

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 O oxygen 8	16 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 [98]	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

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.



P 7 8 9 5 0 A 0 2 2 8



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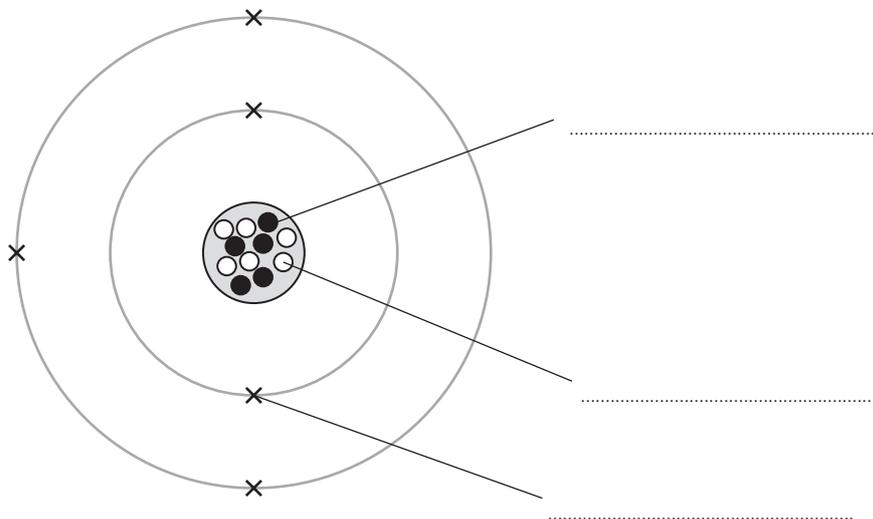
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Answer ALL questions.

Some questions must be answered with a cross . 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)

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2

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(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)

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

(1)

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

What flame colour indicates the presence of lithium ions?

(1)

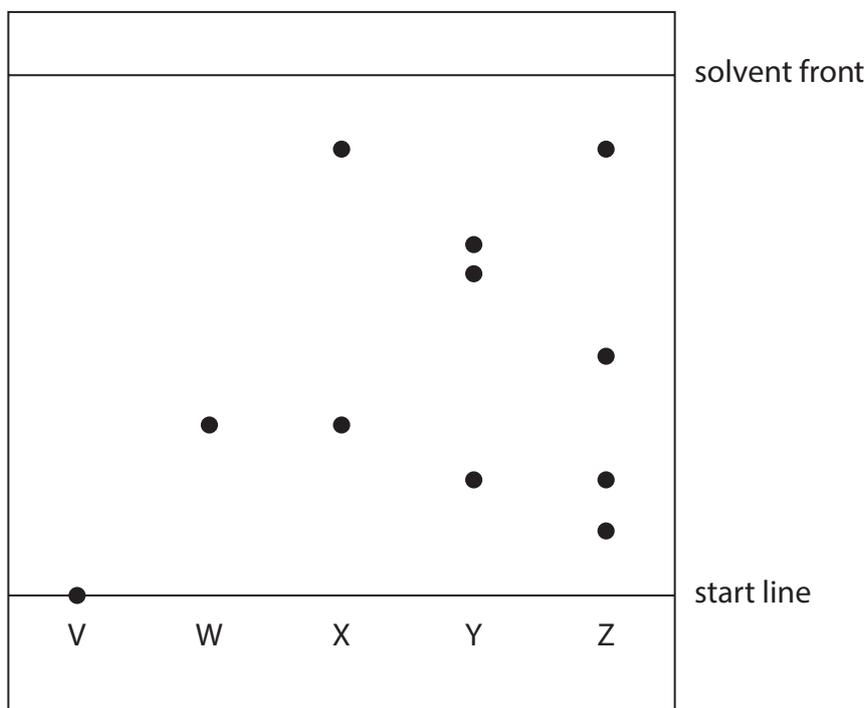
- A** lilac
- B** orange
- C** red
- D** yellow

(Total for Question 2 = 8 marks)



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)

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

(2)

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(c) Explain how the chromatogram shows that

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

(3)

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(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)



4 Calcium phosphate is an ionic compound with the formula $\text{Ca}_3(\text{PO}_4)_2$

(a) (i) What is the total number of atoms in the formula $\text{Ca}_3(\text{PO}_4)_2$? (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 $\text{Ca}_3(\text{PO}_4)_2$ (2)

M_r of $\text{Ca}_3(\text{PO}_4)_2$ =

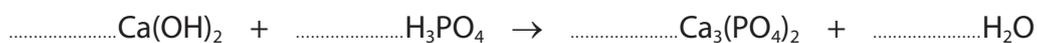
(ii) Calculate the percentage by mass of calcium in calcium phosphate. (2)

percentage =%

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

Complete the equation for this reaction.

(1)



(Total for Question 4 = 7 marks)



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5 Butane (C₄H₁₀) is an alkane.

(a) Explain why butane is a saturated hydrocarbon.

(3)

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

Give a chemical equation for this combustion reaction.

(2)

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(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)

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

(1)

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

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

(2)

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(ii) Draw the displayed formula of each isomer.

(2)

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

(3)

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(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 | |
|----------------------------|----------------------|-----------|-----------------------|--------|
| <input type="checkbox"/> A | aluminium | copper | iron | zinc |
| <input type="checkbox"/> B | aluminium | iron | zinc | copper |
| <input type="checkbox"/> C | aluminium | zinc | iron | copper |
| <input type="checkbox"/> D | zinc | aluminium | iron | copper |

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

(2)

test

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result

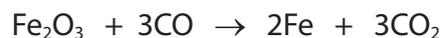
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(e) A sample of iron(III) oxide reacts with excess carbon monoxide.

This is the equation for the reaction.



(i) Explain why this is a redox reaction.

(2)

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(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)



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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)



(b) This is the student's method.

Step 1 add 50 cm³ of sodium hydroxide solution to a glass beaker

Step 2 record the initial temperature of the sodium hydroxide solution

Step 3 add 5 cm³ 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 cm³ of acid has been added.

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

(2)

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(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 $^{\circ}\text{C}$	21.0	22.3	23.8	24.4	26.5	28.0	28.5	28.2	27.9

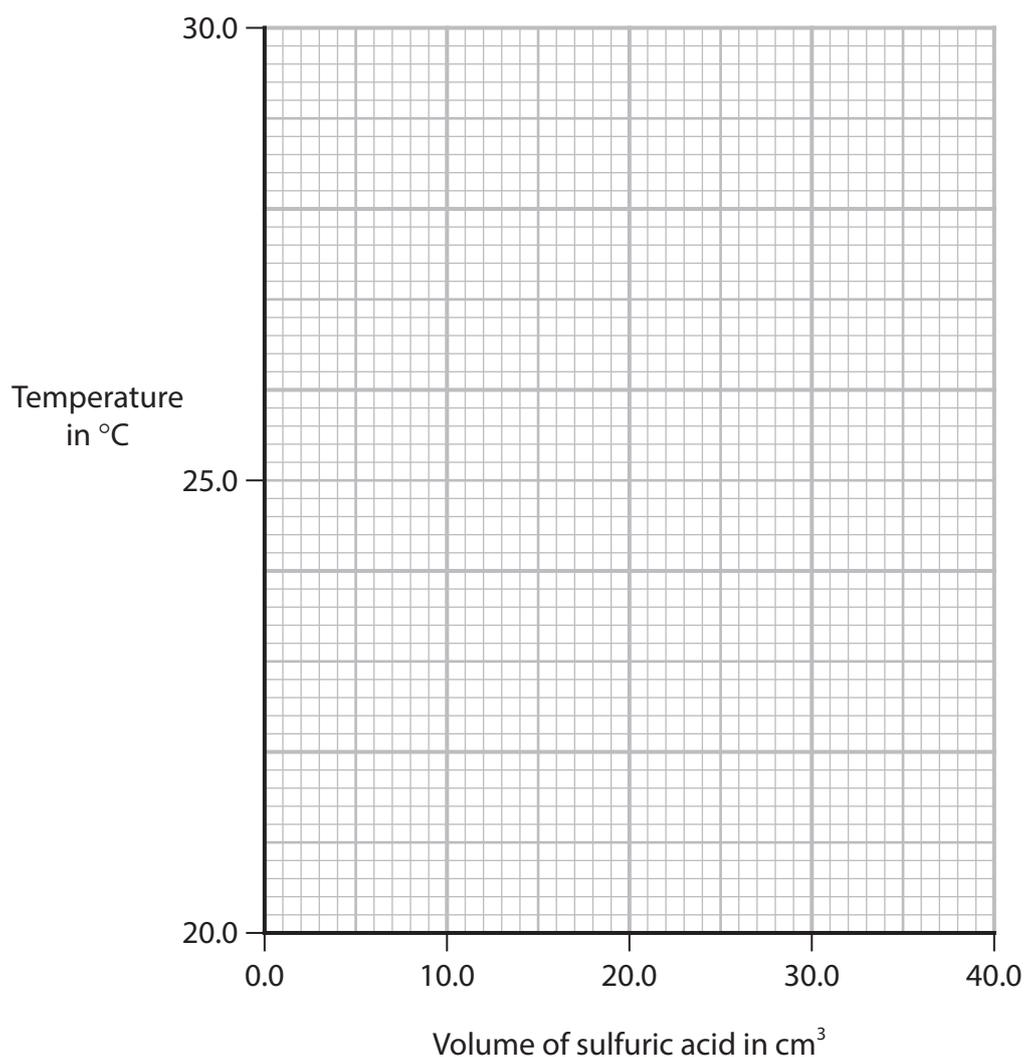
(i) Plot the results on the grid. (1)

(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.

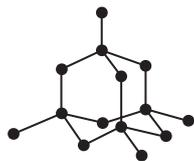
Draw another straight line of best fit through the last three points.

Make sure that the two lines cross. (2)

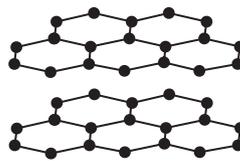


8 Diamond and graphite are two naturally-occurring forms of carbon.

They both have giant covalent structures.



diamond



graphite

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

(3)

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

Refer to structure and bonding in your answer.

(6)

Area with horizontal dotted lines for writing the answer.

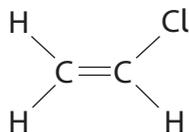
(Total for Question 8 = 9 marks)



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)

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(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)

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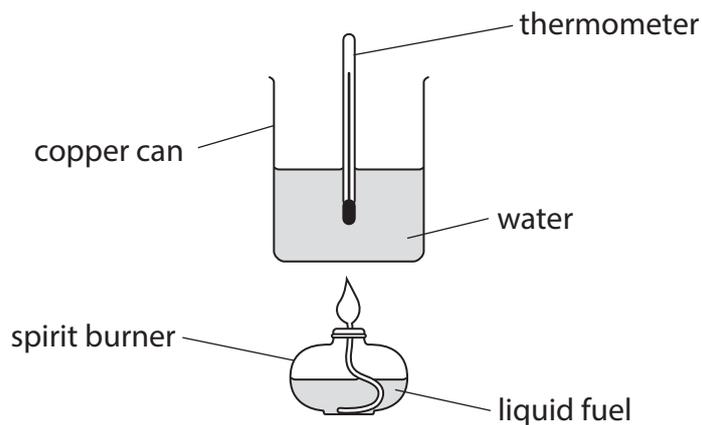
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10 A student uses this apparatus to investigate the energy content of different fuels.



(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

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2

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(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 $^{\circ}\text{C}$	18
final temperature of water in $^{\circ}\text{C}$	30

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

[for water, $c = 4.2 \text{ J/g}^{\circ}\text{C}$ 1.0 cm^3 of water has mass = 1.0 g]

(2)

$$Q = \dots\dots\dots \text{ J}$$

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

[for ethanol, $M_r = 46$]

Include a sign in your answer.

(5)

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

(Total for Question 10 = 11 marks)

TOTAL FOR PAPER = 110 MARKS



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