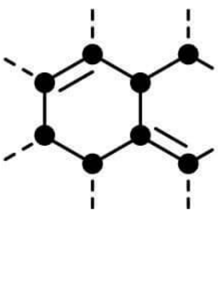
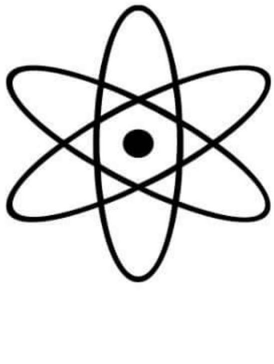
Swakeleys School FOR GIRLS

GCSE to A-LEVEL Chemistry transition booklet





Moving from GCSE Science to A Level can be a daunting leap. You'll be expected to remember a lot more facts, equations, and definitions, and you will need to learn new maths skills and develop confidence in applying what you already know to unfamiliar situations. This worksheet aims to give you a head start by helping you:

- to pre-learn some useful knowledge from the first chapters of your A Level course
- understand and practise of some of the maths skills you'll need.

Learning objectives

After completing the worksheet you should be able to:

- define practical science key terms
- recall the answers to the retrieval questions
- perform maths skills including:
    - ➔ converting between units and standard form and decimals
    - ➔ balancing chemical equations
    - ➔ rearranging equations
    - ➔ calculating moles and masses
    - ➔ calculating percentage yield and percentage error
    - ➔ interpreting graphs of reactions.

Part 1 - Skills in chemistry

1. Vocabulary for practical work

There are many words used in practical work, many of which you may recognise from your GCSE studies. Please complete the glossary for these command words.

Key word	Definition
Accuracy	
Anomaly	
Categoric	
Variable	
Continuous variable	
Control variable	
Dependent variable	
Independent variable	
Measurement error	
Precision	
Random error	
Repeatable	
Reproducible	
Resolution	
Systematic error	
True value	
Uncertainty	
Validity	
Zero error	

2. Atomic structure

Learn the answers to the questions below then cover the answers column with a piece of paper and write as many answers as you can. Check and repeat.

What does an atom consist of?	a nucleus containing protons and neutrons, surrounded by electrons
What are the relative masses of a proton, neutron, and electron?	1, 1, and $\frac{1}{1840}$ respectively
What are the relative charges of a proton, neutron, and electron?	+1, 0, and -1 respectively
How do the number of protons and electrons differ in an atom?	they are the same because atoms have neutral charge
What force holds an atomic nucleus together?	strong nuclear force
What is the atomic number of an element?	the number of protons in the nucleus of a single atom of an element
What is the mass number of an element?	number of protons + number of neutrons
What is an isotope?	an atom with the same number of protons but different number of neutrons
What is an ion?	an atom, or group of atoms, with a charge
What is the function of a mass spectrometer?	it accurately determines the mass and abundance of separate atoms or molecules, to help us identify them
What is a mass spectrum?	the output from a mass spectrometer that shows the different isotopes that make up an element
What is the total number of electrons that each electron shell (main energy level) can contain?	$2n^2$ electrons, where n is the number of the shell
How many electrons can the first three electron shells hold each?	2 electrons (first shell), 8 electrons (second shell), 18 electrons (third shell)
What are the first four electron sub-shells (orbitals) called?	s, p, d, and f (in order)
How many electrons can each orbital hold?	a maximum of 2 electrons
Define the term ionisation energy, and give its unit	the energy it takes to remove a mole of electrons from a mole of atoms in the gaseous state, unit = kJ mol^{-1}
What is the equation for relative atomic mass (A_r)?	relative atomic mass = $\frac{\text{average mass of 1 atom}}{\frac{1}{12}^{\text{th}} \text{ mass of 1 atom of } ^{12}\text{C}}$
What is the equation for relative molecular mass (M_r)?	relative molecular mass = $\frac{\text{average mass of 1 molecule}}{\frac{1}{12}^{\text{th}} \text{ mass of 1 atom of } ^{12}\text{C}}$

Part 2 - Maths skills in chemistry

1. Standard form

In science, very large and very small numbers are usually written in standard form.

Standard form is writing a number in the format $A \times 10^x$ where A is a number from 1 to 10 and x is the number of places you move the decimal place.

For example, to express a large number such as 50 000 mol dm^{-3} in standard form,

A = 5 and x = 4 as there are four numbers after the initial 5.

Therefore, it would be written as 5×10^4 mol dm^{-3}.

To give a small number such as 0.000 02 Nm^2 in standard form, A = 2 and there are

five numbers before it so x = −5.

Please complete the table:

Number	Standard Form	Number	Standard Form
8 937	8.937×10^3	0.001 68	
6 832 000 000	6.832×10^9	0.000 009 36	
0.02678	2.678×10^{-2}		6.73×10^{-4}
0.000 000 000 000 376	3.76×10^{-13}		3.193×10^5
8 245 000	8.245	602 000 000 000 000 000 000 000	

So it is written as 2×10−5 Nm^2.

2. Significant figures and decimals

1. Give the following values in the stated number of significant figures (s.f.).

a) 36.937 (3 s.f.)

b) 258 (2 s.f.)

c) 0.043 19 (2 s.f.)

d) 7 999 032 (1 s.f.)

2. Use the equation: number of molecules = number of moles × 6.02 × 10^{23} molecules per mole to calculate the number of molecules in 0.5 moles of oxygen. Write your answer in standard form to 3 s.f.

3. Give the following values in the stated number of decimal places (d.p.).

a) 4.763 (1 d.p.)

b) b 0.543 (2 d.p.)

c) c 1.005 (2 d.p.)

d) d 1.9996 (3 d.p.)

3. Converting units

Units

Scientists often use a **prefix** on the front of the unit.

terra (T)	x 10^{12}	1 000 000 000 000
giga (G)	x 10^{9}	1 000 000 000
mega (M)	x 10^{6}	1 000 000
kilo (k)	x 10^{3}	1 000
milli (m)	x 10^{-3}	0.001
micro (μ)	x 10^{-6}	0.000 001
nano (n)	x 10^{-9}	0.000 000 001
pico (p)	x 10^{-12}	0.000 000 000 001

1.28 mm	1.28 x 10^{-3} m	1.28 x 10^{-3} m	0.001 28m
786 pm	786 x 10^{-12} m	7.86 x 10^{-10} m	0.000 000 000 786

Questions

1. Complete the table after the examples shown:

Distance	In metres		
	Working	Standard form	Full number
375 Gm			
128 nm			
0.786 nm			
35 mm			
20.1 Tm			

2. The radius of a hydrogen atom is 25 pm. Write this in metres in both standard form and as a full number.

standard form .... full number ....

3. The radius of a copper atom is 0.135 nm. Write this in metres in both standard form and as a full number.

standard form .... full number ....

4. The radius of a carbon atom is 70 pm. The nucleus is 10000 times smaller. Give the radius of a carbon nucleus in metres in both standard form and as a full number.

standard form .... full number ....

5. The radius of a nitrogen atom is 65 pm. The radius of a silver atom is 0.160 nm. Give the radius of both atoms in standard form in metres and state which atom is bigger.

nitrogen atom .... silver atom .... larger atom = ...

6. The diameter of a carbon atom is 140 pm. How many carbon atoms would fit in a line of carbon atoms 0.30 m long? Show your working and give your answer to 3sf.

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7 The diameter of a copper atom is 0.270 nm. How many copper atoms would fit in a line of copper atoms 50 cm long? Show your working and give your answer to 3sf.

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3. Balancing equations

When new substances are made during chemical reactions, atoms are not created or destroyed – they just become rearranged in new ways.

So, there is always the same number of each type of atom before and after the reaction, and the total mass before the reaction is the same as the total mass after the reaction.

This is known as the conservation of mass.

You need to be able to use the principle of conservation of mass to write formulae, and balanced chemical equations and half equations.

The equation below shows the correct formulae but it is not balanced.

$H_2 + O_2 \rightarrow H_2O$

While there are two hydrogen atoms on both sides of the equation, there is only one oxygen atom on the right-hand side of the equation against two oxygen atoms on the left-hand side.

Therefore, a two must be placed before the H_2O. $H_2 + O_2 \rightarrow 2H_2O$

Now the oxygen atoms are balanced but the hydrogen atoms are no longer balanced.

A two must be placed in front of the H2. $2H_2 + O_2 \rightarrow 2H_2O$

The number of hydrogen and oxygen atoms is the same on both sides, so the equation is balanced

1. Balance the following equations.
    a) $C + O_2 \rightarrow CO$
    b) $N_2 + H_2 \rightarrow NH_3$

c) $C_2H_4 + O_2 \rightarrow H_2O + CO_2$

2. Balance the equations below.

a) $C_6H_{14} + O_2 \rightarrow CO_2 + H_2O$

b) $NH_2CH_2COOH + O_2 \rightarrow CO_2 + H_2O + N_2$

3. Balance the equations below.

a) $Mg(OH)_2 + HNO_3 \rightarrow Mg(NO_3)_2 + H_2O$

b) $Fe(NO_3)_2 + Na_3PO_4 \rightarrow Fe_3(PO_4)_2 + NaNO_3$

4. Molar calculations

Look at this worked example. A student heated 2.50 g of calcium carbonate, which decomposed as shown in the equation:

$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$

The molar mass of calcium carbonate is 100.1 g mol^{-1}.

a Calculate the amount, in moles, of calcium carbonate that decomposes.

$$n = \frac{m}{M} = 2.50/100.1 = 0.025\ \text{mol}$$

b Calculate the amount, in moles, of carbon dioxide that forms.

From the balanced equation, the number of moles of calcium carbonate = number of moles of carbon dioxide = 0.025 mol

Practice questions

1 In a reaction, 0.486 g of magnesium was added to oxygen to produce magnesium oxide.

$2Mg(s) + O_2(g) \rightarrow 2MgO(s)$

a Calculate the amount, in moles, of magnesium that reacted.

b Calculate the amount, in moles, of magnesium oxide made.

c Calculate the mass, in grams, of magnesium oxide made.

2 Oscar heated 4.25 g of sodium nitrate. The equation for the decomposition of sodium nitrate is:

$2NaNO_3(s) \rightarrow 2NaNO_2(s) + O_2(g)$

a Calculate the amount, in moles, of sodium nitrate that reacted.

b Calculate the amount, in moles, of oxygen made.

3 0.500 kg of magnesium carbonate decomposes on heating to form magnesium oxide and carbon dioxide. Give your answers to 3 significant figures.

$MgCO_3(s) \rightarrow MgO(s) + CO_2(g)$

a Calculate the amount, in moles, of magnesium carbonate used.

b Calculate the amount, in moles, of carbon dioxide produced.

Answers

Balancing equations

2 Balancing chemical equations

1 **a** $2C + O_2 \rightarrow 2CO$ **b** $N_2 + 3H_2 \rightarrow 2NH_3$

c $C_2H_4 + 3O_2 \rightarrow 2H_2O + 2CO_2$

2 **a** $C_6H_{14} + 9\frac{1}{2}O_2 \rightarrow 6CO_2 + 7H_2O$ **or** $2C_6H_{14} + 19O_2 \rightarrow 12CO_2 + 14H_2O$

b $2NH_2CH_2COOH + 4\frac{1}{2}O_2 \rightarrow 4CO_2 + 5H_2O + N_2$

or $4NH_2CH_2COOH + 9O_2 \rightarrow 8CO_2 + 10H_2O + 2N_2$

3 **a** $Mg(OH)_2 + 2HNO_3 \rightarrow Mg(NO_3)_2 + 2H_2O$

b $3Fe(NO_3)_2 + 2Na_3PO_4 \rightarrow Fe_3(PO_4)_2 + 6NaNO_3$

4 Molar calculations

1 **a** $\frac{0.486}{24.3} = 0.02$ mol **b** 0.02 mol

c $0.02 \times 40.3 = 0.806$ g

2 **a** $\frac{4.25}{85} = 0.05$ mol **b** $\frac{0.05}{2} = 0.025$ mol

3 **a** $\frac{500}{84.3} = 5.93$ mol **b** 5.93 mol