

Write your name here

Surname

Other names

**Pearson Edexcel**  
**Level 1/Level 2 GCSE (9-1)**

Centre Number

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Candidate Number

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# Chemistry

## Paper 1

**Higher Tier**

Sample Assessment Materials for first teaching September 2016

**Time: 1 hour 45 minutes**

Paper Reference

**1CH0/1H**

**You must have:**

Calculator, ruler

Total Marks

### Instructions

- Use **black** ink or ball-point pen.
- **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.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

### Information

- The total mark for this paper is 100
- The marks for **each** question are shown in brackets  
– *use this as a guide as to how much time to spend on each question.*
- In questions marked with an asterisk (\*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

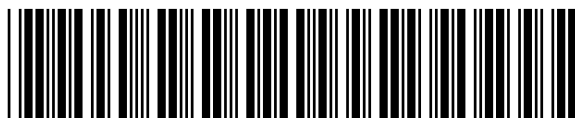
### Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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**PEARSON**

Answer ALL questions. Write your answers in the spaces provided.

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 Mixtures of coloured substances can be separated by paper chromatography.
- (a) Paper chromatography was used to separate a mixture of blue and red inks. A spot of the mixture was placed on chromatography paper as shown in Figure 1.

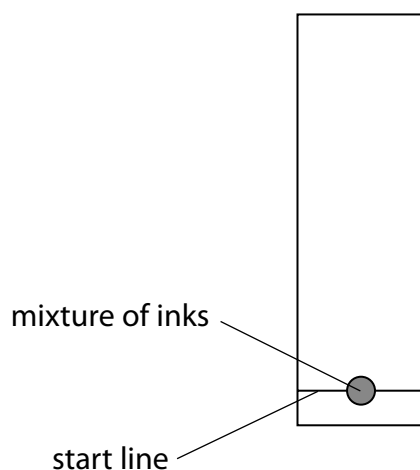


Figure 1

- (i) Give a reason why the start line is drawn in pencil rather than in ink.

(1)

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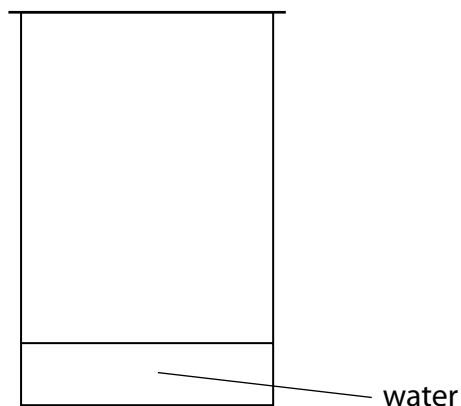
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- (ii) The chromatography paper, with the spot of mixture on it, was placed in a beaker with the bottom of the paper in water.

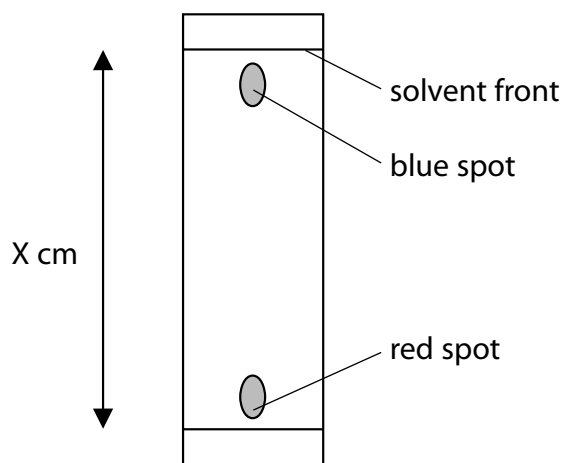
On Figure 2, complete the diagram showing the position of the chromatography paper with the spot of mixture at the start of the experiment.

(1)



**Figure 2**

- (iii) The chromatography was carried out and the result is shown in Figure 3.



**Figure 3**

The blue spot had moved 14.5 cm and the solvent front had moved 15.3 cm.

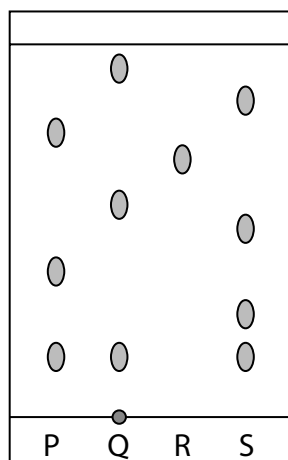
Calculate the  $R_f$  value of the substance in the blue spot, giving your answer to 2 significant figures.

$$R_f \text{ value} = \frac{\text{distance travelled by a dye}}{\text{distance travelled by solvent front}}$$

(2)

$R_f$  value = .....

- (b) **P, Q, R** and **S** are mixtures of food colourings.  
They are investigated using paper chromatography.  
Figure 4 shows the chromatogram at the end of the experiment.



**Figure 4**

- (i) Which mixture contains an insoluble food colouring? (1)

- A** mixture **P**
- B** mixture **Q**
- C** mixture **R**
- D** mixture **S**

- (ii) Give a change that could be made to the experiment to obtain an  $R_f$  value for the insoluble colouring. (1)

- (iii) Explain, by referring to Figure 4, which mixture is separated into the greatest number of soluble food colourings by this chromatography experiment. (2)

**(Total for Question 1 = 8 marks)**

2 Ionic compounds contain ions.

(a) The numbers of electrons, neutrons and protons in four particles, **W**, **X**, **Y** and **Z**, are shown in Figure 5.

particle	electrons	neutrons	protons
<b>W</b>	9	10	9
<b>X</b>	10	14	12
<b>Y</b>	16	16	16
<b>Z</b>	18	18	16

**Figure 5**

Explain which particle, **W**, **X**, **Y** or **Z**, is a negative ion.

(2)

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(b) Calcium nitrate contains calcium ions and nitrate ions.

Calculate the relative formula mass of calcium nitrate,  $\text{Ca}(\text{NO}_3)_2$ .  
(relative atomic masses: Ca = 40, N = 14, O = 16)

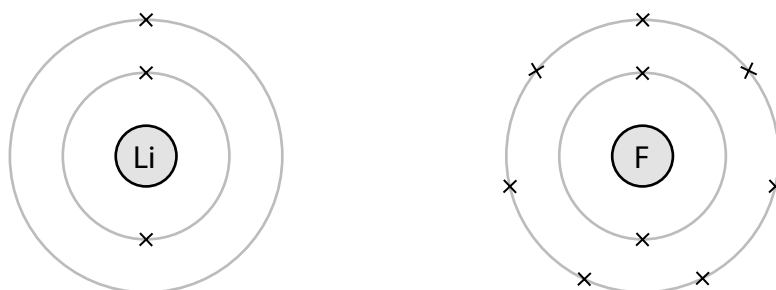
(2)

relative formula mass = .....

(c) Lithium fluoride, LiF, is an ionic compound.

It contains lithium cations and fluoride anions.

The electronic configurations of a lithium atom and of a fluorine atom are shown in Figure 6.



**Figure 6**

Complete Figure 7 to show the electronic configurations and charges of the ions in lithium fluoride.

(4)



charge on ion .....

charge on ion .....

**Figure 7**

**(Total for Question 2 = 8 marks)**

3 A student carried out an experiment to see how reactive different metals are when they are placed in dilute hydrochloric acid.

A sample of each metal was placed in a separate test tube of acid.

(a) When zinc reacts with dilute hydrochloric acid, a gas is given off and zinc chloride is formed.

(i) Which gas is given off?

- A carbon dioxide
- B chlorine
- C hydrogen
- D oxygen

(1)

(ii) What is the formula of zinc chloride?

- A ZnCl
- B Zn<sub>2</sub>Cl
- C ZnCl<sub>2</sub>
- D Zn<sub>2</sub>Cl<sub>2</sub>

(1)

(b) In the experiment, the student used the same amount of each metal in a finely powdered form.

State **two** factors, concerning the hydrochloric acid, which should also be controlled to produce valid results.

(2)

1 .....

2 .....

(c) Part of the reactivity series is shown in Figure 8.

<b>most reactive</b>	magnesium
	aluminium
	iron
<b>least reactive</b>	silver

**Figure 8**

Iron is extracted from its ore by heating with carbon.  
Aluminium is extracted from its ore using a different method.

(i) Give the name of the method used to extract aluminium. (1)

(ii) Explain why aluminium is extracted by a different method rather than heating the ore with carbon. (2)

(d) The extraction of iron involves the reduction of iron oxide,  $\text{Fe}_2\text{O}_3$ , by carbon monoxide, CO. During this reaction, the iron oxide is reduced to iron, Fe, and the carbon monoxide is oxidised to carbon dioxide.

Write the balanced equation for the reaction. (2)

**(Total for Question 3 = 9 marks)**



4 The method used to prepare a salt depends on its solubility in water.

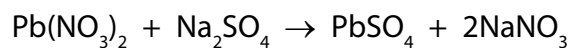
(a) Complete Figure 9 by placing one tick in each row to show whether the salt is soluble or insoluble.

(2)

salt	soluble	insoluble
ammonium chloride		
lithium sulfate		
magnesium carbonate		

Figure 9

(b) Lead nitrate solution mixed with sodium sulfate solution forms lead sulfate as a precipitate.



The theoretical yield of lead sulfate for this reaction was 2.85 g.

The actual yield of lead sulfate obtained was 2.53 g.

Calculate the percentage yield of lead sulfate in this experiment.

Give your answer to two significant figures.

(3)

percentage yield = .....%

(c) The method used to make the lead sulfate is:

- pour 100 cm<sup>3</sup> lead nitrate solution into a beaker
- add drops of sodium sulfate solution until a precipitate is seen
- allow the precipitate to settle to the bottom of the beaker
- pour off the liquid
- use a spatula to transfer the solid lead sulfate onto a filter paper

Explain **two** ways of improving this experimental method to increase the amount and quality of lead sulfate obtained from the same volume of lead nitrate solution.

(4)

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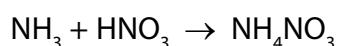
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(d) Ammonium nitrate is produced from ammonia and nitric acid on a large scale in industry.

Ammonium nitrate can also be made in the laboratory by titrating ammonia solution with dilute nitric acid.



Ammonium nitrate crystals can then be obtained by evaporating off some of the water from the solution.

Give **two** reasons why this laboratory method is not suitable for use on a large scale in industry.

(2)

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**(Total for Question 4 = 11 marks)**

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5 Objects made from transition metals are sometimes coated with a thin layer of another transition metal to improve their appearance and to protect against corrosion.

(a) Figure 10 shows equipment that can be used to electroplate an iron spoon with silver.

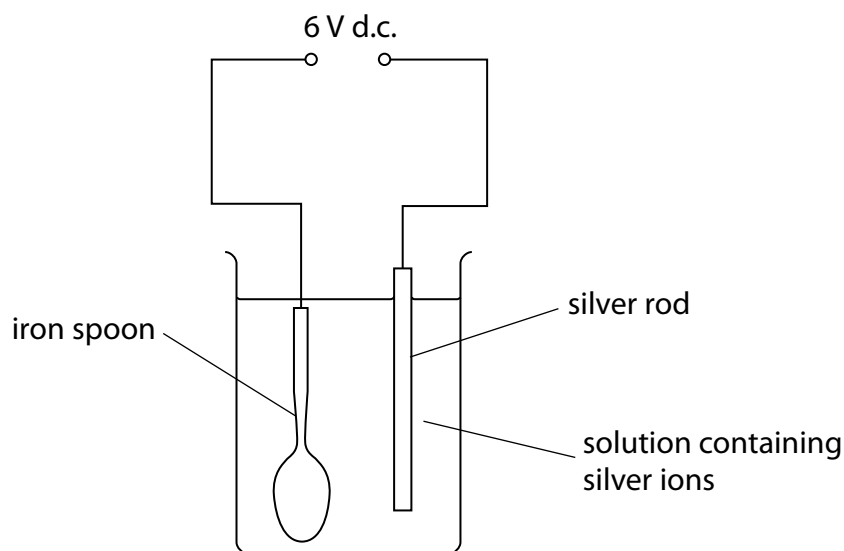


Figure 10

(i) Which row of the table correctly shows the charge on the silver rod electrode and the type of reaction occurring at this electrode?

(1)

	charge	type of reaction
<input type="checkbox"/> A	negative	oxidation
<input type="checkbox"/> B	negative	reduction
<input type="checkbox"/> C	positive	oxidation
<input type="checkbox"/> D	positive	reduction

(ii) Silver metal is deposited on the spoon.

Which half-equation represents this reaction?

(1)

- A**  $\text{Ag} + \text{e} \rightarrow \text{Ag}^+$
- B**  $\text{Ag} \rightarrow \text{Ag}^+ + \text{e}^-$
- C**  $\text{Ag}^+ + \text{e} \rightarrow \text{Ag}$
- D**  $\text{Ag}^+ \rightarrow \text{Ag} + \text{e}^-$

(b) The voltage of a cell is 1.5V.

Give a reason why this voltage of the cell decreases when the cell is left connected in a circuit.

(1)

(c) Duralumin is an alloy of aluminium and copper.

The radii of the aluminium and copper atoms are shown in Figure 11.

	radius of atom / m
aluminium	$1.43 \times 10^{-12}$
copper	$1.27 \times 10^{-12}$

**Figure 11**

Explain why copper added to aluminium to form the alloy makes the alloy stronger than pure aluminium.

(2)

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(d) Gold is often alloyed with other metals when it is used to make jewellery.

The proportion of gold in a piece of gold jewellery is measured in carats.

Pure gold is 24 carats.

A 9 carat gold ring has a mass of 12 g.

Calculate the mass of gold in this ring.

(2)

mass of gold ring = ..... g

**(Total for Question 5 = 7 marks)**

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6 Electrodes are placed in three different solutions, **J**, **K** and **L**.

A 6V direct current source is connected to the electrodes.

Any products formed at the electrodes are identified.

The results are given in Figure 12.

<b>solution</b>	<b>solution conducts electricity</b>	<b>product at cathode</b>	<b>product at anode</b>
<b>J</b>	yes	copper	chlorine
<b>K</b>	yes	hydrogen	oxygen
<b>L</b>	no	none	none

**Figure 12**

(a) Explain which solutions are electrolytes.

(2)

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(b) Which material is most suitable to make the electrodes for the electrolysis of a dilute acid?

(1)

- A** zinc
- B** sulfur
- C** iron
- D** graphite



- (c) When a solution of sodium sulfate,  $\text{Na}_2\text{SO}_4$ , is electrolysed, the products formed at the electrodes are hydrogen and oxygen.

Explain the formation of the products at the electrodes.

(4)

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- (d) Copper is purified by the electrolysis of copper sulfate solution using an impure copper anode and a pure copper cathode.

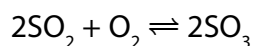
Write the half-equation for the formation of a copper atom from a copper ion.

(2)

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**(Total for Question 6 = 9 marks)**

7 Sulfur trioxide is produced by reacting sulfur dioxide with oxygen.



- (a) (i) This reaction takes place in industry at 1–2 atm pressure and can reach a dynamic equilibrium.

Explain the effect on the rate of attainment of equilibrium, if the process is carried out at a pressure higher than 1–2 atm.

(3)

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- (ii) What volume of oxygen, in  $\text{cm}^3$ , would react completely with  $500 \text{ cm}^3$  sulfur dioxide? (1)

- A  $500 \div 2$
- B 500
- C  $500 \times 2$
- D  $500 \times 32$

- (b) When there are alternative methods of producing a product, the final pathway is chosen by considering atom economy, cost of energy, yield of product and rates of reactions.

State another factor that should also be considered.

(1)

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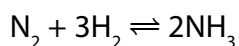
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\* (c) The reaction between nitrogen and hydrogen is exothermic.



If nitrogen and hydrogen were reacted at 150 atm pressure and 300 °C, without a catalyst, some ammonia would be formed.

In the Haber process a pressure of 150 atm and a temperature of 450 °C are used, in the presence of an iron catalyst.

Explain why the conditions used in the Haber process are better than the first set of conditions for the manufacture of ammonia.

(6)

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**(Total for Question 7 = 11 marks)**

8 Figure 13 shows a model of how particles are arranged in a solid.

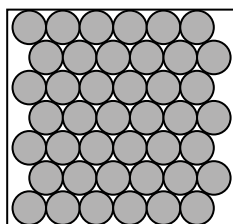


Figure 13

(a) (i) State **two** ways in which this model fails to accurately represent a crystal of sodium chloride.

(2)

1 .....

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2 .....

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(ii) Magnesium oxide has a melting point of  $2852^{\circ}\text{C}$ .

Explain why magnesium oxide has such a high melting point.

(3)

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- (b) (i) Carbon dioxide can be formed by the reaction of calcium carbonate,  $\text{CaCO}_3$ , with dilute hydrochloric acid.

Write the balanced equation for this reaction.

(3)

- (ii) The thermal decomposition of copper carbonate forms copper oxide and carbon dioxide.



15.0 g of pure copper carbonate is decomposed completely.

Calculate the mass of solid produced.

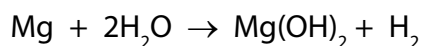
(relative atomic masses: C = 12.0; O = 16.0; Cu = 63.5)

Give your answer to two significant figures.

(2)

mass of solid = ..... g

(c) Magnesium reacts with water in the form of steam as shown in the equation.



2.4 g of magnesium reacts with sufficient steam for a complete reaction to form 5.8 g of magnesium hydroxide and 0.2 g of hydrogen.

Show, by calculation, that the law of conservation of mass applies to this reaction.

(relative atomic masses: H = 1.0, O = 16, Mg = 24)

(3)

**(Total for Question 8 = 13 marks)**

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9 Some acids such as hydrochloric acid are described as strong acids.  
Some acids such as ethanoic acid are described as weak acids.

(a) (i) Explain the difference between a strong acid and a weak acid.

(2)

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(ii) Give a reason why adding hydroxide ions to an acid solution leads to an increase in pH.

(1)

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(b) The salt zinc nitrate can be made by reacting zinc oxide, ZnO, with dilute nitric acid, HNO<sub>3</sub>.

Write the balanced equation for this reaction.

(2)

.....

(c) 50 cm<sup>3</sup> of potassium hydroxide solution of concentration 40 g dm<sup>-3</sup> is needed for an experiment.

Calculate the mass of potassium hydroxide that must be dissolved in water to make 50 cm<sup>3</sup> of solution of this concentration.

(2)

mass of potassium hydroxide = ..... g

\* (d) Salts of metals can be made by reacting one of the metal's compounds with the appropriate acid.

Plan an experiment to prepare pure, dry crystals of magnesium sulfate,  $\text{MgSO}_4$ , by reacting a suitable magnesium compound with a suitable acid.

You may use equations if you wish.

(6)

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**(Total for Question 9 = 13 marks)**

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- 10 (a) In an experiment, ammonia gas is made by heating a mixture of ammonium chloride and calcium hydroxide.



10.0g of ammonium chloride is added to an excess of calcium hydroxide.

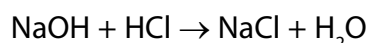
Calculate the maximum volume of ammonia gas that could be formed.

(relative atomic mass H = 1.00, N = 14.0, O = 16.0 and Ca = 40.0; one mole of any gas occupies 24 dm<sup>3</sup> at room temperature and pressure)

(2)

volume = ..... dm<sup>3</sup>

- (b) Sodium hydroxide solution reacts with hydrochloric acid.



- (i) 25.0 cm<sup>3</sup> of 0.100 mol dm<sup>-3</sup> sodium hydroxide, NaOH, solution is added to 35.0 cm<sup>3</sup> of 0.0750 mol dm<sup>-3</sup> dilute hydrochloric acid, HCl.

Use the information to determine which reagent is in excess.

(3)

- (ii) To find the exact amount of dilute hydrochloric acid that reacts with  $25.0 \text{ cm}^3$  of the sodium hydroxide solution, a titration is carried out. Figure 14 shows the results for the titrations.

	1st titration	2nd titration	3rd titration	4th titration
final burette reading / $\text{cm}^3$	37.60	36.20	39.15	38.40
initial burette reading / $\text{cm}^3$	1.80	0.00	3.95	2.10
volume of acid used / $\text{cm}^3$	35.80	36.20	35.20	36.30

Figure 14

In this titration, the accurate volumes of acid used that are within  $0.20 \text{ cm}^3$  of each other are considered concordant volumes.

Use the concordant results to calculate the mean volume of hydrochloric acid required.

(1)

mean volume = .....  $\text{cm}^3$

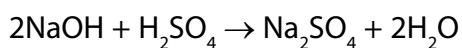
- (iii) During the titration, the indicator used changed colour at the end point.

Which of the following shows an indicator with the colour change that would be seen in this titration?

(1)

	indicator	colour in alkali	colour at end point
<input type="checkbox"/>	A phenolphthalein	colourless	pink
<input type="checkbox"/>	B phenolphthalein	pink	yellow
<input type="checkbox"/>	C methyl orange	red	yellow
<input type="checkbox"/>	D methyl orange	yellow	orange

- (c) In another titration, 25.0 cm<sup>3</sup> of a different sodium hydroxide solution is titrated with 0.200 mol dm<sup>-3</sup> sulfuric acid, H<sub>2</sub>SO<sub>4</sub>.



24.80 cm<sup>3</sup> of acid are required to neutralise 25.0 cm<sup>3</sup> of the sodium hydroxide solution.

Calculate the concentration of the sodium hydroxide solution, NaOH, in mol dm<sup>-3</sup>.

(4)

concentration = ..... mol dm<sup>-3</sup>

**(Total for Question 10 = 11 marks)**

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**TOTAL FOR PAPER = 100 MARKS**

# 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>P</b> phosphorus 15	16 <b>O</b> oxygen 8	17 <b>F</b> fluorine 9	18 <b>Ne</b> neon 10									
	19 <b>K</b> potassium 19	20 <b>Ca</b> calcium 20	23 <b>Sc</b> scandium 21	24 <b>Ti</b> titanium 22	25 <b>V</b> vanadium 23	26 <b>Cr</b> chromium 24	27 <b>Mn</b> manganese 25	28 <b>Fe</b> iron 26	29 <b>Co</b> cobalt 27	30 <b>Ni</b> nickel 28	31 <b>Cu</b> copper 29	32 <b>Zn</b> zinc 30	33 <b>Ga</b> gallium 31	34 <b>Ge</b> germanium 32	35 <b>As</b> arsenic 33	36 <b>Se</b> selenium 34	37 <b>Br</b> bromine 35	38 <b>Kr</b> krypton 36	
	39 <b>Rb</b> rubidium 37	40 <b>Sr</b> strontium 38	89 <b>Y</b> yttrium 39	90 <b>Zr</b> zirconium 40	91 <b>Nb</b> niobium 41	92 <b>Mo</b> molybdenum 42	93 <b>Tc</b> technetium 43	101 <b>Ru</b> ruthenium 44	102 <b>Rh</b> rhodium 45	103 <b>Pd</b> palladium 46	104 <b>Ag</b> silver 47	105 <b>Cd</b> cadmium 48	106 <b>In</b> indium 49	107 <b>Sn</b> tin 50	108 <b>Sb</b> antimony 51	109 <b>Te</b> tellurium 52	110 <b>I</b> iodine 53	111 <b>Xe</b> xenon 54	
	133 <b>Cs</b> caesium 55	137 <b>Ba</b> barium 56	139 <b>La*</b> lanthanum 57	178 <b>Hf</b> hafnium 72	179 <b>Ta</b> tantalum 73	180 <b>W</b> tungsten 74	181 <b>Re</b> rhenium 75	186 <b>Os</b> osmium 76	187 <b>Ir</b> iridium 77	188 <b>Pt</b> platinum 78	196 <b>Au</b> gold 79	201 <b>Hg</b> mercury 80	202 <b>Tl</b> thallium 81	204 <b>Pb</b> lead 82	208 <b>Bi</b> bismuth 83	209 <b>Po</b> polonium 84	210 <b>At</b> astatine 85	222 <b>Rn</b> radon 86	
	[223] <b>Fr</b> francium 87	[226] <b>Ra</b> radium 88	[227] <b>Ac*</b> actinium 89	[261] <b>Rf</b> rutherfordium 104	[262] <b>Db</b> dubnium 105	[266] <b>Sg</b> seaborgium 106	[268] <b>Mt</b> meitnerium 109	[277] <b>Hs</b> hassium 108	[271] <b>Ds</b> darmstadtium 110	[272] <b>Rg</b> roentgenium 111	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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