GradeMax

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)

Tuesday 11 November 2025

Morning (Time: 2 hours)

Paper reference 4CH1/1C 4SD0/1C

Chemistry

UNIT: 4CH1
Science (Double Award) 4SD0
PAPER: 1C

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **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 ▶

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M:1/1/1/1/1/1/1/1/1/1/1

P 7 8 7 6 6 R A 0 1 2 8

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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.

4CH1 | 2025 | October/November | Paper 1 | GradeMax

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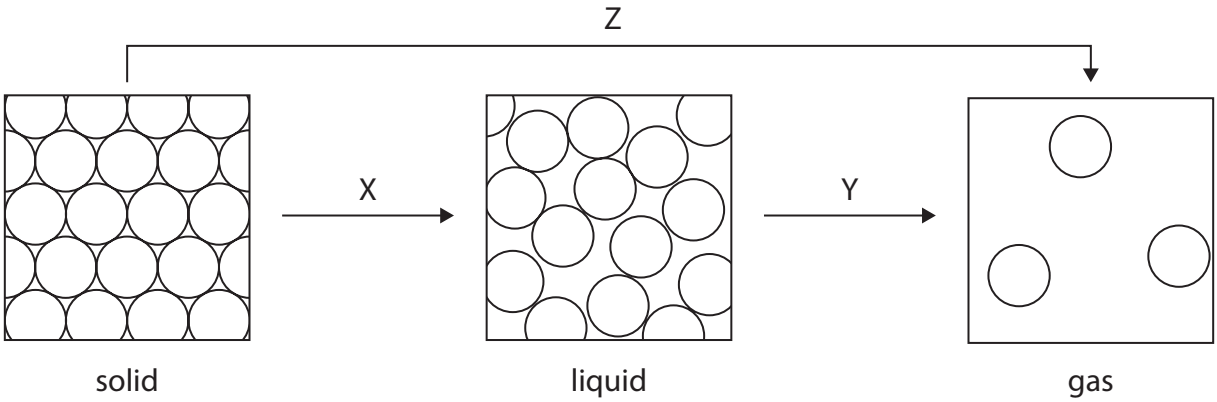
Answer ALL questions.

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 The diagram shows how particles are arranged in the three states of matter.



(a) Give the names of the changes of state labelled X, Y and Z.

(3)

X .....

Y .....

Z .....

(b) Water vapour condenses to form water.

Give the equation for this change of state.

Include the state symbols.

(2)

.....

(c) Describe how particles are arranged differently in solids and gases.

(2)

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(Total for Question 1 = 7 marks)

2 The box gives the names of some gases in the atmosphere.

argon		carbon dioxide
nitrogen	oxygen	water vapour

(a) Choose gases from the box to answer these questions.

(i) Identify the gas with a molecule that contains a triple bond.

(1)

.....

(ii) Identify the gas in the atmosphere that exists as individual atoms.

(1)

.....

(iii) Identify the gas needed for combustion reactions.

(1)

.....

(b) Explain how carbon dioxide can be formed from copper(II) carbonate.

(2)

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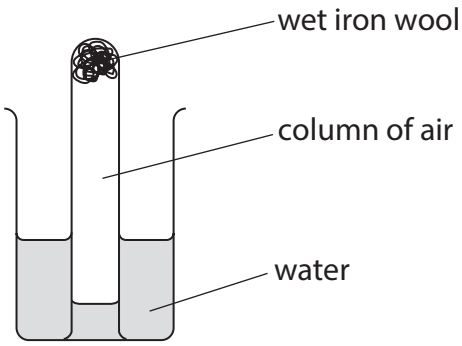
(c) A student uses this apparatus to calculate the percentage of oxygen in a sample of air.



This is the student's method.

- measure the initial height of the column of air
- leave the apparatus for one week
- measure the final height of the column of air

The table shows the student's results.

Final height of column of air in mm	77
Initial height of column of air in mm	93

(i) Use the student's results to calculate the percentage of oxygen in the sample of air.

(2)

percentage = ... %

(ii) The percentage of oxygen in air is approximately 21%.

Suggest an improvement to the method that would increase the accuracy of the student's results.

(1)

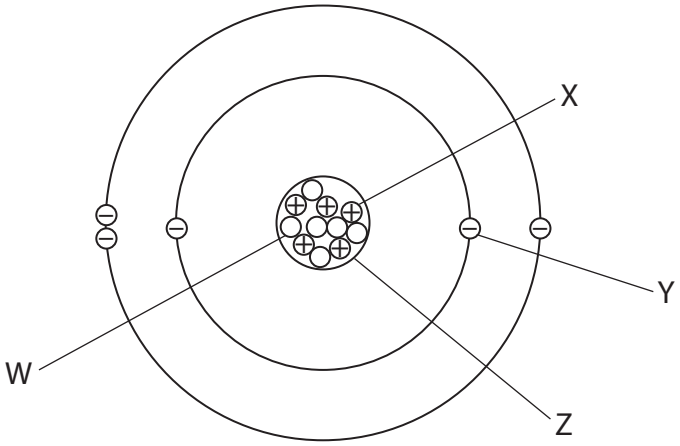
.....

.....

(Total for Question 2 = 8 marks)

3 This question is about atomic structure and the Periodic Table.

(a) The diagram shows an atom of an element.



Use the diagram to answer these questions.

(i) Which particle is a proton?

(1)

☒ **A** W

☒ **B** X

☒ **C** Y

☒ **D** Z

(ii) Which particle has a relative charge of 0?

(1)

☒ **A** W

☒ **B** X

☒ **C** Y

☒ **D** Z

(iii) Name the part of the atom labelled Z.

(1)

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(iv) What is the group number of this element?

(1)

- ☒ **A** 2
- ☒ **B** 3
- ☒ **C** 5
- ☒ **D** 11

(v) What is the period number of this element?

(1)

- ☒ **A** 2
- ☒ **B** 3
- ☒ **C** 5
- ☒ **D** 11

(vi) Give the chemical symbol of this element.

(1)

.....

(b) State what type of particle is formed when an atom loses its outer shell electrons.

(1)

.....

(c) The table shows the atomic number and the relative atomic mass (to 1 decimal place) of the elements in a period of the Periodic Table.

Element	Li	Be	B	C	N	O	F	Ne
Atomic number	3	4	5	6	7	8	9	10
Relative atomic mass	6.9	9.0	10.8	12.0	14.0	16.0	19.0	20.2

(i) On the grid, add an appropriate scale to the *y*-axis, starting at 6.0

(1)

(ii) Plot the data on the grid. Do not join the points.

(2)

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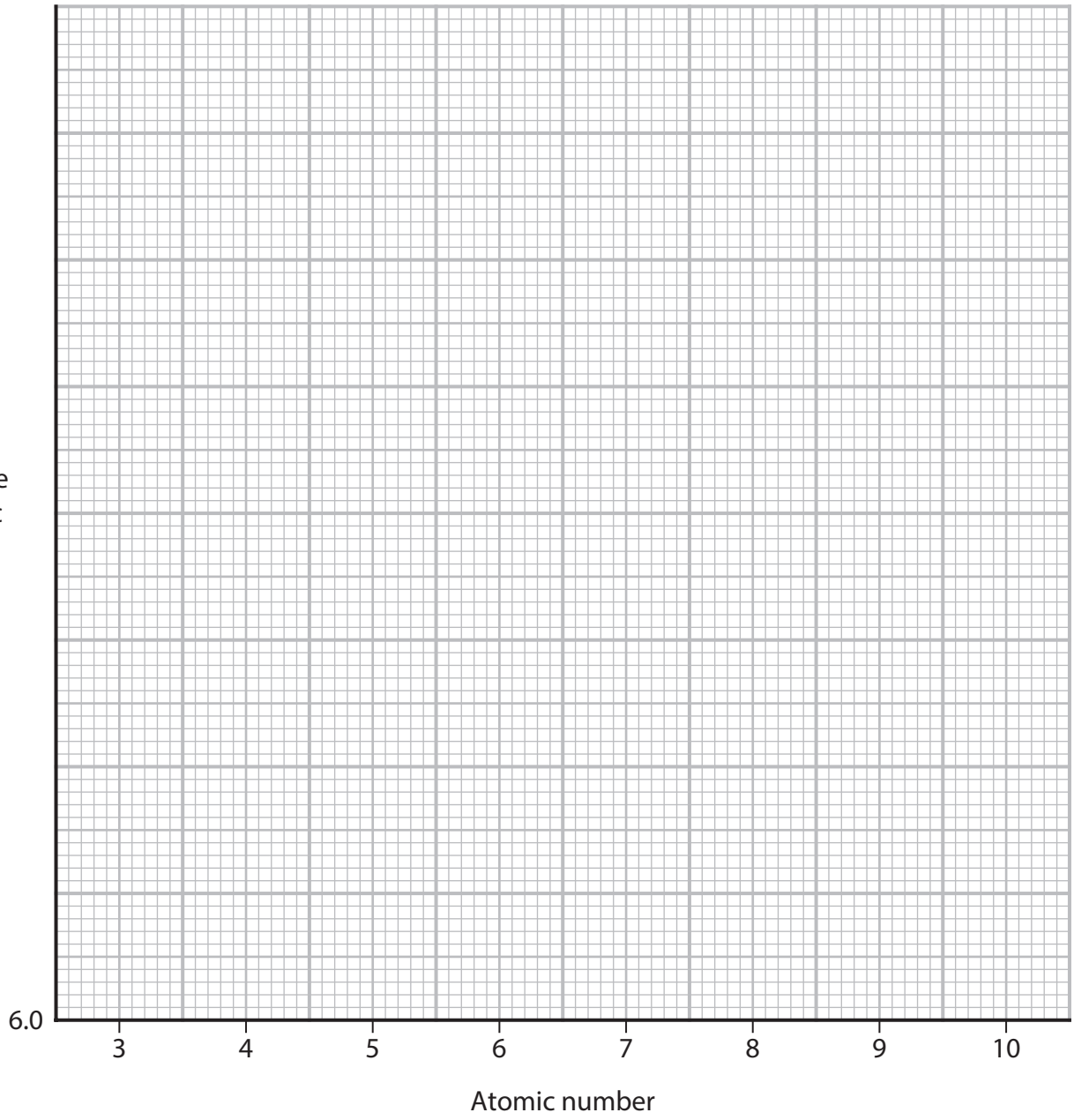

(iii) Identify the relationship between relative atomic mass and atomic number for the elements in this period.

(1)

.....

.....

(Total for Question 3 = 11 marks)

4 This question is about ammonium chloride.

(a) Draw a diagram to show the arrangement of the electrons in a chloride ion.

(2)

(b) Two beakers are unlabelled. One beaker contains a solution of ammonium chloride and the other beaker contains a solution of ammonium sulfate.

Describe tests that can be carried out to confirm that one beaker contains ammonium chloride and the other beaker contains ammonium sulfate.

(6)

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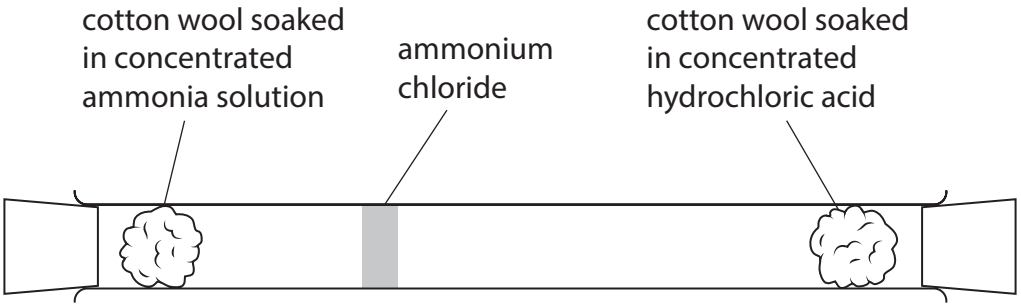
(c) A student draws a diagram to show the formation of solid ammonium chloride in a glass tube.



(i) Explain the mistake in the student's diagram.

(3)

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(ii) Complete the equation for the reaction in the glass tube by adding state symbols.

(1)

NH_3 (.....) + HCl (.....) $\rightleftharpoons$ NH_4Cl (.....)

(Total for Question 4 = 12 marks)

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5 This question is about displacement reactions.

A student uses this method to investigate what happens when excess metal is added to a solution of copper(II) sulfate.

- pour some copper(II) sulfate solution into a polystyrene cup and record the temperature
- add excess metal W to the polystyrene cup and stir the mixture
- record the maximum temperature reached
- calculate the temperature increase of the solution

The student repeats the method for metals X, Y and Z.

For each metal, the student records three sets of results.

(a) Give a reason why the student could not use copper(II) carbonate instead of copper(II) sulfate.

(1)

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.....

(b) Explain why a polystyrene cup is used instead of a glass beaker.

(2)

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.....

(c) Give two variables the student should control in the investigation.

(2)

1 .....

.....

.....

2 .....

.....

.....

(d) The table shows the student's results.

Metal	Temperature increase in °C			Mean temperature increase in °C
	experiment 1	experiment 2	experiment 3	
W	4.0	2.0	4.2	4.1
X	0.0	0.0	0.0	0.0
Y	6.1	6.3	6.0	
Z	8.1	8.5	8.9	8.5

(i) Calculate the mean temperature increase for metal Y.

Give your answer to two significant figures.

(2)

mean temperature increase = ... °C

(ii) Explain whether the anomalous result in experiment 2 could have been caused by stirring the mixture too quickly.

(2)

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(iii) Explain the order of reactivity for metals W, X, Y and Z.

(2)

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(iv) Explain why metal X could be silver.

(2)

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(Total for Question 5 = 13 marks)

6 Ethene can be obtained from crude oil using these two processes.

Process 1 crude oil $\rightarrow$ kerosene

Process 2 kerosene $\rightarrow$ octane (C_8H_{18}) + ethene

(a) (i) Give the name of process 1.

(1)

(ii) Sketch a labelled diagram showing how the kerosene fraction is obtained from crude oil in process 1.

(5)

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(b) (i) Give the two conditions needed for a reaction to occur in process 2.

(2)

1 .....

2 .....

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

(1)

$C_{14}H_{30} \rightarrow$ ..... + ...

(c) Explain one use of octane as fuel.

(3)

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(d) (i) Using displayed formulae, give the equation for the conversion of ethene into poly(ethene).

(2)

(ii) Give the term used to describe ethene in the polymerisation process.

(1)

.....

(Total for Question 6 = 15 marks)

7 A student uses this method to investigate the reaction between sodium hydroxide solution and dilute nitric acid.

Step **1** pour 20 cm^3 of dilute nitric acid into a 100 cm^3 glass beaker

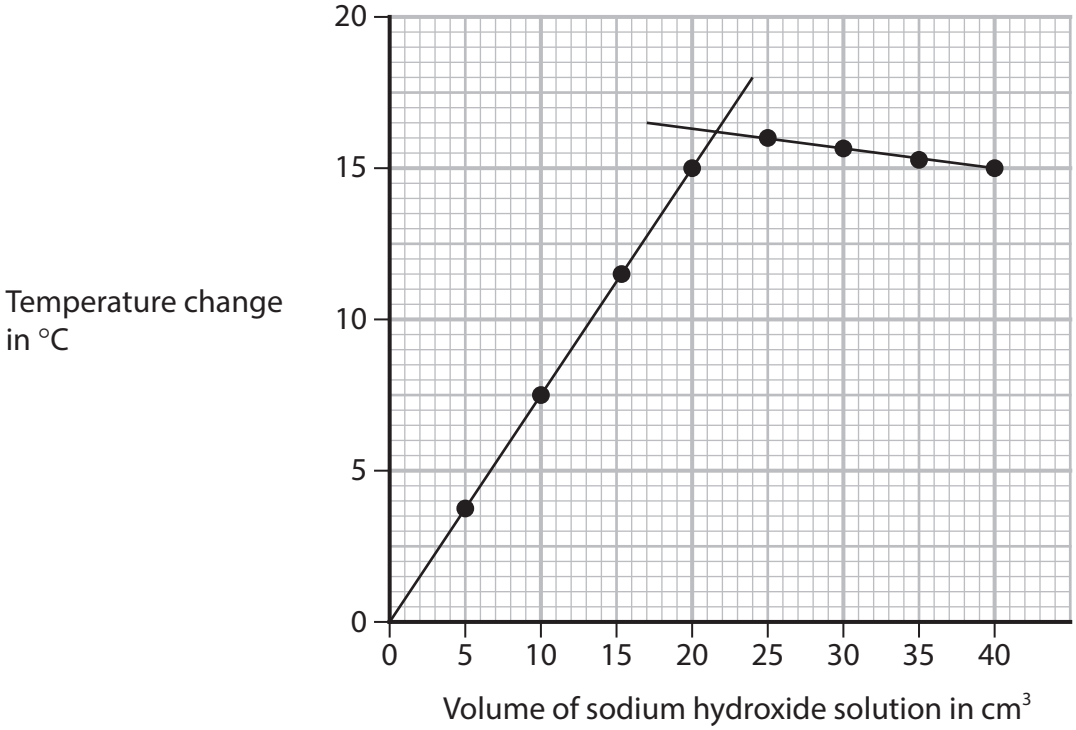
Step **2** measure the temperature of the acid

Step **3** add 5 cm^3 of sodium hydroxide solution and stir the mixture

Step **4** record the highest temperature reached

The student repeats steps **3** and **4** until a total of 40 cm^3 of sodium hydroxide solution has been added.

(a) The graph shows the student's results.



(i) Determine the volume of sodium hydroxide solution at the point where the lines cross.

(1)

volume = ... cm^3

(ii) Determine the maximum temperature change reached during the investigation.

(1)

maximum temperature change = ... °C

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(b) The student makes this statement about the shape of the graph.

The first line on the graph shows that the temperature rises at a steady rate as more nitric acid is added and at 40 cm^3, the acid has been neutralised by the sodium hydroxide.

The student's statement includes some mistakes and is incomplete.

(i) Give two mistakes in the student's statement.

(2)

1 .....

.....

.....

.....

2 .....

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.....

(ii) Add another sentence to complete the student's statement.

(1)

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.....

(c) The student repeats the investigation.

The student starts with 25 cm^3 of dilute nitric acid at 19 °C.

The student finds that 25 cm^3 of sodium hydroxide solution is needed for complete neutralisation.

The student calculates that the heat energy (Q) released is 3780 J.

[for the solution, c = 4.2 J / g / °C]

[mass for 1.0 cm^3 of solution = 1.0 g]

(i) Calculate the maximum temperature reached.

(4)

maximum temperature = ... °C

(ii) The amount of dilute nitric acid used in the investigation was 0.079 mol.

Calculate the value of ΔH, in kJ / mol, for the neutralisation reaction.

Include a sign in your answer.

(3)

ΔH = ... kJ / mol

(Total for Question 7 = 12 marks)

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8 This question is about ionic compounds.

(a) The table shows the formulae of some ions.

It also shows the formulae of some compounds containing these ions.

Complete the table by giving the missing information.

(3)

Ions	Li^+	Mg^{2+}	Al^{3+}
NO_3^-	$LiNO_3$		$Al(NO_3)_3$
SO_4^{2-}		$MgSO_4$	$Al_2(SO_4)_3$
PO_4^{3-}	Li_3PO_4	$Mg_3(PO_4)_2$	

(b) Explain why magnesium oxide has a higher melting point than sodium chloride.

Refer to structure and bonding in your answer.

(5)

(Total for Question 8 = 8 marks)

9 This question is about propene and propane.

(a) Complete the table by giving the missing information about **propene**.

(3)

Displayed formula of propene	
Molecular formula of propene	C_3H_6
Empirical formula of propene	
Relative formula mass of propene	

(b) Draw a dot-and-cross diagram for **propane**.

Include only outer shell electrons.

(2)

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(c) Propene and propane react with bromine.

(i) Which row shows the correct number of products for these reactions?

(1)

		Propene and bromine	Propane and bromine
☒	**A**	1	1
☒	**B**	1	2
☒	**C**	2	1
☒	**D**	2	2

(ii) Give the reaction condition needed for propane and bromine to react together.

(1)

.....

(iii) A compound formed in the reaction between bromine water and an alkene has this percentage composition by mass.

C = 25.9% H = 5.0% O = 11.5% Br = 57.6%

Calculate the empirical formula of this compound.

(3)

empirical formula = ...

(d) Ethene and propene contain the same functional group.

(i) State what is meant by the term **functional group**.

(1)

.....

.....

(ii) Draw an isomer of propene that does not have the same functional group.

(1)

(Total for Question 9 = 12 marks)

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10 This question is about aluminium sulfate.

Aluminium reacts with sulfuric acid to form aluminium sulfate.

This is the equation for the reaction.

$$2Al + 3H_2SO_4 \rightarrow Al_2(SO_4)_3 + 3H_2$$

(a) What is the total number of elements in the formula $Al_2(SO_4)_3$?

(1)

- ☒ **A** 3
- ☒ **B** 5
- ☒ **C** 14
- ☒ **D** 17

(b) A student uses this method to prepare some aluminium sulfate crystals.

Step **1** add powdered aluminium to a beaker of dilute sulfuric acid and stir

Step **2** keep stirring and adding powdered aluminium until it is in excess

Step **3** filter the reaction mixture

Step **4** heat the filtrate to evaporate some water and produce a saturated solution

Step **5** allow the saturated solution to cool so that crystals form

Step **6** filter to obtain the crystals and leave to dry

(i) During step 3, the reaction mixture is filtered.

Identify the substance that remains in the filter paper and the substances in the beaker after this filtration.

(2)

filter paper

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beaker

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(ii) State why the aluminium is added until it is in excess.

(1)

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(iii) Explain why powdered aluminium is used.

(2)

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Question 10 continues on the next page

(c) The student adds 3.20 g of aluminium to 0.120 mol of dilute sulfuric acid.

(i) Show that sulfuric acid is not in excess.

(2)

(ii) The student calculates the percentage yield of aluminium sulfate obtained from 0.120 mol of sulfuric acid as 113%.

Calculate the mass, in grams, of aluminium sulfate produced if the yield is 113%.

(3)

mass = ... g

(iii) Suggest a mistake the student made when carrying out the method that caused the percentage yield to be greater than 100%.

(1)

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(Total for Question 10 = 12 marks)

TOTAL FOR PAPER = 110 MARKS

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