

C4 Chemical Calculations Homework task 1

Q1.

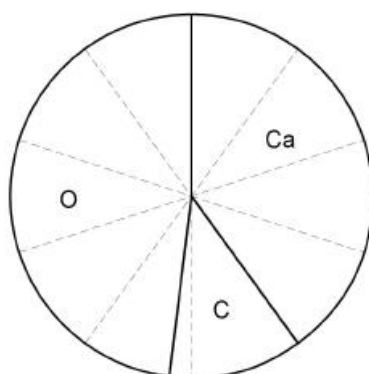
This question is about oxygen and compounds of oxygen.

- (a) What is the state symbol of oxygen at room temperature?

(1)

- (b) **Figure 1** shows the percentage by mass of the elements calcium, carbon and oxygen in calcium carbonate.

Figure 1



What is the percentage by mass of calcium in calcium carbonate?

Percentage = _____ %

(1)

- (c) At high temperature, sodium nitrate decomposes into sodium nitrite and oxygen.

A student heats three samples of sodium nitrate.

The mass of each sample was 4.50 g

The mass of solid after heating was recorded.

Table 1 shows the mass of solid after heating in each experiment.

Table 1

Experiment	Mass of solid after heating in g
1	3.76
2	3.98
3	4.09

Calculate the mean mass of solid after heating.

Give your answer to 3 significant figures.

Mean mass of solid after heating = _____ g

(3)

(d) **Table 2** shows the electronic structure of hydrogen and oxygen.

Table 2

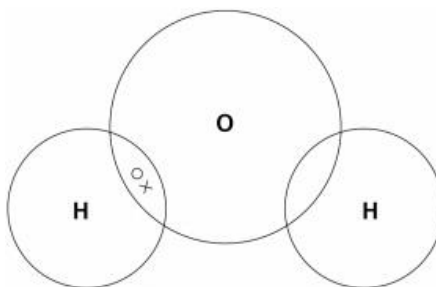
Element	Electronic structure
Hydrogen	1
Oxygen	2,6

Figure 2 shows part of a dot and cross diagram of a molecule of water (H_2O).

Complete the dot and cross diagram.

You should show only the electrons in the outer energy levels.

Figure 2



(2)

Oxygen and sulfur are examples of simple molecules.

(e) Complete the sentence.

Choose the answer from the box.

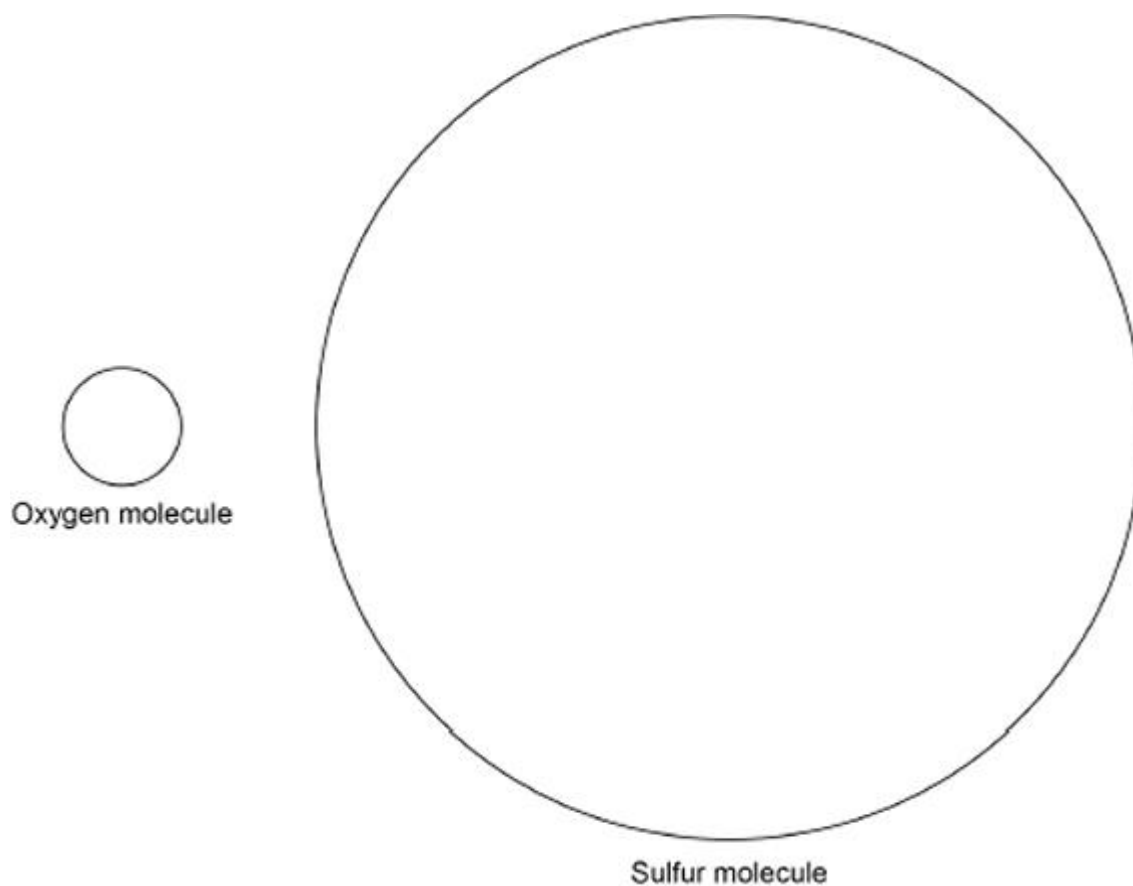
covalent	ionic	metallic
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There are _____ bonds between the atoms of oxygen in an oxygen molecule.

(1)

- (f) **Figure 3** shows the relative sizes of an oxygen molecule and a sulfur molecule.

Figure 3



How does the boiling point of sulfur compare with the boiling point of oxygen?

Complete the sentences.

The boiling point of sulfur is _____ the boiling point of oxygen.

This is because in sulfur the intermolecular forces are _____
than the intermolecular forces in oxygen.

(2)
(Total 10 marks)

Q2.

Iron is an essential part of the human diet. Iron(II) sulfate is sometimes added to white bread flour to provide some of the iron in a person's diet.



- (a) The formula of iron(II) sulfate is FeSO_4

Calculate the relative formula mass (M_r) of FeSO_4

Relative atomic masses: O = 16; S = 32; Fe = 56.

The relative formula mass (M_r) = _____

(2)

- (b) What is the mass of one mole of iron(II) sulfate? Remember to give the unit.

(1)

- (c) What mass of iron(II) sulfate would be needed to provide 28 grams of iron?

Remember to give the unit.

(1)

(Total 4 marks)

HIGHER TIER QUESTIONS

Q3.

This question is about atoms and isotopes.

- (a) Atoms contain protons, neutrons and electrons.

A lithium atom has the symbol ${}^7_3\text{Li}$

Explain, in terms of sub-atomic particles, why the mass number of this lithium atom is 7.

(3)

- (b) Amounts of substances can be described in different ways.

Complete the sentences.

One mole of a substance is the relative formula mass in

The relative atomic mass of an element compares the mass of an atom of an element with the mass of an atom of

(2)

- (c) Two isotopes of oxygen are ${}^{18}_8\text{O}$ and ${}^{16}_8\text{O}$

Describe the similarities and differences between the isotopes ${}^{18}_8\text{O}$ and ${}^{16}_8\text{O}$

You should refer to the numbers of sub-atomic particles in each isotope.

(3)

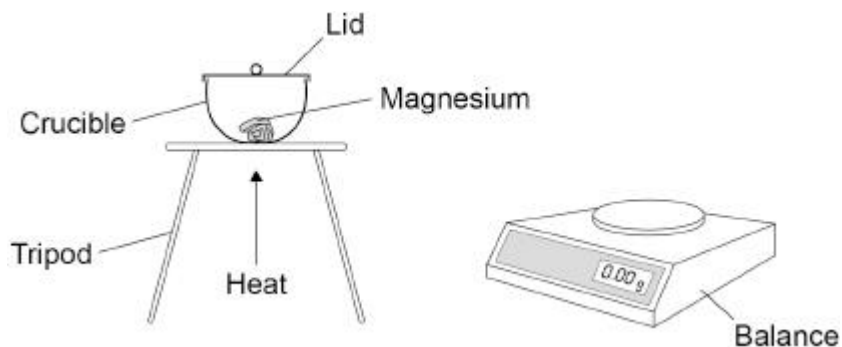
(Total 8 marks)

Q4.

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)

Mark schemes

Q1.

(a) (g)

*allow g
ignore formulae*

1

(b) 40 (%)

1

(c)

$$\frac{3.76 + 3.98 + 4.09}{3} \quad \text{or} \quad \frac{11.83}{3}$$

an answer of 3.94 (g) scores 3 marks

$$= 3.943(33333333333333333333)$$

1

$$= 3.94 \text{ (g)}$$

*allow a correctly written answer to 3 significant figures from
an incorrectly calculated mean*

1

(d) one shared pair in each overlap

*allow combination of circles, dots, crosses or e⁽⁻⁾
do **not** accept extra electron(s) on outer shell of hydrogen*

1

4 non-bonding electrons in outer shell of oxygen

ignore any inner shell electrons

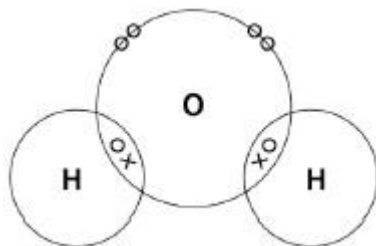


diagram scores 2 marks

1

(e) covalent

1

(f) higher (than)

1

stronger
(than between oxygen molecules)

1

[10]

Q2.

- (a) 152 correct answer with **or** without working = **2 marks**
 56 + 32 + (4 × 16) gains **1** mark
ignore any units 2
- (b) 152g(rams)
*ecf from the answer to (a) and **g***
must have unit g / gram / gramme / grams etc
*accept **g** / mol **or g** per mole **or g mole⁻¹** **or g/mol** **or g per mol** **or g mol⁻¹***
*do **not** accept g m*
*do **not** accept G* 1
- (c) 76(g)
ecf from their answer to (a) or (b) divided by 2
ignore units 1

[4]

Q3.

- (a) because this lithium atom has
 3 protons 1
 and 4 neutrons 1
 mass number is total of neutrons and protons
accept protons and neutrons have a mass of 1
accept number of neutrons = 7 - 3(protons)
ignore mass of electron is negligible 1
- (b) grams
accept g 1
¹²C
*allow carbon-12 **or** C-12*
*ignore hydrogen **or** H* 1
- (c) any **three** from:
max 2 if no numbers given
numbers if given must be correct
- both have 8 protons
accept same number of protons
 - ¹⁸O has 10 neutrons
 - ¹⁶O has 8 neutrons

accept different number of neutrons or ^{18}O has two more neutrons for 1 mark

- both have 8 electrons.

accept same number of electrons

3

[8]

Q4.

- (a) (mass of oxygen = $0.20 - 0.12$) = 0.08 (g)

1

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

1

$$= 0.0025$$

allow 1 mark for 0.005

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

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

$$= 0.62598 \text{ (g)}$$

1

$$= 0.626 \text{ (g)}$$

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 : O_2 (molecules)

or

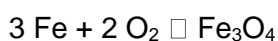
3:4 ratio Fe : O (atoms)

1

(formula) Fe_3O_4

allow 1 mark for Fe_3O_2 from 3:2 ratio Fe : O (atoms) (MP2 but not MP1)

1



allow multiples

allow correct use of incorrectly determined formula

allow 1 mark for Fe, O_2 and Fe_3O_4

or

allow 1 mark for Fe, O₂ and incorrectly determined formula

2

[12]