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Centre Number	Candidate Number
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Pearson Edexcel International GCSE (9–1)

Tuesday 11 November 2025

Morning (Time: 2 hours)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%; padding: 2px;">Paper reference</td> <td style="padding: 2px;">4CH1/1C 4SD0/1C</td> </tr> </table>	Paper reference	4CH1/1C 4SD0/1C
Paper reference	4CH1/1C 4SD0/1C		

Chemistry

UNIT: 4CH1

Science (Double Award) 4SD0

PAPER: 1C

<p>You must have: Calculator, ruler</p>	<p>Total Marks</p>
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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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The Periodic Table of the Elements

1	2	3	4	5	6	7	0										
7 Li lithium 3	9 Be beryllium 4	11 Na sodium 11	12 C carbon 6	13 Al aluminium 13	14 N nitrogen 7	15 P phosphorus 15	16 O oxygen 8	17 F fluorine 9	18 Ne neon 10								
19 K potassium 19	20 Ca calcium 20	21 Sc scandium 21	22 Ti titanium 22	23 V vanadium 23	24 Cr chromium 24	25 Mn manganese 25	26 Fe iron 26	27 Co cobalt 27	28 Ni nickel 28	29 Cu copper 29	30 Zn zinc 30	31 Ga gallium 31	32 Ge germanium 32	33 As arsenic 33	34 Se selenium 34	35 Br bromine 35	36 Kr krypton 36
37 Rb rubidium 37	38 Sr strontium 38	39 Y yttrium 39	40 Zr zirconium 40	41 Nb niobium 41	42 Mo molybdenum 42	43 Tc technetium 43	44 Ru ruthenium 44	45 Rh rhodium 45	46 Pd palladium 46	47 Ag silver 47	48 Cd cadmium 48	49 In indium 49	50 Sn tin 50	51 Sb antimony 51	52 Te tellurium 52	53 I iodine 53	54 Xe xenon 54
55 Cs caesium 55	56 Ba barium 56	57 La* lanthanum 57	72 Hf hafnium 72	73 Ta tantalum 73	74 W tungsten 74	75 Re rhenium 75	76 Os osmium 76	77 Ir iridium 77	78 Pt platinum 78	79 Au gold 79	80 Hg mercury 80	81 Tl thallium 81	82 Pb lead 82	83 Bi bismuth 83	84 Po polonium 84	85 At astatine 85	86 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						

1	H
	hydrogen
	1

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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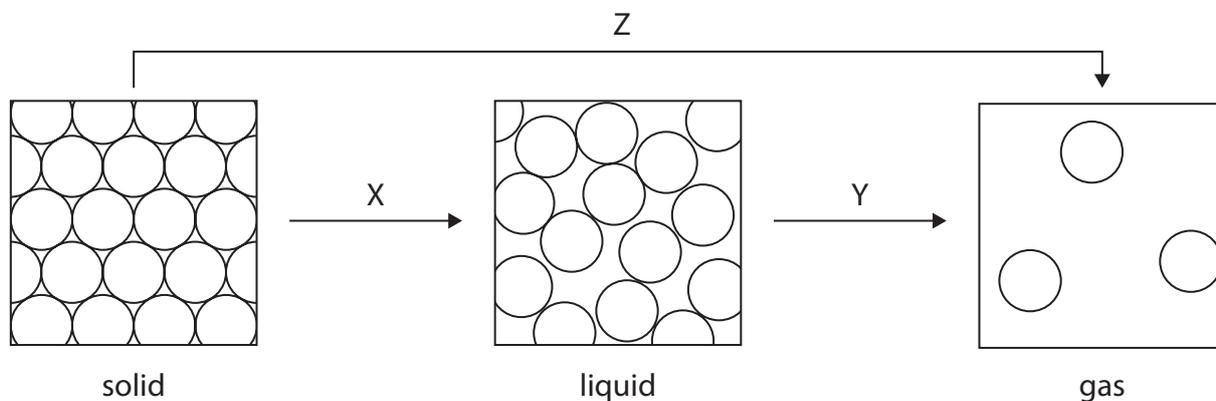
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Answer ALL questions.

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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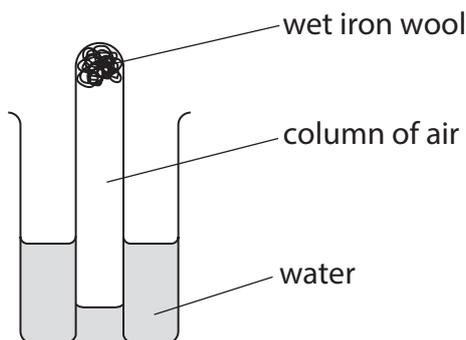


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(c) A student uses this apparatus to calculate the percentage of oxygen in a sample of air.



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)

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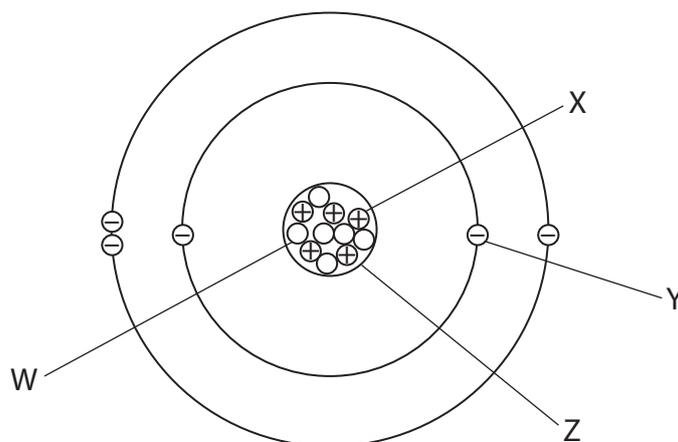
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(Total for Question 2 = 8 marks)



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)

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- (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

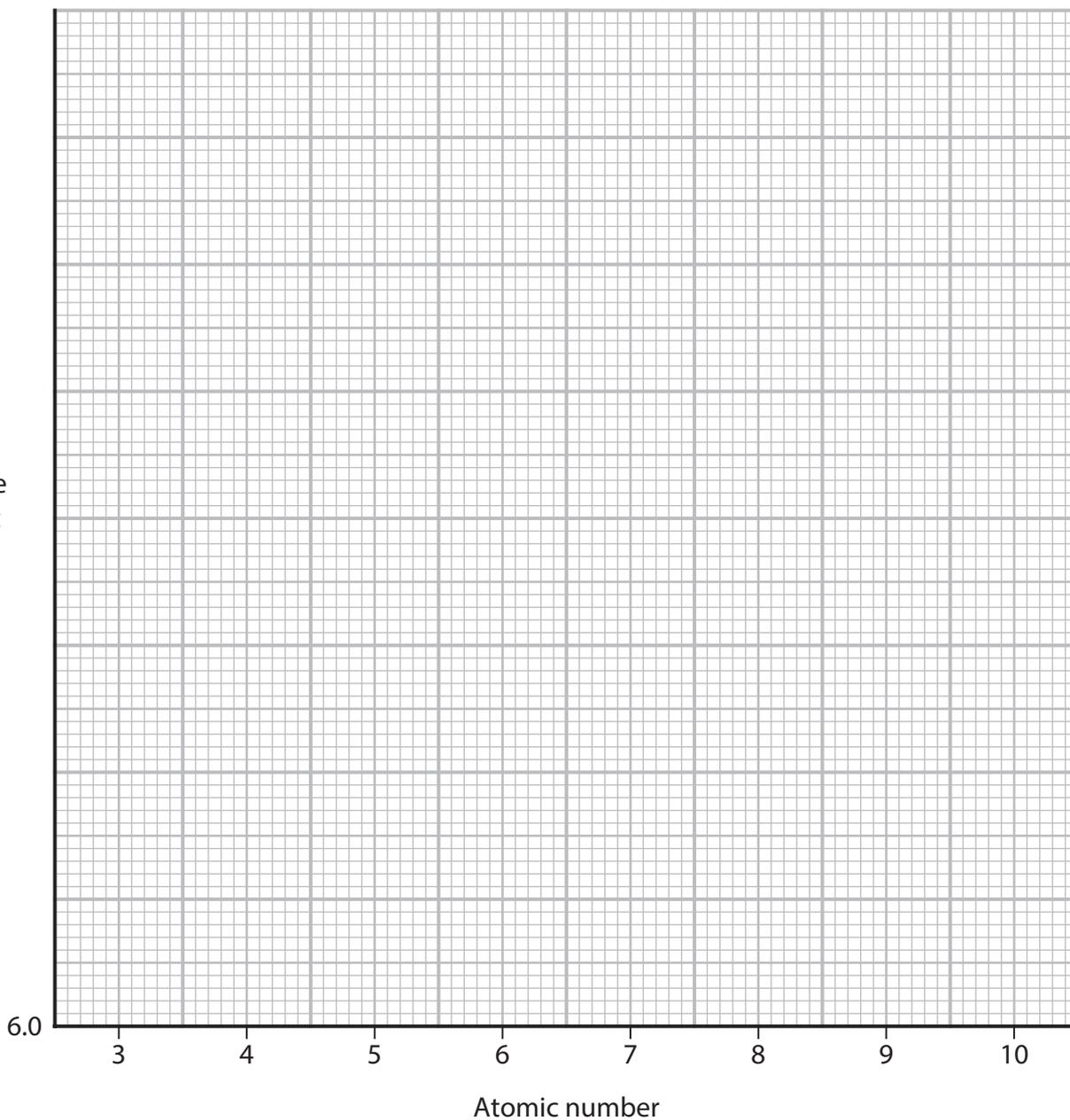
- (i) On the grid, add an appropriate scale to the y-axis, starting at 6.0 (1)
- (ii) Plot the data on the grid. Do not join the points. (2)

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Relative atomic mass



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

(1)

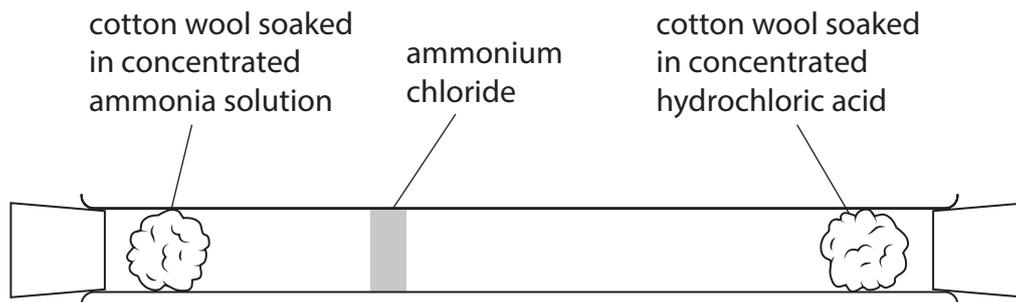
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(Total for Question 3 = 11 marks)



- (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)

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

(1)



(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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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) 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)

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(Total for Question 6 = 15 marks)

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

Step 1 pour 20 cm³ of dilute nitric acid into a 100 cm³ glass beaker

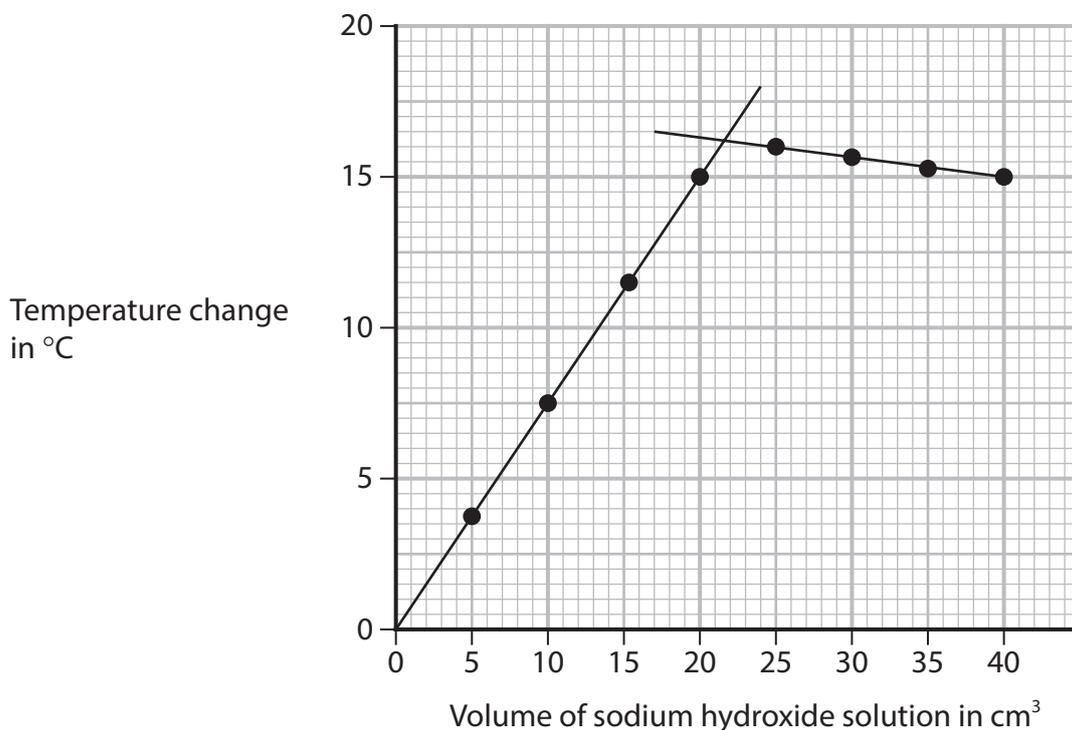
Step 2 measure the temperature of the acid

Step 3 add 5 cm³ 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 cm³ 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 = cm³

(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 cm³, 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

.....

.....

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

(1)

.....

.....

.....



(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, $c = 4.2 \text{ J/g}^\circ\text{C}$]

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

(i) Calculate the maximum temperature reached.

(4)

maximum temperature = $^\circ\text{C}$

(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)

$\Delta H = \dots\dots\dots \text{kJ/mol}$

(Total for Question 7 = 12 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
<input type="checkbox"/> A	1	1
<input type="checkbox"/> B	1	2
<input type="checkbox"/> C	2	1
<input type="checkbox"/> 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.

$$\text{C} = 25.9\% \quad \text{H} = 5.0\% \quad \text{O} = 11.5\% \quad \text{Br} = 57.6\%$$

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.



(a) What is the total number of elements in the formula $\text{Al}_2(\text{SO}_4)_3$?

(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

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



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(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)

.....
.....
.....

(Total for Question 10 = 12 marks)

TOTAL FOR PAPER = 110 MARKS

