Preparing to begin A-level Chemistry

at

Hereford Sixth Form College

Introduction

These pages aim to make sure that your knowledge and understanding from GCSE have put you in a good place to begin the A-level work next year. They focus on topics from GCSE and key skills (especially Maths skills) which will continue to be really important as you move on to a broader and deeper understanding at A-level.

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A1.2 Multiplying and dividing

If there's a division we can multiply both sides. Let's consider the very familiar equation for *velocity*:

$$ὺ \quad \frac{\quad}{\quad}$$

If we want to make *distance* the subject, we need to spot that *distance* is currently being divided by *time*. So, let's multiply both sides by time. This is what happens:

$$ὺ \quad \frac{\quad}{\quad}$$

But *time/time* is just equal to 1. So we end up with:

$$ὺ$$

Which is what we wanted to do.

What if we wanted to make ***time*** the subject?

Look at the last equation above. We are multiplying *time* by *velocity*. Let's divide both sides by *velocity* to get rid of it from the left-hand side. We end up with:

$$\frac{ὺ}{ὺ} \quad \frac{\quad}{ὺ}$$

But again, divide a quantity by itself gives you 1. So we end up with:

$$\frac{\quad}{ὺ}$$

Which is what we wanted to do.

A2 Significant Figures

A2.2 Your turn.

Write the following numbers to the specified number of significant figures.

i. 1.345 *to 3 significant figures* *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*

ii. 3.14159265 *to 5 significant figures* *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*

iii.

A3 Standard form

A3.1 What is standard form?

It is very common in science to give numbers – especially very small or very big ones – in standard form:

e.g. 52171 can be written as 5.2171×10^4 and 0.0000337 is 3.37×10^{-5}

They all have an index: this is the number written as a superscript. This tells us how many tens are in the multiplication we do to form that number. For example, 10^2 tells us that we have carried out 10x10. 10^3 says 10x10x10 and so on.

The number in front tells us how many “lots” of this we have. So, 1.2×10^2 tells us that we have carried out 10x10 to arrive at 100, then we have 1.2 “lots” of this, so (1.2 x 100) or 120.

A4.3 Converting volume units.

How many cm^2 are in 1 m^2? It's not 100!

Remember that we calculate area by multiplying two lengths together. So an area of 1m2 is calculated by multiplying: 1 m x 1 m. This is actually 100 cm x 100 cm so in cm^2, the area is 100 cm x 100 cm = 10,000 cm^2. The conversion factor is 10,000.

So, convert the lengths before working out the area.

Now, volumes are calculated by multiplying three lengths. 1 m^3 is calculated by multiplying: 1 m x 1m x 1 m. This is 100 cm x 100 cm x 100 cm = 1,000,000 cm^3. 1 m^3 is a lot of cm^3! The conversion factor is 1,000,000.

So, convert the lengths before working out the volume.

A4.4 Your turn. Convert the following volumes. Bear in mind what you learned earlier: when you convert, are you making the number bigger or smaller? Are you multiplying or dividing?

. 3

. 30,000 .

. 1.6

iii.

A6 Answers to self-marked Maths skills questions

A1.4 Your turn.

Make C the subject of the following equations. Keep applying addition, subtraction, multiplication or division to each side until you get it. Or, move quantities diagonally if they're multiplying or dividing.

. .

.

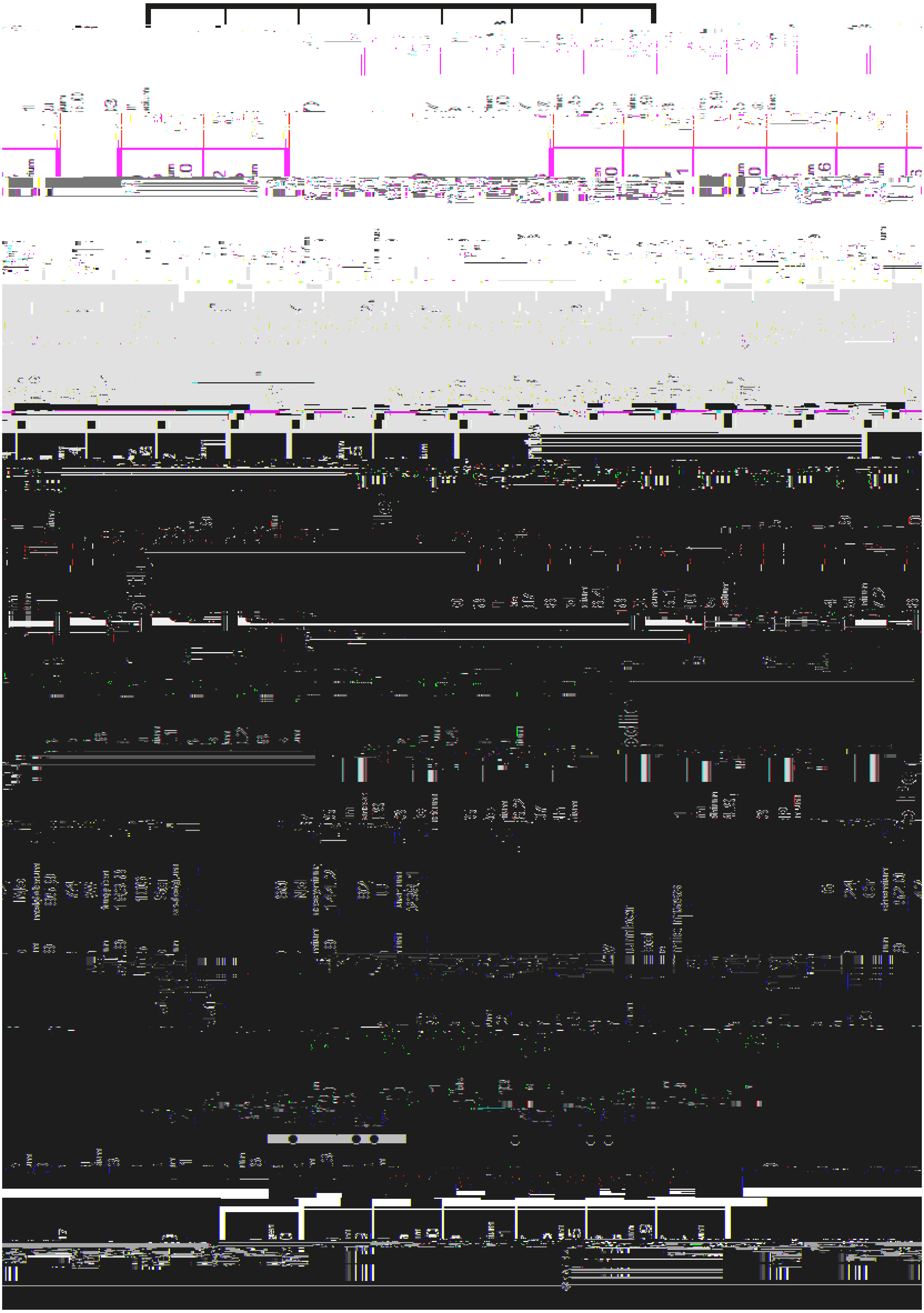
A3.4 Your turn

Write the following in standard form. If it’s not clear, assume 2 significant figures.

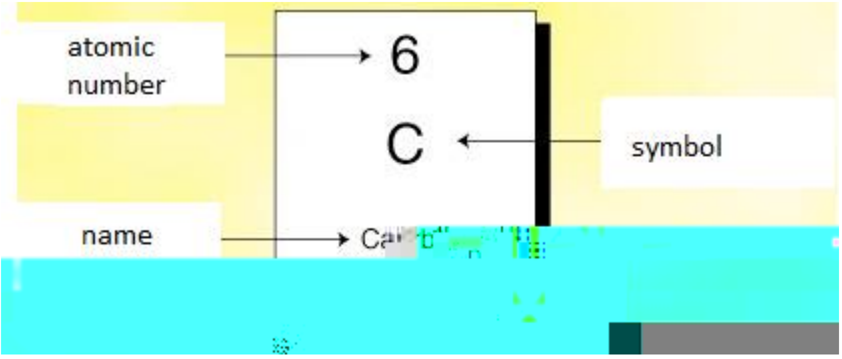
. 100,000	$1x10^{5}$	. 130	$1.3x10^{2}$
. 150,000	$1.5x10^{5}$	ὺ. 0.001	$1x10^{-3}$
ὺ. 0.000067	$6.7x10^{-5}$		

A4.2 Your turn. Convert the following numbers. Think about whether you are making the number larger or smaller.

. 5	5000 m	. 0.3



Each element has its own square on the table which includes three key pieces of information:



The atomic number is the number of protons in the nucleus of an atom of that element. It defines the element. This number does not change in chemical reactions. Changing the nucleus is in the domain of physicists.

The relative atomic mass is the average mass of an atom of an element. More about this later.

B1.2 Your turn

1. You've probably never met any rubidium (atomic number 37) but see if you can predict what sort of properties it might have, from its position in the table.

i. How many electrons in the outer shell?
ii. How many shells does it have?
iii. Will it react by giving electrons or receiving them? (think about elements in the group)
iv. Will it tend to form a cation or an anion?
v. Will the products of its reaction with water be acidic or alkaline?
vi. Will it be reactive or relatively inert?

2. Which elements are these?

Group 14 (old group 4), Period 3

2 shells, 7 electrons in the outer shell

B2 Atoms and Ions

B2.1 What's inside an atom or ion?

Atoms are of protons and neutrons (which are packed together in the nucleus) and electrons, which occupy most of the space in the atom, outside the nucleus. You need to know the basic properties of these particles:

PARTICLE	RELATIVE MASS	CHARGE
Proton	1	+1
Neutron	1	0
Electron	approx. 1/2000	-1

A few key points:

B3.5 Relative formula mass, r

Relative formula mass lets us work with substances with more than one atom in their formula by simply adding up the individual relative atomic masses to get the relative formula mass (M_r).

Oxygen exists as molecules made up of pairs of oxygen atoms, so its formula is O_2. The relative formula mass is therefore:

$$M_r = 2 \times A_r = 2 \times 16.0 = 32.0 \text{ for } O_2.$$

Sodium oxide has the formula Na_2O. So its M_r is given by:

$$2 \times A_r \text{ of sodium} + A_r \text{ of oxygen} = (2 \times 23.0) + 16.0 = 62.0$$

So 1 mole of oxygen molecules has a mass of 32.0 g. This isn't the same as 1 mole of oxygen atoms – this would have a mass of 16.0, because we're not counting the same thing. 1 mole of N atoms has a mass of about 14.0. 1 mole of N_2 molecules has a mass of about 28 g though.

- One mole of any substance has a mass (in grams) equal to the relative formula mass (M_r) of the substance.

B3.6 Your turn

1. What is the relative formula mass of CH_4?

2. What would be the mass of 2 moles of CH_4 molecules?

3. A molecule containinmpnlyiboeld3(y)]TETa@0.000008871 0 595.32 841.92 reW*nBT/F1 11.04 Tf1 0 0 1 270.04 256.4

B4 Structure and Bonding

There are basically 3 ways in which atoms can form strong bonds to other atoms:

Ionic bonding is electrostatic attraction between oppositely charged ions. It most commonly occurs when a metal forms a compound with a non-metal

When metals in the main groups of the Periodic Table (it's more complex for the transition elements) react with non-metals, the metal atoms usually lose all of their outer shell electrons to

B5.2 Your turn

1. Balance the following by adding balancing numbers.

i.	C	+	H_2	→	CH_4		
ii.	Si	+	Cl_2	→	$SiCl_4$		
iii.	H_2	+	F_2	→	HF		
iv.	CH_4	+	O_2	→	CO_2	+	H_2O

2. Write the name and the symbol for what you get when:

   (i) An oxygen atom gains two electrons. O^{2-}

   (ii) An aluminium atom loses three electrons Al^{3+}

B3.2 Your turn

1. Sulfur occurs as a mixture of 3 isotopes: ^{32}S: 94.9% ^{33}S: 0.80% ^{34}S : 4.3%.
   Calculate the relative atomic mass of sulfur.

$$\frac{(32x94.9) + (33x0.8) + (34x4.3)}{100} = 32.09$$

B3.4 Your turn

1. What is the mass of 3 moles of fluorine atoms?
   1 mole has a mass of 19.0 g so 3 moles has a mass of 3x19.0 g = 57.0 g
2. How many atoms are there?
   Each mole has N_A atoms, so 3 moles has 3xN_A or 3x6.022x10^{23} = 18.066x10^{23} (or 1.8066x10^{24})
3. A sample of Ne (neon) atoms has a mass of 4.0 g. How many moles is this?
   One mole has a mass of 20.2 g. So 4.0 g is 4/20.2 = 0.20 mole
4. How many atoms are in the sample of Neon?
   1 mole has N_A atoms so 0.20 mole has 0.20 x N_A = 1.2x10^{23}

B3.6 Your turn

1. What is the relative formula mass of CH_4?
   12.0 + 4(1.0) = 16.0
2. What would be the mass of 2 moles of CH_4 molecules?
   One mole would have a mass of 16.0 g, so 2 moles has a mass of 2x16.0 = 32.0 g
3. A molecule containing only carbon and hydrogen has a relative formula mass of 44.0. It has 3 carbon atoms. How many H atoms are there?
   3 C atoms have a combined mass of 3x12.0 = 36.0. This leaves a mass of 44.0-36.0 = 8.0 which is 8.0/1.0 = 8 hydrogens. 3 carbons and 8 hydrogens together have a formula C_3H_8.