



# The Periodic Table of the Elements

1	2	3	4	5	6	7	0	
7 <b>Li</b> lithium 3	9 <b>Be</b> beryllium 4	11 <b>Na</b> sodium 11	12 <b>C</b> carbon 6	13 <b>Al</b> aluminium 13	14 <b>N</b> nitrogen 7	15 <b>O</b> oxygen 8	16 <b>F</b> fluorine 9	17 <b>Ne</b> neon 10
19 <b>K</b> potassium 19	20 <b>Ca</b> calcium 20	21 <b>Sc</b> scandium 21	22 <b>Ti</b> titanium 22	23 <b>V</b> vanadium 23	24 <b>Cr</b> chromium 24	25 <b>Mn</b> manganese 25	26 <b>Fe</b> iron 26	27 <b>Co</b> cobalt 27
37 <b>Rb</b> rubidium 37	38 <b>Sr</b> strontium 38	39 <b>Y</b> yttrium 39	40 <b>Zr</b> zirconium 40	41 <b>Nb</b> niobium 41	42 <b>Mo</b> molybdenum 42	[98] <b>Tc</b> technetium 43	44 <b>Ru</b> ruthenium 44	45 <b>Rh</b> rhodium 45
55 <b>Cs</b> caesium 55	56 <b>Ba</b> barium 56	57 <b>La*</b> lanthanum 57	72 <b>Hf</b> hafnium 72	73 <b>Ta</b> tantalum 73	74 <b>W</b> tungsten 74	75 <b>Re</b> rhenium 75	76 <b>Os</b> osmium 76	77 <b>Ir</b> iridium 77
[223] <b>Fr</b> francium 87	[226] <b>Ra</b> radium 88	[227] <b>Ac*</b> actinium 89	104 <b>Rf</b> rutherfordium 104	105 <b>Db</b> dubnium 105	106 <b>Sg</b> seaborgium 106	107 <b>Bh</b> bohrium 107	108 <b>Hs</b> hassium 108	109 <b>Mt</b> meitnerium 109
85 <b>Rb</b> rubidium 37	88 <b>Sr</b> strontium 38	89 <b>Y</b> yttrium 39	91 <b>Zr</b> zirconium 40	93 <b>Nb</b> niobium 41	96 <b>Mo</b> molybdenum 42	101 <b>Ru</b> ruthenium 44	103 <b>Rh</b> rhodium 45	106 <b>Pd</b> palladium 46
133 <b>Cs</b> caesium 55	137 <b>Ba</b> barium 56	139 <b>La*</b> lanthanum 57	178 <b>Hf</b> hafnium 72	181 <b>Ta</b> tantalum 73	184 <b>W</b> tungsten 74	190 <b>Os</b> osmium 76	192 <b>Ir</b> iridium 77	195 <b>Pt</b> platinum 78
131 <b>Xe</b> xenon 54	127 <b>I</b> iodine 53	128 <b>Te</b> tellurium 52	112 <b>Cd</b> cadmium 48	115 <b>In</b> indium 49	119 <b>Sn</b> tin 50	122 <b>Sb</b> antimony 51	127 <b>Bi</b> bismuth 83	131 <b>Xe</b> xenon 54
131 <b>Xe</b> xenon 54	127 <b>I</b> iodine 53	128 <b>Te</b> tellurium 52	112 <b>Cd</b> cadmium 48	115 <b>In</b> indium 49	119 <b>Sn</b> tin 50	122 <b>Sb</b> antimony 51	127 <b>Bi</b> bismuth 83	131 <b>Xe</b> xenon 54
[222] <b>Rn</b> radon 86	[210] <b>At</b> astatine 85	[209] <b>Po</b> polonium 84	201 <b>Hg</b> mercury 80	204 <b>Tl</b> thallium 81	207 <b>Pb</b> lead 82	209 <b>Bi</b> bismuth 83	[210] <b>At</b> astatine 85	[222] <b>Rn</b> radon 86
Elements with atomic numbers 112-116 have been reported but not fully authenticated								

1	<b>H</b> hydrogen 1
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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.**

Some questions must be answered with a cross  $\boxtimes$ . If you change your mind about an answer, put a line through the box  $\boxtimes$  and then mark your new answer with a cross  $\boxtimes$ .

1 This question is about organic compounds.

(a) What is the name of the compound with the formula  $C_4H_{10}$ ?

(1)

- A butane  
 B ethane  
 C pentane  
 D propane

(b) What is the general formula for alkanes?

(1)

- A  $C_nH_{2n}$   
 B  $C_nH_{2n+1}$   
 C  $C_nH_{2n-2}$   
 D  $C_nH_{2n+2}$

(c) Calculate the relative formula mass ( $M_r$ ) of  $C_3H_8$

(1)

$M_r = \dots\dots\dots$

(d) Give the displayed formula of methane.

(1)

(e) Name the compound formed when many molecules of  $C_2H_4$  join together.

(1)

(Total for Question 1 = 5 marks)





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3 Argon and oxygen are two gases found in the atmosphere.

(a) (i) What is the approximate percentage by volume of argon in dry air?

(1)

- A 0.01 %
- B 0.1 %
- C 1 %
- D 10 %

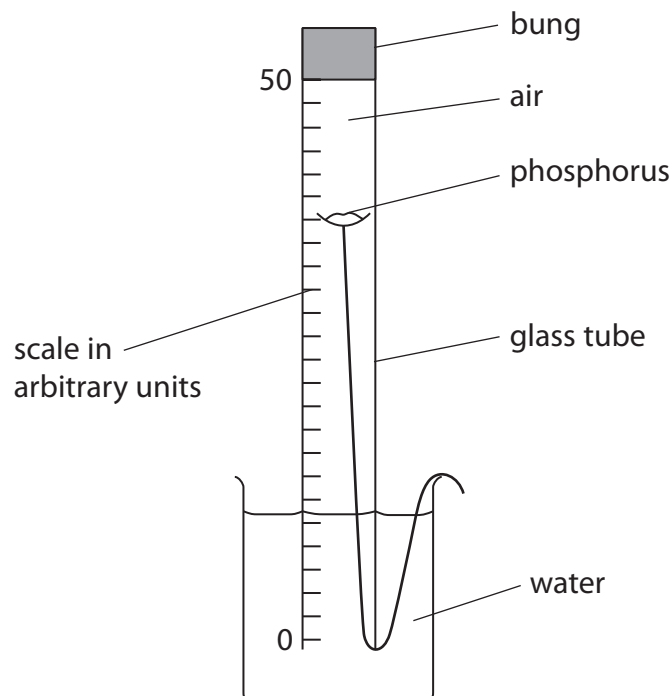
(ii) Give a test for oxygen.

(1)

(b) Oxygen reacts with hot phosphorus to form white fumes of phosphorus oxide.

A scientist uses this reaction to find the approximate percentage by volume of oxygen in a sample of air.

The diagram shows the apparatus the scientist uses.



This is the scientist's method.

- remove the bung and record the initial water level in the glass tube
- use a hot metal rod to ignite the phosphorus and quickly replace the bung
- wait until all the white fumes have disappeared and the water level in the glass tube stops rising
- record the final water level in the glass tube

(i) Give a reason why the scientist quickly replaces the bung.

(1)

(ii) The table shows the scientist's results.

initial water level in arbitrary units	10.0
final water level in arbitrary units	18.3

Use the diagram and the results to calculate the percentage by volume of oxygen in the sample of air.

Give your answer to 3 significant figures.

(4)

percentage of oxygen = ..... %

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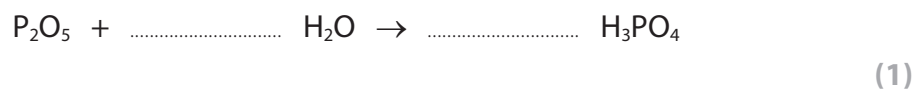
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(c) The fumes of phosphorus oxide dissolve in the water and react to form a solution of phosphoric acid.

(i) Complete the chemical equation for this reaction.



(ii) Describe how to show whether the solution is strongly acidic or weakly acidic. (3)

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**(Total for Question 3 = 11 marks)**



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4 Marble chips react with hydrochloric acid to form calcium chloride solution, water and carbon dioxide.

(a) A student gives this incorrect equation for the reaction.



Identify two changes that should be made to the student's equation.

(2)

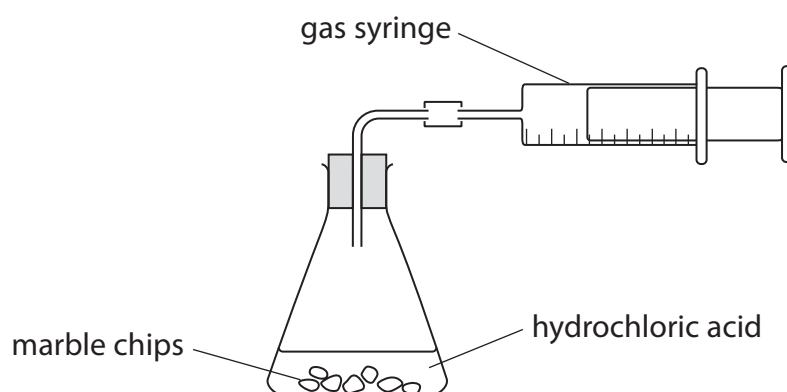
1 .....

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2 .....

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(b) The student uses this apparatus to investigate the effect of the concentration of hydrochloric acid on the rate of the reaction with marble chips.



In the first experiment the student records the total volume of carbon dioxide gas in the gas syringe every 30 seconds.

(i) When the reaction has finished, some marble chips remain in the flask.

Give a conclusion the student could make about the reaction.

(1)

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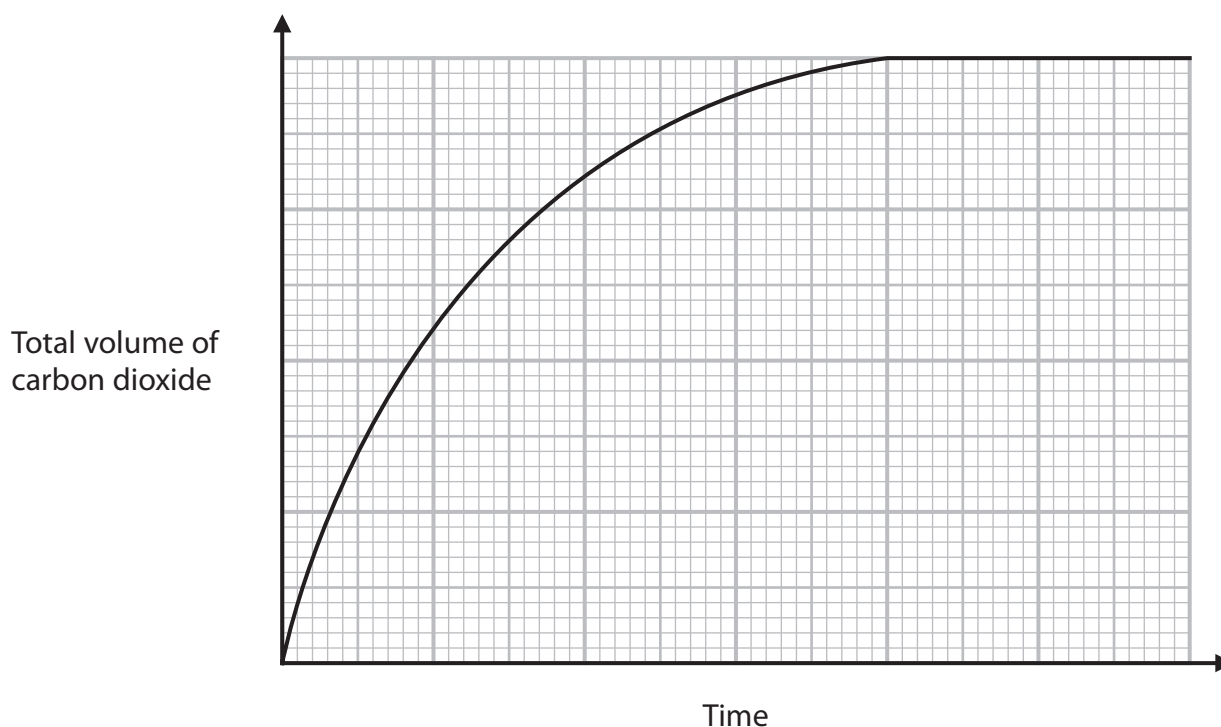
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(ii) State how the student would know that the reaction has finished.

(1)

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



Explain how the shape of the curve shows how the rate of reaction changes as the time increases.

(3)

(iv) The student repeats the experiment using the same mass of marble chips and the same volume of hydrochloric acid. However, the acid is only half as concentrated as the acid used in the first experiment.

On the grid, draw the curve you would expect the student to obtain in the second experiment.

(2)

**(Total for Question 4 = 9 marks)**

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5 Hydrogen sulfide (H<sub>2</sub>S) contains covalent bonds between the sulfur atom and the hydrogen atoms.  
Hydrogen sulfide has a low melting point and a low boiling point and is a gas at room temperature.

(a) Describe how covalent bonds are formed.

(2)

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(b) Explain why hydrogen sulfide has a low boiling point.

Refer to structure and forces of attraction in your answer.

(3)

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(c) Diamond is also a covalent substance, but it has a very high melting point.

Give the type of structure in diamond.

(1)

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**(Total for Question 5 = 6 marks)**

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6 Caesium (Cs) is an element in Group 1 of the Periodic Table.

An atom of one of the isotopes of caesium has atomic number 55 and mass number 133

(a) Determine the numbers of protons, neutrons and electrons in this atom. (2)

protons

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neutrons

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electrons

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(b) A small piece of sodium metal is added to a trough of water. A rapid reaction takes place.

A small piece of caesium metal is added to another trough of water.

(i) Predict one observation that could be made in both reactions. (1)

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(ii) Predict how the reaction of caesium with water compares with the reaction of sodium with water.

Refer to the trend in reactivity of Group 1 metals in your answer. (3)

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(c) Caesium reacts with chlorine gas ( $\text{Cl}_2$ ) to form caesium chloride.

(i) State the name given to the group of the Periodic Table that contains chlorine. (1)

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(ii) Give a chemical equation for the reaction between caesium and chlorine. (1)

(d) The bonding in caesium chloride is ionic.

(i) Describe how caesium atoms and chlorine atoms form ions, giving the charges on the ions. (3)

(ii) Explain what is meant by the term **ionic bonding**. (2)

(iii) Solid caesium chloride has a giant ionic lattice.  
Give a physical property of caesium chloride. (1)

**(Total for Question 6 = 14 marks)**

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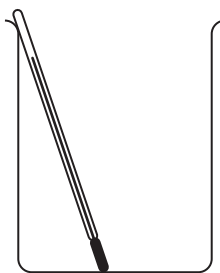
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P 7 4 4 9 8 A 0 1 5 2 0

7 When a salt dissolves in water, a heat energy change may occur.

A student uses this apparatus to find the heat energy change that occurs when magnesium sulfate dissolves in water.



This is the student's method.

Step 1 add  $50.0\text{ cm}^3$  of water to the beaker

Step 2 record the initial temperature of the water

Step 3 add  $3.0\text{ g}$  of magnesium sulfate and stir carefully using the thermometer

Step 4 record the highest temperature of the solution

(a) Explain how Step 4 shows what type of heat energy change occurs when the magnesium sulfate dissolves.

(2)

(b) Explain one change that could be made to the student's apparatus that would improve the accuracy of the results.

(2)



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

initial temperature of the water	19.5°C
highest temperature of the solution	30.7°C

Calculate the heat energy change ( $Q$ ), in kJ, that occurs when magnesium sulfate dissolves in water.

[for the solution, mass of  $1.00 \text{ cm}^3 = 1.00 \text{ g}$   $c = 4.2 \text{ J/g/}^\circ\text{C}$ ]

(4)

$Q = \dots\dots\dots$  kJ

**(Total for Question 7 = 8 marks)**

**TOTAL FOR PAPER = 60 MARKS**



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