ii) Use the data in the tables to calculate the total amount of energy released when all of the bonds in the products are made.

(1)

energy released = ... kJ

(iii) Calculate the enthalpy change, ΔH, in kJ/mol, for the reaction. Include a sign in your answer.

(3)

ΔH = ... kJ/mol

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(b) Explain, in terms of bonds broken and bonds made, why this reaction is exothermic.

(2)

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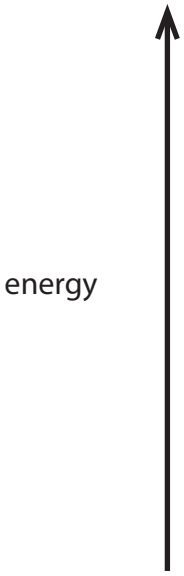
(c) Draw an energy level diagram for the reaction between N_2H_4 and H_2O_2

(3)



(d) The equation for the reaction between lithium and water is

$$2Li(s) + 2H_2O(l) \rightarrow 2LiOH(aq) + H_2(g)$$

(i) A mass of 0.500 g of lithium reacts with an excess of water.

Calculate the volume, in cm^3, of hydrogen gas produced at rtp.

[molar volume of a gas at rtp = 24 000 cm^3]

Give your answer to three significant figures.

(3)

volume = ... cm^3

(Total for Question 8 = 13 marks)

End of Question Paper

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