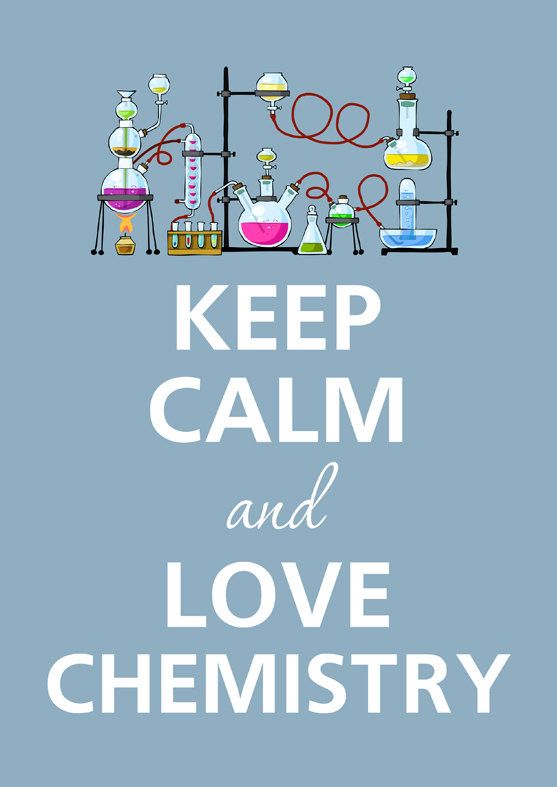
**Transition Pack for A Level Chemistry**

**A Level Chemistry Summer Holiday Homework – please email Dr Piercy on** [**rpi@cdarwin.com**](mailto:rpi@cdarwin.com) **if you need further guidance or support.**

1. Read through the transition pack provided, do any of the tasks therein you wish.
2. **Complete the baseline assessment at the end of the transition pack provided – this will be collected when you start in September**
3. Ensure you remember your GCSE chemistry (much is covered in the transition pack).
4. **There will be a week 6 assessment in October which will include some of this work.**

**Get ready for A-level!**

**A guide to help you get ready for A-level Chemistry, including everything from topic guides to days out and online learning courses.**



So you are considering A Level Chemistry?

This pack contains a programme of activities and resources to prepare you to start an A level in Chemistry in September. It is aimed to be used after you complete your GCSE, throughout the remainder of the summer term and over the Summer Holidays to ensure you are ready to start your course in September.

**Videos to watch online**

**Rough science – the Open University – 34 episodes available**

Real scientists are ‘stranded’ on an island and are given scientific problems to solve using only what they can find on the island.

Great fun if you like to see how science is used in solving problems.

There are six series in total

<http://www.dailymotion.com/playlist/x2igjq_Rough-Science_rough-science-full-series/1#video=xxw6pr>

or

<https://www.youtube.com/watch?v=lUoDWAt259I>

**A thread of quicksilver – The Open University**

A brilliant history of the most mysterious of elements – mercury. This program shows you how a single substance led to empires and war, as well as showing you come of the cooler properties of mercury.

https://www.youtube.com/watch?v=t46lvTxHHTA

**10 weird and wonderful chemical reactions**

10 good demonstration reactions, can you work out the chemistry of …. any… of them?

<https://www.youtube.com/watch?v=0Bt6RPP2ANI>

**Pre-Knowledge Topics**

**Chemistry topic 1 – Electronic structure, how electrons are arranged around the nucleus**

A periodic table can give you the proton / atomic number of an element, this also tells you how many electrons are in the ***atom***.

**You will have used the rule of electrons shell filling, where:**

The first shell holds up to 2 electrons, the second up to 8, the third up to 8 and the fourth up to 18 (or you may have been told 8).

 Atomic number =3, electrons = 3, arrangement 2 in the first shell and 1 in the second or

Li = 2,1

At **A level** you will learn that the electron structure is more complex than this, and can be used to explain a lot of the chemical properties of elements.

The ‘shells’ can be broken down into ‘orbitals’, which are given letters:’s’ orbitals, ‘p’ orbitals and ‘d’ orbitals.

You can read about orbitals here:

<http://www.chemguide.co.uk/atoms/properties/atomorbs.html#top>

**Chemistry topic 2 – Oxidation and reduction**

At GCSE you know that oxidation is adding oxygen to an atom or molecule and that reduction is removing oxygen, or that oxidation is removing hydrogen and reduction is adding hydrogen. You may have also learned that oxidation is removing electrons and reduction is adding electrons.

At A level we use the idea of ***oxidation number*** a lot!

You know that the metals in group 1 react to form ions that are +1, i.e. Na+ and that group 7, the halogens, form -1 ions, i.e. Br-.

We say that sodium, when it has reacted has an oxidation number of +1 and that bromide has an oxidation number of -1.

All atoms that are involved in a reaction can be given an oxidation number.

An element, Na or O2 is always given an oxidation state of zero (0), any element that has reacted has an oxidation state of + or -.

As removing electrons is **reduction**, if, in a reaction the element becomes **more** negative it has been reduced, if it becomes more positive it has been oxidised.

-5 0 +5

You can read about the rules for assigning oxidation numbers here:

<http://www.dummies.com/how-to/content/rules-for-assigning-oxidation-numbers-to-elements.html>

Elements that you expect to have a specific oxidation state actually have different states, so for example you would expect chlorine to be -1, it can have many oxidation states: NaClO, in this compound it has an oxidation state of +1

There are a few simple rules to remember:

Metals have a + oxidation state when they react.

Oxygen is ‘king’ it always has an oxidation state of -2

Hydrogen has an oxidation state of +1 (except metal hydrides)

The charges in a molecule must cancel.

Examples: Sodium nitrate, NaNO3 sulfate ion, SO42-

Na +1 3x O2- 4xO2- and 2- charges ‘showing’

+1 -6 -8 -2

To cancel: N = +5 S = +6

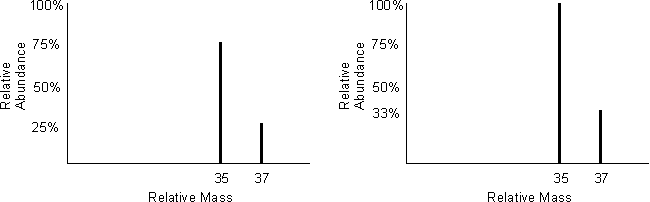
**Chemistry topic 3 – Isotopes and mass**

You will remember that an isotopes are elements that have differing numbers of neutrons. Hydrogen has 3 isotopes;

Isotopes occur naturally, so in a sample of an element you will have a mixture of these isotopes. We can accurately measure the amount of an isotope using a **mass spectrometer**. You will need to understand what a mass spectrometer is and how it works at A level. You can read about a mass spectrometer here:

<http://www.kore.co.uk/tutorial.htm>

<http://filestore.aqa.org.uk/resources/chemistry/AQA-7404-7405-TN-MASS-SPECTROMETRY.PDF>

A mass spectrum for the element chlorine will give a spectrum like this:

75% of the sample consist of chlorine-35, and 25% of the sample is chlorine-37.

Given a sample of naturally occurring chlorine ¾ of it will be Cl-35 and ¼ of it is Cl-37. We can calculate what the **mean** mass of the sample will be:

Mean mass = 75 x 35 + 25 x 37 = 35.5

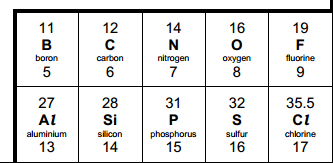
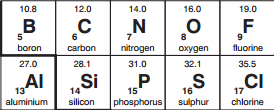
100 100

If you look at a periodic table this is why chlorine has an atomic mass of 35.5.

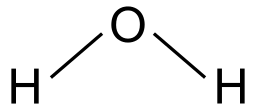
<http://www.avogadro.co.uk/definitions/ar.htm>

An A level periodic table has the masses of elements recorded much more accurately than at GCSE. Most elements have isotopes and these have been recorded using mass spectrometers.

**GCSE A level**

Given the percentage of each isotope you can calculate the mean mass which is the accurate atomic mass for that element.

**Chemistry topic 4 – The shapes of molecules and bonding.**

Have you ever wondered why your teacher drew a water molecule like this?

The lines represent a covalent bond, but why draw them at an unusual angle?

If you are unsure about covalent bonding, read about it here:

<http://www.chemguide.co.uk/atoms/bonding/covalent.html#top>

At A level you are also expected to know how molecules have certain shapes and why they are the shape they are.

You can read about shapes of molecules here:

<http://www.chemguide.co.uk/atoms/bonding/shapes.html#top>

**Chemistry topic 5 – Chemical equations**

Balancing chemical equations is the stepping stone to using equations to calculate masses in chemistry.

There are loads of websites that give ways of balancing equations and lots of exercises in balancing.

Some of the equations to balance may involve strange chemical, don’t worry about that, the key idea is to get balancing right.

<http://www.chemteam.info/Equations/Balance-Equation.html>

This website has a download; it is safe to do so:

<https://phet.colorado.edu/en/simulation/balancing-chemical-equations>

**Chemistry topic 6 – Measuring chemicals – the mole**

From this point on you need to be using an A level periodic table, not a GCSE one you can view one here:

<https://www.ocr.org.uk/Images/281617-periodic-table-of-the-elements-poster.pdf>

Now that we have our chemical equations balanced, we need to be able to use them in order to work out masses of chemicals we need or we can produce.

The ***mole*** is the chemists equivalent of a dozen, atoms are so small that we cannot count them out individually, we weigh out chemicals.

For example: magnesium + sulfur  magnesium sulfide

Mg + S  MgS

We can see that one atom of magnesium will react with one atom of sulfur, if we had to weigh out the atoms we need to know how heavy each atom is.

From the periodic table: Mg = 24.3 and S = 32.1

If I weigh out exactly 24.3g of magnesium this will be 1 mole of magnesium, if we counted how many atoms were present in this mass it would be a huge number (6.02 x 1023!!!!), if I weigh out 32.1g of sulfur then I would have 1 mole of sulfur atoms.

So 24.3g of Mg will react precisely with 32.1g of sulfur, and will make 56.4g of magnesium sulfide.

Here is a comprehensive page on measuring moles, there are a number of descriptions, videos and practice problems.

You will find the first 6 tutorials of most use here, and problem sets 1 to 3.

<http://www.chemteam.info/Mole/Mole.html>

**Chemistry topic 7 – Solutions and concentrations**

In chemistry a lot of the reactions we carry out involve mixing solutions rather than solids, gases or liquids.

You will have used bottles of acids in science that have labels saying ‘Hydrochloric acid 1M’, this is a solution of hydrochloric acid where 1 mole of HCl, hydrogen chloride (a gas) has been dissolved in 1dm3 of water.

The dm3 is a cubic decimetre, it is actually 1 litre, but from this point on as an A level chemist you will use the dm3 as your volume measurement.

<http://www.docbrown.info/page04/4_73calcs11msc.htm>

**Chemistry topic 8 – Titrations**

One key skill in A level chemistry is the ability to carry out accurate titrations, you may well have carried out a titration at GCSE, at A level you will have to carry them out very precisely **and** be able to describe in detail how to carry out a titration - there will be questions on the exam paper about how to carry out practical procedures.

You can read about how to carry out a titration here, the next page in the series (page 5) describes how to work out the concentration of the unknown.

<http://www.bbc.co.uk/schools/gcsebitesize/science/triple_aqa/further_analysis/analysing_substances/revision/4/>

Remember for any titration calculation you need to have a balanced symbol equation; this will tell you the ratio in which the chemicals react.

E.g. a titration of an unknown sample of sulfuric acid with sodium hydroxide.

A 25.00cm3 sample of the unknown sulfuric acid was titrated with 0.100moldm-3 sodium hydroxide and required exactly 27.40cm3 for neutralisation. What is the concentration of the sulfuric acid?

**Step 1**: the equation 2NaOH + H2SO4  Na2SO4 + 2H2O

**Step 2**; the ratios 2 : 1

**Step 3**: how many moles of sodium hydroxide 27.40cm3 = 0.0274dm3

number of moles = c x v = 0.100 x 0.0274 = 0.00274 moles

**step 4**: Using the ratio, how many moles of sulfuric acid

for every 2 NaOH there are 1 H2SO4 so, we must have 0.00274/2 =0.00137 moles of H2SO4

**Step 5**: Calculate concentration. concentration = moles/volume in dm3 = 0.00137/0.025 = ***0.0548 moldm-3***

Here are some additional problems, which are harder, ignore the questions about colour changes of indicators.

<http://www.docbrown.info/page06/Mtestsnotes/ExtraVolCalcs1.htm>

**Chemistry topic 9 – Organic chemistry – functional groups**

At GCSE you would have come across **hydrocarbons** such as alkanes (ethane etc) and alkenes (ethene etc). You may have come across molecules such as alcohols and carboxylic acids. At A level you will learn about a wide range of molecules that have had atoms added to the carbon chain. These are called functional groups, they give the molecule certain physical and chemical properties that can make them incredibly useful to us.

Here you are going to meet a selection of the functional groups, learn a little about their properties and how we give them logical names.

You will find a menu for organic compounds here:

<http://www.chemguide.co.uk/orgpropsmenu.html#top>

And how to name organic compounds here:

<http://www.chemguide.co.uk/basicorg/conventions/names.html#top>

**Chemistry topic 10 – Acids, bases, pH**

At GCSE you will know that an acid can dissolve in water to produce H+ ions, at A level you will need a greater understanding of what an acid or a base is.

Read the following page and answer the questions

<http://www.chemguide.co.uk/physical/acidbaseeqia/theories.html#top>

<http://www.chemguide.co.uk/physical/acidbaseeqia/acids.html#top>

**YEAR 11 INTO YEAR 12 TRANSITION WORK**

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| **Activity 1 Scientific vocabulary: Designing an investigation** |
| Link each term on the left to the correct definition on the right. |

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| **Activity 2 Scientific vocabulary: Making measurements** |
| Link each term on the left to the correct definition on the right. |

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| **Activity 3 Scientific vocabulary: Errors** |
| Link each term on the left to the correct definition on the right. |

Understanding and using SI units

Every measurement has a size (eg 2.7) and a unit (eg metres or kilograms). Sometimes, there are different units available for the same type of measurement. For example, milligram, gram, kilogram and tonne are all units used for mass.

There is a standard system of units, called the SI units, which are used for most scientific purposes.

These units have all been defined by experiment so that the size of, say, a metre in the UK is the same as a metre in China.

There are seven SI base units, which are given in the table.

|  |  |  |
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| **Physical quantity** | **Unit** | **Abbreviation** |
| Mass | kilogram | kg |
| Length | metre | m |
| Time | second | s |
| Electric current | ampere | A |
| Temperature | kelvin | K |
| Amount of substance | mole | mol |
| luminous intensity | candela | cd |

All other units can be derived from the SI base units. For example, area is measured in metres square (written as m2) and speed is measured in metres per second (written as m s–1: not that this is a change from GCSE, where it would be written as m/s).

Using prefixes and powers of ten

Very large and very small numbers can be complicated to work with if written out in full with their SI unit. For example, measuring the width of a hair or the distance from Manchester to London in metres (the SI unit for length) would give numbers with a lot of zeros before or after the decimal point, which would be difficult to work with.

So, we use prefixes that multiply or divide the numbers by different powers of ten to give numbers that are easier to work with. You will be familiar with the prefixes milli (meaning 1/1000), centi (1/100), and kilo (1 × 1000) from millimetres, centimetres and kilometres.

There is a wide range of prefixes. Most of the quantities in scientific contexts will be quoted using the prefixes that are multiples of 1000. For example, we would quote a distance of 33 000 m as   
33 km.

The most common prefixes you will encounter are given in the table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Prefix** | **Symbol** | **Power of 10** | **Multiplication factor** | |
| Tera | T | 1012 | 1 000 000 000 000 | |
| Giga | G | 109 | 1 000 000 000 | |
| Mega | M | 106 | 1 000 000 | |
| kilo | k | 103 | 1000 | |
| deci | d | 10-1 | 0.1 | 1/10 |
| centi | c | 10-2 | 0.01 | 1/100 |
| milli | m | 10-3 | 0.001 | 1/1000 |
| micro | μ | 10-6 | 0.000 001 | 1/1 000 000 |
| nano | n | 10-9 | 0.000 000 001 | 1/1 000 000 000 |
| pico | p | 10-12 | 0.000 000 000 001 | 1/1 000 000 000 000 |
| femto | f | 10–15 | 0.000 000 000 000 001 | 1/1 000 000 000 000 000 |

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| **Activity 4 SI units and prefixes** |
| 1. What would be the most appropriate unit to use for the following measurements? 2. The mass of water in a test tube. 3. The volume of water in a burette. 4. The time taken for a solution to change colour. 5. The radius of a gold atom. 6. The number of particles eg atoms in a chemical. 7. The temperature of a liquid. 8. Re-write the following quantities using the correct SI units. 9. 0.5 litres 10. 5 minutes 11. 20 °C 12. 70 °F 13. 10 ml (millilitres) 14. 5.5 tonnes 15. 96.4 microlitres (µl) 16. Scientists have been developing the production of a new material through the reaction of two constituents.   Before going to commercial production, the scientists must give their data in the correct SI units.   1. The flow rate of the critical chemical was reported as 240 grams per minute at a temperature of 20 °C.   Re-write this flow rate using the correct SI units. Show your working. |

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| **Activity 5 Converting data** |
| Re-write the following.   1. 0.1 metres in millimetres 2. 1 centimetre in millimetres 3. 104 micrograms in grams 4. 1.1202 kilometres in metres 5. 70 decilitres in millilitres 6. 70 decilitres in litres 7. 10 cm3 in litres 8. 2140 pascals in kilopascals |

The delta symbol (Δ)

The delta symbol (Δ) is used to mean ‘change in’. You might not have seen this symbol before in your GCSE Chemistry course, although it is used in some equations in GCSE Physics.

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| **Activity 6 Using the delta symbol** |
| In exothermic and endothermic reactions there are energy changes.  The diagram below shows the reaction profile for the reaction between zinc and copper sulfate solution.     1. Which letter represents the products of the reaction? 2. Which letter represents the activation energy? 3. Complete the sentence using the words below.  |  |  |  |  | | --- | --- | --- | --- | | The reaction is |  | and therefore ΔH is |  |  |  |  |  |  | | --- | --- | --- | --- | | endothermic | exothermic | negative | positive | |

Practical skills

The practical skills you learnt at GCSE will be further developed through the practicals you undertake at A-level. Your teacher will explain in more detail the requirements for practical work in Chemistry.

There is a practical handbook for Chemistry, which has lots of very useful information to support you in developing these important skills. You can download a copy [here:](https://www.aqa.org.uk/resources/science/as-and-a-level/teach/practicals)

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| **Activity 7 Electrolysis** |
| Students were investigating if the time the current flows through an electrolyte affects the amount of copper deposited on the negative electrode.     1. Write a hypothesis for this investigation. 2. What do you predict will be the result of this investigation? 3. For this investigation, give 4. the independent variable 5. the dependent variable 6. a control variable. 7. What is the difference between repeatable and reproducible results? 8. What would be the most likely resolution of the balance you use in a school lab? 9. How could you make the reading more precise? 10. Random errors cause readings to be spread about the true value.   How could you reduce the effect of random errors and make the results more accurate?   1. The results the student recorded are given in the table.  |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Time / minutes** | **Increase in mass / g** | | | **Mean** | | 2 | 0.62 | 0.64 | 0.45 |  | | 4 | 0.87 | 0.83 | 0.86 |  | | 6 | 0.99 | 1.02 | 0.97 |  | | 8 | 1.06 | 1.05 | 1.08 |  | | 10 | 1.10 | 1.12 | 1.10 |  |     Calculate the mean increase in mass for each time measurement. |

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| 1. Plot a graph of your results. |

Using maths skills

Throughout your A-level Chemistry course you will need to be able to use maths skills you have developed in your GCSE Chemistry and GCSE maths courses, such as using standard form, rounding correctly and quoting your answer to an appropriate number of significant figures.

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| **Activity 8 Using maths skills** |
| 1. Write the following numbers in standard form: 2. 4000 3. 1 000 000 4. Zinc oxide can be produced as nanoparticles.   A nanoparticle of zinc oxide is a cube of side 82nm.    Calculate the surface area of a nanoparticle of zinc oxide. Give your answer in standard form   1. Express the following numbers to 3 significant figures: 2. 57 658 3. 0.045346 4. Toothpaste may contain sodium fluoride (NaF).   The concentration of sodium fluoride can be expressed in parts per million (ppm). 1 ppm represents a concentration of 1 mg in every 1 kg of toothpaste.  A 1.00 g sample of toothpaste was found to contain 2.88 × 10–5 mol of sodium fluoride.  Calculate the concentration of sodium fluoride, in ppm, for the sample of toothpaste.    Give your answer to 3 significant figures.  **Use the following information to help you**  To convert moles to grams use g = moles × relative formula mass  Relative formula mass of NaF = 42 |

**Using the periodic table**

During your course you will need to become familiar with the periodic table of the elements, and be able to use information from the table to answer questions.

There is a copy of the periodic table that you will be given to use in your exams on the next page.

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| **Activity 9 Atoms** |
| 1. Give the atomic number of: 2. Osmium 3. Lead 4. Sodium 5. Chlorine 6. Give the relative atomic mass (Ar) of: 7. Helium 8. Francium 9. Barium 10. Oxygen 11. What is the number of neutrons in each of the following elements? 12. Fluorine 13. Beryllium 14. Gold |

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| **Activity 10 Formulae of common compounds** |
| State the formulae of the following compounds:   1. Methane 2. Sulfuric acid 3. Potassium manganate (VII) 4. Water |

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| **Activity 11 Ions and ionic compounds** |
| The table below lists the formulae of some common ions.   |  |  |  |  | | --- | --- | --- | --- | | **Positive ions** | | **Negative ions** | | | **Name** | **Formula** | **Name** | **Formula** | | Aluminium | Al3+ | Bromide | Br– | | Ammonium | NH4+ | Carbonate | CO32– | | Barium | Ba2+ | Chloride | Cl– | | Calcium | Ca2+ | Fluoride | F– | | Copper(II) | Cu2+ | Iodide | I– | | Hydrogen | H+ | Hydroxide | OH– | | Iron(II) | Fe2+ | Nitrate | NO3– | | Iron(III) | Fe3+ | Oxide | O2– | | Lead | Pb2+ | Sulfate | SO42– | | Lithium | Li+ | Sulfide | S2– | | Magnesium | Mg2+ |  |  | | Potassium | K+ |  |  | | Silver | Ag+ |  |  | | Sodium | Na+ |  |  | | Zinc | Zn2+ |  |  |   Use the table to state the formulae for the following ionic compounds.   1. Magnesium bromide 2. Barium oxide 3. Zinc chloride 4. Ammonium chloride 5. Ammonium carbonate 6. Aluminium bromide 7. Calcium nitrate 8. Iron (II) sulfate 9. Iron (III) sulfate |

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| **Activity 12 Empirical formula** |
| Use the periodic table on page 21 to help you answer these questions.   1. The smell of a pineapple is caused by ethyl butanoate.   A sample is known to contain:  0.360 g of carbon  0.060 g of hydrogen  0.160 g of oxygen.  What is the empirical formula of ethyl butyrate?   1. What is the empirical formula of a compound containing:   0.479 g of titanium  0.180 g of carbon  0.730 g of oxygen   1. A 300g sample of a substance is analysed and found to contain only carbon, hydrogen and oxygen.   The sample contains 145.9 g of carbon and 24.32 g of hydrogen.  What is the empirical formula of the compound?   1. Another 300 g sample is known to contain only carbon, hydrogen and oxygen.   The percentage of carbon is found to be exactly the same as the percentage of oxygen.  The percentage of hydrogen is known to be 5.99%.  What is the empirical formula of the compound? |

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| **Activity 13 Balancing equations** |
| 1. Write balanced symbol equations for the following reactions.   You’ll need to use the information on the previous pages to work out the formulae of the compounds.  Remember some of the elements may be diatomic molecules.   1. Aluminium + oxygen  aluminium oxide 2. Methane + oxygen  carbon dioxide + water 3. Calcium carbonate + hydrochloric acid  calcium chloride + water + carbon dioxide 4. Chalcopyrite is a sulfide mineral with formula CuFeS2.   Chalcopyrite is the most important copper ore. It is a sulfide mineral, a member of iron (2+) sulfides and a copper sulfide.  Copper can be produced from rock that contains CuFeS2 in two stages.  Balance the equations for the two stages in this process.  **Hint: remember that sometimes fractions have to be used to balance equations.**  Stage 1:           CuFeS2 + O2 + SiO2  Cu2S + Cu2O + SO2 + FeSiO   Stage 2:           Cu2S + CuO  Cu + SO2 |

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| **Activity 14 Moles** |
| The amount of a substance is measured in moles (the SI unit). The mass of one mole of a substance in grams is numerically equal to the relative formula mass of the substance. One mole of a substance contains the same number of the stated particles, atoms or ions as one mole of any other substance. The number of atoms, molecules or ions in a mole of a given substance is the Avogadro constant. The value of the Avogadro constant is  6.02 × 1023 per mole.  Complete the table. Use the periodic table on page 21 to help you.   |  |  |  |  | | --- | --- | --- | --- | | **Substance** | **Mass of substance in grams** | **Amount in moles** | **Number of particles** | | Helium |  |  | 18.12 × 1023 | | Chlorine (Cl) | 14.2 |  |  | | Methane |  | 4 |  | | Sulfuric acid | 4.905 |  |  | |

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| **Activity 15 Isotopes and calculating relative atomic mass** |
| 1. What is the relative atomic mass of bromine if the two isotopes 79Br and 81Br exist in equal amounts? 2. A sample of neon is made up of three isotopes:   20Ne accounts for 90.9%  21Ne accounts for 0.3%  22Ne accounts for 8.8%.  What is the relative atomic mass of neon?  Give your answer to 4 significant figures.   1. Copper’s isotopes are 63Cu and 65Cu.   If the relative atomic mass of copper is 63.5, what are the relative abundances of these isotopes? |