

Atomic Structure Homework task 1

Q1.

Magnesium is in Group 2 of the periodic table.

1.0 g of magnesium reacted with chlorine to produce magnesium chloride.

(a) Which types of element react when magnesium reacted with chlorine?

Tick (✓) **one** box.

A metal and a metal

A metal and a non-metal

A non-metal and a non-metal

(1)

(b) Write the word equation for the reaction when magnesium reacts with chlorine.

_____ + _____ → _____

(1)

(c) What apparatus was used to measure the mass of 1.0 g of magnesium?

Tick (✓) **one** box.

Balance

Beaker

Ruler

(1)

(d) What mass of magnesium chloride was produced?

Tick (✓) **one** box.

Less than 1.0 g

1.0 g

More than 1.0 g

(1)

(e) Magnesium reacts with oxygen to produce magnesium oxide.

Calculate the percentage mass of magnesium in magnesium oxide (MgO).

Relative atomic mass (A_r): Mg = 24

Relative formula mass (M_r): MgO = 40

Percentage mass of magnesium = _____ %

(2)

Magnesium carbonate decomposes to produce magnesium oxide and carbon dioxide.

The word equation for the reaction is:

magnesium carbonate → magnesium oxide + carbon dioxide

Four students heated 2.00 g of magnesium carbonate for 10 minutes.

The table below shows the results.

Mass of carbon dioxide produced in g				
Student 1	Student 2	Student 3	Student 4	Mean
0.97	0.91	0.50	0.95	X

(f) What is the most likely reason for **Student 3**'s anomalous result?

Tick (✓) **one** box.

The student heated more than 2.00 g of magnesium carbonate.

The student heated the magnesium carbonate for less than 10 minutes.

The student used a higher temperature.

(1)

(g) Calculate value **X** in the table above.

Do **not** use the anomalous result.

Give your answer to 2 significant figures.

X (2 significant figures) = _____ g

(3)

(Total 10 marks)

Q2.

This question is about the periodic table.

(a) **Figure 1** shows part of Mendeleev's version of the periodic table.

Figure 1

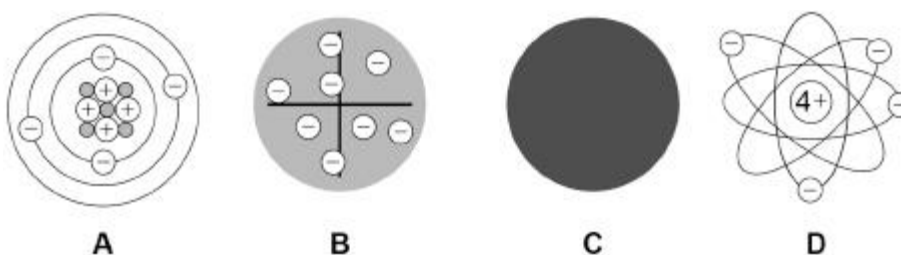
H							
Li	Be	B	C	N	O	F	
Na	Mg	Al	Si	P	S	Cl	
K	Ca		Ti	V	Cr	Mn	Fe Co Ni
Cu	Zn			As	Se	Br	
Rb	Sr	Y	Zr	Nb	Mo		Ru Rh Pd
Ag	Cd	In	Sn	Sb	Te	I	

Which group of elements had **not** been discovered when Mendeleev's version of the periodic table was published?

(1)

Figure 2 represents different models of the atom.

Figure 2



(b) Which model represents the plum pudding model?

Tick (✓) **one** box.

A B C D

(1)

(c) Which model resulted from Chadwick's experimental work?

Tick (✓) **one** box.

A B C D

(1)

Potassium has different isotopes.

(d) What is meant by 'isotopes'?

You should refer to subatomic particles.

(2)

(e) The table below shows the mass numbers and the percentage abundance of two isotopes of potassium.

Mass number	Percentage abundance
39	93.1
41	6.9

Calculate the relative atomic mass (A_r) of potassium.

Give your answer to 1 decimal place.

Relative atomic mass (1 decimal place) = _____

(3)

(Total 8 marks)

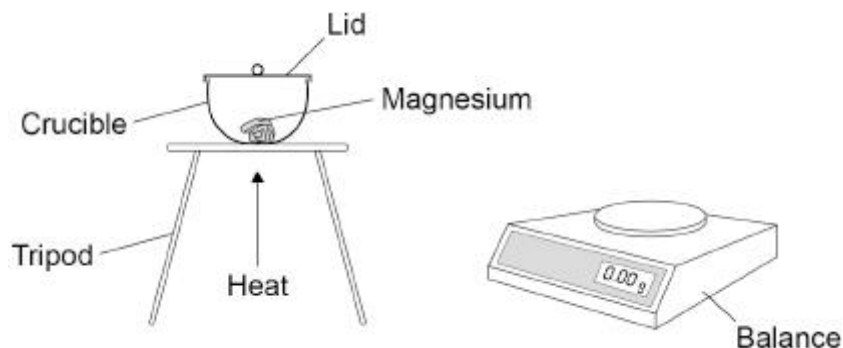
HIGHER TIER QUESTIONS

Q3.

Metal oxides are produced when metals are heated in air.

A student investigated the change in mass when 0.12 g of magnesium was heated in air.

The figure below shows the apparatus.



The student measured the mass of magnesium oxide produced.

- (a) 0.12 g of magnesium reacted to produce 0.20 g of magnesium oxide.

Calculate the number of moles of oxygen gas (O_2) that reacted.

Relative atomic mass (A_r): $O = 16$

Moles of oxygen gas = _____

(3)

- (b) The student repeated the experiment **without** a lid on the crucible.

Suggest why the mass of magnesium oxide produced would be different without a lid on the crucible.

(2)

- (c) Copper reacts with oxygen to produce copper oxide.

63.5 g of copper produces 79.5 g of copper oxide.

Calculate the mass of copper oxide produced when 0.50 g of copper reacts with

oxygen.

Give your answer to 3 significant figures.

Mass (3 significant figures) = _____ g

(3)

(d) Iron reacts with oxygen to produce an oxide of iron.

0.015 moles of iron reacts with 0.010 moles of oxygen gas (O₂).

Determine:

- the formula of the iron oxide produced
- the balanced symbol equation for the reaction.

Formula of iron oxide = _____

Balanced symbol equation

(4)

(Total 12 marks)

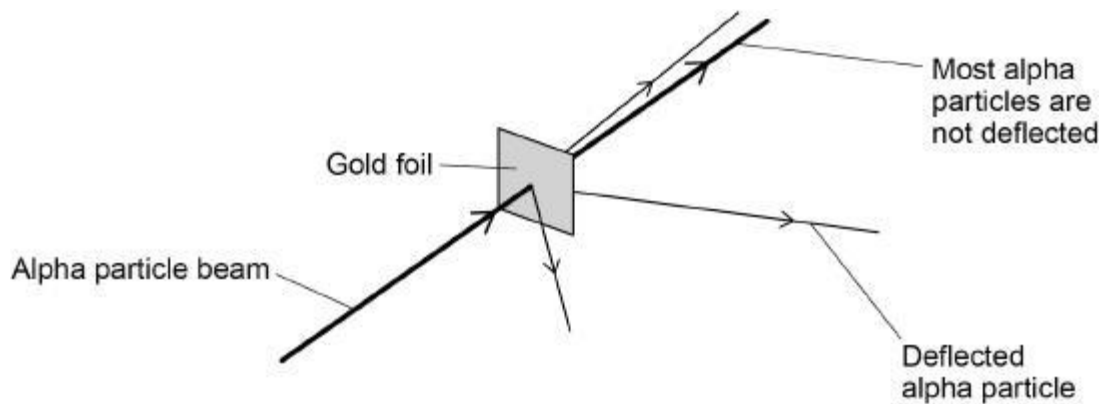
Q4.

This question is about gold and compounds of gold.

(a) In the alpha particle scattering experiment alpha particles are fired at gold foil.

Alpha particles are positively charged.

The diagram below shows the results.



What **two** conclusions can be made from the results?

Tick (✓) **two** boxes.

Atoms are balls of positive charge with embedded electrons.

Atoms are tiny spheres that cannot be divided.

Atoms have a positively charged nucleus.

Mass is concentrated in the nucleus in the centre of atoms.

Neutrons exist within the nucleus.

(b) The gold foil is:

- 4.00×10^{-7} metres thick
- 2400 atoms thick.

What is the diameter of one gold atom in metres?

Give your answer to 3 significant figures.

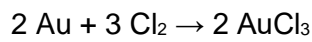
Diameter of one gold atom (3 significant figures) = _____ m

(3)

(c) Gold reacts with the elements in Group 7 of the periodic table.

0.175 g of gold reacts with chlorine.

The equation for the reaction is:



Calculate the mass of chlorine needed to react with 0.175 g of gold.

Give your answer in mg

Relative atomic masses (A_r): Cl = 35.5 Au = 197

Mass of chlorine = _____ mg

(5)

(Total 10 marks)

Mark schemes

Q1.

(a) a metal and a non-metal 1

(b) magnesium + chlorine → magnesium chloride
allow Mg for magnesium
allow Cl₂ for chlorine
allow MgCl₂ for magnesium chloride 1

(c) balance 1

(d) more than 1.0 g 1

(e) $(\% =) \frac{24}{40} \times 100$ 1

= 60 (%) 1

(f) the student heated the magnesium carbonate for less than ten minutes 1

(g) $\frac{0.97 + 0.91 + 0.95}{3}$ **or** $\frac{2.83}{3}$ 1

= 0.943333 (g)

allow for 1 mark
 $\frac{0.97 + 0.91 + 0.50 + 0.95}{4}$ **or** $\frac{3.33}{4}$
= 0.8325 (g)

= 0.94 (g)

allow an answer correctly rounded to 2 significant figures using values from the table

1

[10]

Q2.

(a) (Group) 0
or
noble gases 1

(b) B 1

(c) A 1

(d) (atoms with the) same number of protons

allow atoms with the same atomic number
allow atoms of the same element
ignore the same number of electrons

1

(but with) different numbers of neutrons

ignore (but with) different mass numbers

do **not** accept (but with) different relative atomic mass

1

(e)
$$\frac{(39 \times 93.1) + (41 \times 6.9)}{100}$$

1

= 39.138

1

= 39.1

allow correctly rounded answer to 1 decimal place from an incorrect calculation using all the values given in the question

1

[8]

Q3.

(a) (mass of oxygen = 0.20 – 0.12) = 0.08 (g)

1

(moles of oxygen) = $\frac{0.08}{32}$

1

= 0.0025

allow 1 mark for 0.005

if derived from $\frac{0.08}{16}$

1

(b) (without a lid the) mass of magnesium oxide was less

1

(because) products escaped allow magnesium oxide escaped

1

(c) (mass of copper oxide =)

$\frac{79.5}{63.5} \times 0.5$

1

= 0.62598 (g)

1

= 0.626 (g)

allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses all the values in the question

1

- (d) 3:2 ratio Fe : O₂ (molecules)
or
 3:4 ratio Fe : O (atoms) 1

(formula) Fe₃O₄

allow 1 mark for Fe₃O₂ from 3:2 ratio Fe : O (atoms) (MP2 but not MP1)

1

3 Fe + 2 O₂ → Fe₃O₄

allow multiples

allow correct use of incorrectly determined formula

allow 1 mark for Fe, O₂ and Fe₃O₄

or

allow 1 mark for Fe, O₂ and incorrectly determined formula

2

[12]

Q4.

- (a) atoms have a positively charged nucleus. 1

mass is concentrated in the nucleus in the centre of atoms.

1

- (b)

$$\frac{4 \times 10^{-7}}{2400}$$

1

$$= 1.66666 \times 10^{-10}$$

1

$$= 1.67 \times 10^{-10} \text{ (m)}$$

allow 0.000 000 000 167 (m)

allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses the values in the question

1

- (c) (moles Au = $\frac{0.175}{197}$ ⇒) 0.000888 1

$$\text{(moles Cl}_2 = 0.000888 \times \frac{3}{2} \text{ ⇒) } 0.00133$$

allow a correct calculation using an incorrectly calculated value of moles of gold

1

$$\text{(mass Cl}_2 \text{ ⇒) } 0.00133 \times 71$$

allow a correct calculation using an incorrectly calculated value of moles of chlorine

1

= 0.0946 (g)

1

= 94.6 (mg)

*allow a correct conversion using an incorrectly
calculated mass of chlorine*

1

alternative approach:

(from equation 2 moles of Au reacts with 3 moles of Cl₂)

(so) 394 g Au reacts with 213 g Cl₂ (1)

1 g Au reacts with ($\frac{213}{394}$ =)
0.54 g Cl₂ (1)

*allow a correct calculation using an incorrectly
calculated value of mass of gold and / or chlorine*

0.175 g Au reacts with

0.54 × 0.175 g Cl₂ (1)

*allow a correct calculation using an incorrectly
calculated value of mass of gold and / or chlorine*

= 0.0946 (g) (1)

= 94.6 (mg) (1)

*allow a correct conversion using an incorrectly
calculated mass of chlorine*

[10]