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)

Monday 19 May 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 ▶

P78950A

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

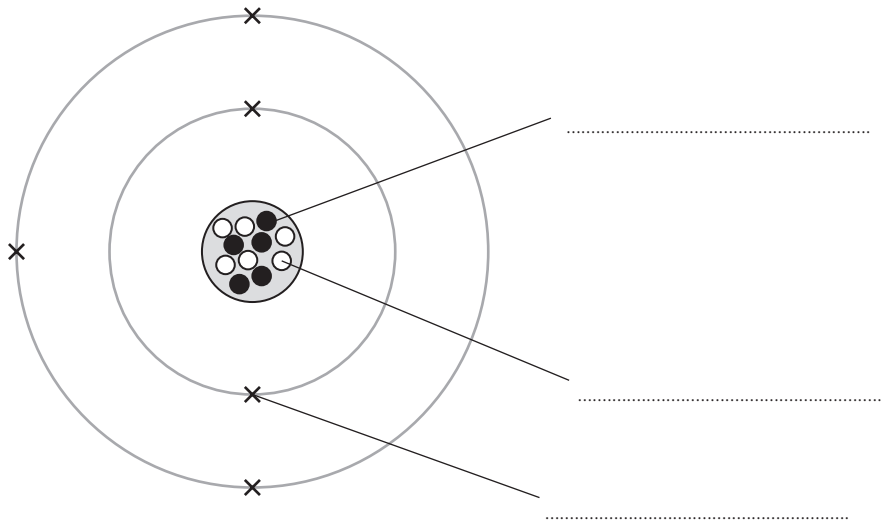
**** The lanthanoids (atomic numbers 58–71) and the actinoids (atomic numbers 90–103) have been omitted.***

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

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 represents an atom of an element.



(a) Label the three subatomic particles on the diagram.

(3)

(b) Use information from the diagram to complete the table for this element.

(4)

mass number	
group number	
period number	
electronic configuration	

(c) Give the name of this element.

(1)

.....

(Total for Question 1 = 8 marks)

2 A small piece of lithium is added to a trough of water.

(a) State two observations made when lithium reacts with water.

(2)

1 .....

.....

2 .....

.....

(b) What are the products of the reaction?

(1)

- ☒ **A** lithium hydroxide and hydrogen
- ☒ **B** lithium hydroxide and oxygen
- ☒ **C** lithium oxide and hydrogen
- ☒ **D** lithium oxide and oxygen

(c) After the reaction is complete, a few drops of universal indicator are added to the solution in the trough.

(i) Explain the colour and pH of the solution in the trough.

(3)

.....

.....

.....

.....

.....

.....

(ii) Give the formula of the ion responsible for this pH.

(1)

.....

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(d) Lithium ions can be identified using a flame test.

What flame colour indicates the presence of lithium ions?

(1)

- ☒ **A** lilac
- ☒ **B** orange
- ☒ **C** red
- ☒ **D** yellow

(Total for Question 2 = 8 marks)

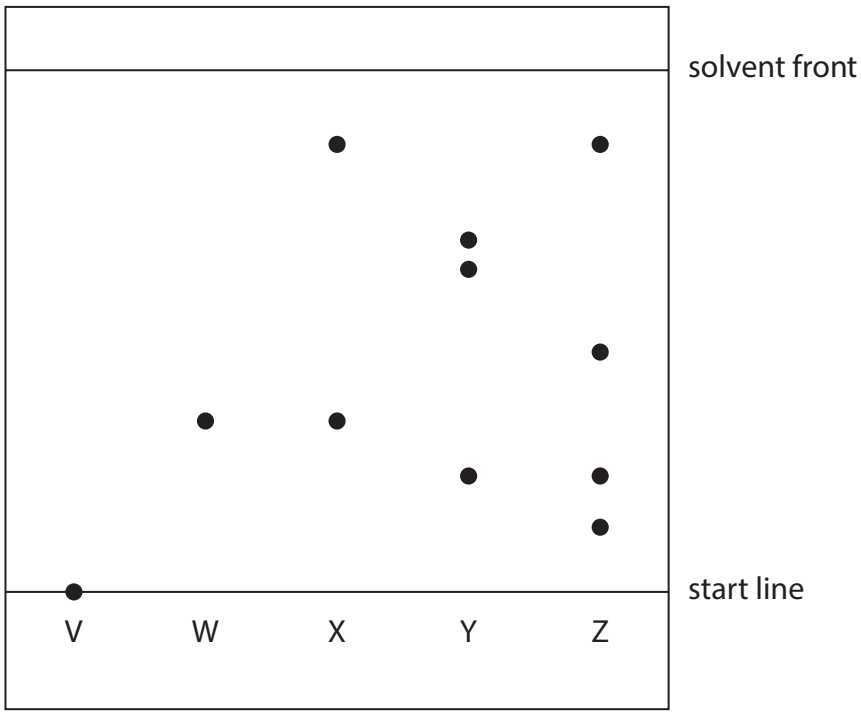
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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

The chromatogram shows the results of the investigation.



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

(2)

(b) Explain which two inks contain the dye that is most soluble in the solvent.

(2)

(c) Explain how the chromatogram shows that

- W contains only one dye
- V may contain more than one dye

(3)

.....

.....

.....

.....

.....

.....

(d) Calculate the R_f value for the dye in W.

Give your answer to two significant figures.

(4)

R_f value = ...

(Total for Question 3 = 11 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

4 Calcium phosphate is an ionic compound with the formula $Ca_3(PO_4)_2$

(a) (i) What is the total number of atoms in the formula $Ca_3(PO_4)_2$?

(1)

☒ **A** 8

☒ **B** 11

☒ **C** 13

☒ **D** 19

(ii) What are the correct charges on the ions in calcium phosphate?

(1)

☒ **A** Ca^{2+} and PO_4^{2-}

☒ **B** Ca^{2+} and PO_4^{3-}

☒ **C** Ca^{3+} and PO_4^{2-}

☒ **D** Ca^{3+} and PO_4^{3-}

(b) (i) Calculate the relative formula mass (M_r) of $Ca_3(PO_4)_2$

(2)

M_r of $Ca_3(PO_4)_2$ = ...

(ii) Calculate the percentage by mass of calcium in calcium phosphate.

(2)

percentage = ...%

(c) Calcium hydroxide can react with phosphoric acid to form calcium phosphate.

Complete the equation for this reaction.

(1)

.....$Ca(OH)_2$ + ...H_3PO_4 → .....$Ca_3(PO_4)_2$ + ...H_2O

(Total for Question 4 = 7 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

BLANK PAGE

5 Butane (C_4H_{10}) is an alkane.

(a) Explain why butane is a saturated hydrocarbon.

(3)

(b) (i) When butane burns completely in oxygen, carbon dioxide and water are produced.

Give a chemical equation for this combustion reaction.

(2)

(ii) Incomplete combustion can occur when the oxygen supply is limited.

One product of the incomplete combustion of butane is carbon monoxide.

Give the name of another product of this incomplete combustion.

(1)

(iii) State why carbon monoxide is poisonous to humans.

(1)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(c) C_4H_{10} exists as two isomers.

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

(2)

(ii) Draw the displayed formula of each isomer.

(2)

(d) Explain why hexane (C_6H_{14}) has a higher boiling point than butane (C_4H_{10}).

(3)

(Total for Question 5 = 14 marks)

6 (a) When iron rusts, iron(III) oxide forms.

State two conditions needed for iron to rust.

(2)

1 .....

2 .....

(b) What is the name of the process used to coat iron with zinc?

(1)

- ☒ **A** galvanisation
- ☒ **B** oxidation
- ☒ **C** reduction
- ☒ **D** sacrificial protection

(c) What is the correct order of reactivity of these four metals?

(1)

	most reactive	⟶		**least reactive**
☒ **A**	aluminium	copper	iron	zinc
☒ **B**	aluminium	iron	zinc	copper
☒ **C**	aluminium	zinc	iron	copper
☒ **D**	zinc	aluminium	iron	copper

(d) Describe a test to show that a solution contains Fe^{3+} ions.

(2)

test

.....

.....

result

.....

.....

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(e) A sample of iron(III) oxide reacts with excess carbon monoxide.

This is the equation for the reaction.

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

(i) Explain why this is a redox reaction.

(2)

.....

.....

.....

.....

(ii) Calculate the minimum mass of iron(III) oxide needed to produce a theoretical yield of 28 g of iron.

[for Fe_2O_3 $M_r = 160$]

(3)

minimum mass of iron(III) oxide = ... g

(iii) The actual yield of iron from this sample is 21 g.

Calculate the percentage yield of iron.

(2)

percentage yield = ... %

(Total for Question 6 = 13 marks)

BLANK PAGE

7 A student does an experiment to determine the maximum temperature change when sulfuric acid reacts with sodium hydroxide.

(a) Complete the chemical equation for this neutralisation reaction.

Include the state symbols.

(2)

$2NaOH(aq) + H_2SO_4(aq) \rightarrow$ ..... + ...

(b) This is the student's method.

Step 1 add 50 cm^3 of sodium hydroxide solution to a glass beaker

Step 2 record the initial temperature of the sodium hydroxide solution

Step 3 add 5 cm^3 of dilute sulfuric acid to the beaker

Step 4 stir the mixture and record the highest temperature reached

The student repeats steps 3 and 4 until a total of 40 cm^3 of acid has been added.

Explain one way the student could improve the accuracy of the experiment.

(2)

.....

.....

.....

.....

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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

Total volume of acid in cm^3	0	5	10	15	20	25	30	35	40
Temperature of mixture in °C	21.0	22.3	23.8	24.4	26.5	28.0	28.5	28.2	27.9

(i) Plot the results on the grid.

(1)

(ii) Draw a circle around the anomalous result.

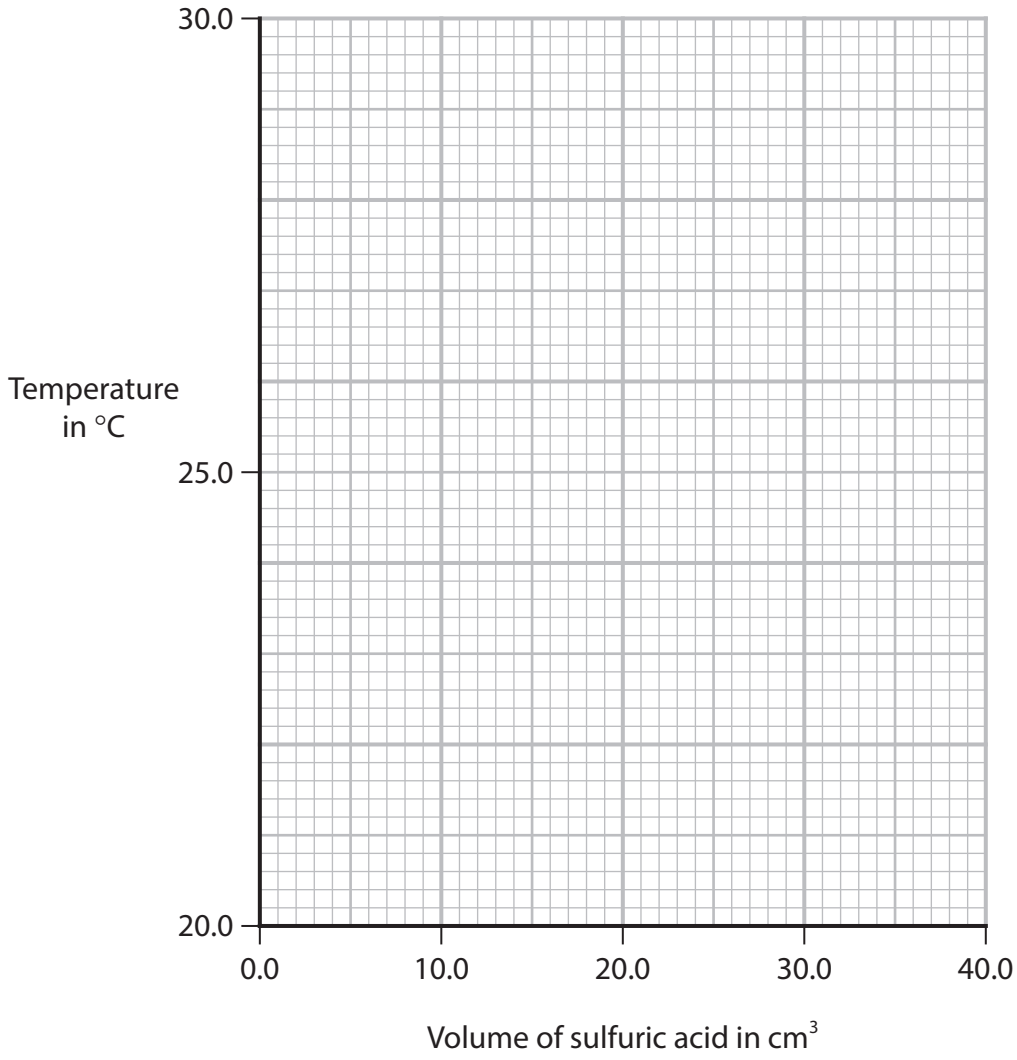
(1)

(iii) Draw a straight line of best fit through the first six points, ignoring the anomalous result.

Draw another straight line of best fit through the last three points.

Make sure that the two lines cross.

(2)



(d) The point where the lines cross shows the volume of acid needed to exactly neutralise the alkali and the maximum temperature reached.

Use your graph to determine these values.

(2)

volume of acid = ... cm^3

maximum temperature = ... °C

(e) Explain what might have caused the anomalous result.

(2)

.....

.....

.....

.....

(Total for Question 7 = 12 marks)

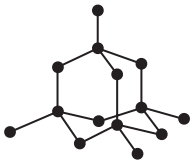
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

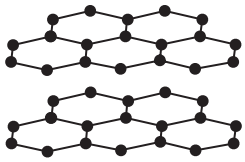
DO NOT WRITE IN THIS AREA

8 Diamond and graphite are two naturally-occurring forms of carbon.

They both have giant covalent structures.



diamond



graphite

(a) Explain, with reference to its bonding, why diamond has a high melting point.

(3)

(b) Explain why graphite is soft and is a conductor of electricity.

Refer to structure and bonding in your answer.

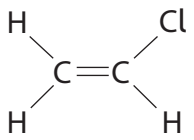
(6)

(Total for Question 8 = 9 marks)

9 This question is about organic compounds.

(a) Chloroethene (C_2H_3Cl) is a covalent molecule that is used to make poly(chloroethene).

This is the displayed formula of chloroethene.



(i) Draw a dot-and-cross diagram of chloroethene.

Show only the outer shell electrons.

(2)

(ii) Describe, in terms of electrostatic attraction, what is meant by a covalent bond.

(2)

(iii) Chloroethene is a monomer.

Draw the displayed formula of the repeat unit of poly(chloroethene).

(1)

(iv) Poly(chloroethene) is non-biodegradable.

There are two main methods used to dispose of poly(chloroethene).

Describe one problem caused by each method.

(4)

1 .....

.....

.....

.....

2 .....

.....

.....

.....

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(b) An organic compound contains this percentage composition by mass.

C = 22.0% H = 4.6% Br = 73.4%

Calculate the empirical formula of this compound.

(3)

empirical formula = ...

(c) Ethane and ethene undergo different types of reaction with bromine.

Describe the differences between these two reactions.

(5)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for Question 9 = 17 marks)

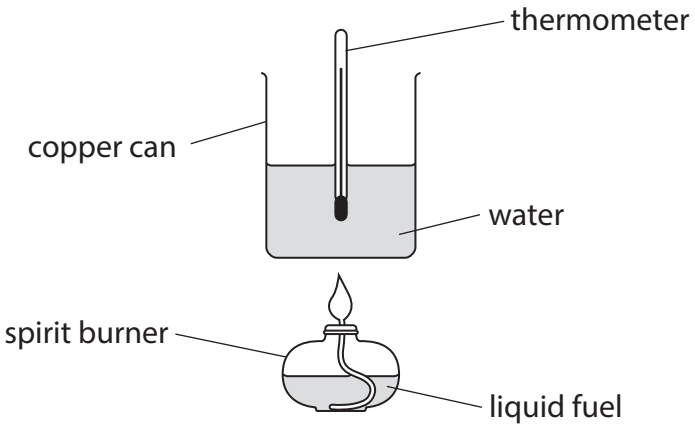
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

BLANK PAGE

10 A student uses this apparatus to investigate the energy content of different fuels.



(a) This is the student's method.

- pour some water into the copper can
- record the mass of the spirit burner and fuel
- measure the initial temperature of the water
- place the spirit burner under the copper can and light the burner
- stop heating the water when the temperature reaches 30°C
- record the new mass of the spirit burner and fuel

The student repeats the experiment with different fuels.

Explain two variables the student should control to make this a valid test.

(4)

1 .....

.....

.....

.....

2 .....

.....

.....

.....

(b) In one of the experiments, the student uses ethanol as the fuel.

These are the student's results for ethanol.

initial mass of spirit burner and ethanol in g	38.52
final mass of spirit burner and ethanol in g	38.29
volume of water in cm^3	100
initial temperature of water in °C	18
final temperature of water in °C	30

(i) Calculate the value of heat energy change (Q) in joules.

[for water, c = 4.2 J/g/°C 1.0 cm^3 of water has mass = 1.0 g]

(2)

Q = ... J

(ii) Calculate the enthalpy change (ΔH) in kJ/mol.

[for ethanol, M_r = 46]

Include a sign in your answer.

(5)

ΔH = ... kJ/mol

(Total for Question 10 = 11 marks)

TOTAL FOR PAPER = 110 MARKS

BLANK PAGE

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

BLANK PAGE

BLANK PAGE