THE DUSTON SCHOOL
Knowledge itself is power
4-19

Year 10 Science Knowledge Booklet

Term 2

Name:	Class:

Year 10 Knowledge quiz timetable and Workbook deadlines.	
9th November	B1
23rd November	C1
7th December	P1

Science Homework 1

Complete the first section of the Exam Practice workbook identified on the front of this Knowledge Organiser ready for the Knowledge Quiz.

Big questions: What is Quantitative Chemistry?

Why is mass conserved in reactions?
Why do some reactions appear to not obey conservation of mass?
Why can we not compare things in grams?
What units are used in chemistry to represent the amount of a substance?
How do chemists or pharmacist know how much of each chemical they need?
Why do chemists add things to excess?
What do we mean by concentration?

Key vocabulary

Conservation of mass	The total mass at start of the reaction is equal to the total mass at the end of the reaction. This is because there are the same number and type of atoms in reactants and products
Relative atomic mass	The relative atomic mass tells us the number of protons and neutrons in an atom. It also tell us how many grams of the substance we need to have 1 mole of it. There are no units
Relative formula mass	The relative formula mass is the sum of the relative atomic masses of the atoms in a compound (e.g CO_2 → 1 Carbon atom (12) 2 oxygen atoms (2x16 = 32) so RFM = 44
Uncertainty	The uncertainty is the interval (range) in which the true value can be expected to be. The higher the uncertainty, the less confident you can be in accuracy of your result
Mole	The amount of a substance, it is essentially telling us the number of particles. 1 mole of a substance has the same number of particles as 1 mole of any other substance
Avogadro's constant	The number of particles in 12g of Carbon -12 → 6.02×10^{23} This is the number of particles in 1 mole
Balanced equation	An equation that shows the relative quantities of reactant and product expressed in the number of moles. It obeys conservation of mass (same number and type of atoms both sides of equation
Limiting reactant	The limiting reactant is the reactant that is used up first in a reaction. It is present in the least number of moles compared to the other reactants (must check mole ratio before determining)
Mole ratio	The mole ratio of one substance to another is based on the balanced equation i.e $2Mg + O_2 \rightarrow 2MgO$ The ratio between Magnesium to oxygen in 2:1 The ratio between magnesium and magnesium oxide is 2:2 → 1:1

Why is mass conserved in reactions?

In a chemical reaction, conservation of mass always occurs.

Conservation of mass → The total mass of the reactants equals the total mass of products, overall no atoms of an element are gained or lost in a reaction

Because no atoms are lost or made, this means we have the same total amount of matter at the start of the reaction as we do in total at the end

Chemical equations use chemical formulas. Each substance is written out using the chemical symbols to identify exactly what elements are present and the number / ratio of them
The number of atoms of each element must be same in reactants and products

Example.

$$H_2 + O_2 \rightarrow H_2O$$
$$H_2 \qquad H_2O$$

Therefore: $\underline{\mathbf{2}}H_2 + O_2 \rightarrow \underline{\mathbf{2}}H_2O$

Why do some reactions appear to not obey conservation of mass?

Conservation of mass means the same total mass of products will be produced.

If one of the reactants or products is a gas, then it will appear as if conservation of mass has not been followed.

If one of the REACTANTS is a gas, then the mass of the products will appear to increase.
This is because the mass of the gas would not have been originally included

If one of the products is a gas, then the mass of the products will appear to decrease, as long as the container is not sealed.

When reading or recording a value, you are never recording the true value. There is always uncertainty in the measurement
Uncertainty → The interval (range) within which the true value is expected to be.

When reading off apparatus with a scale, the uncertainty is $\underline{\pm}$ half the interval between two scale divisions.
When reading off digital apparatus, the error is $\underline{\pm}$ half the last digit

Why can we not compare things in grams?

Mass → How much "matter" in the substance. It is measured in kilograms. Not all particles have the same mass as they have different numbers of protons electrons and neutrons.

To compare the number of particles / amount of a substance in chemistry we need to use a different unit called the mole.

The relative atomic mass is the average mass of atoms of a particular element. It essentially is the number of protons and neutrons in an atom

Relative formula mass is the sum of the relative atomic masses of each atom of each element in a molecule or compound.

Example: Relative formula mass of C_2H_6.

There are 2 atoms of carbon, and 6 atoms of hydrogen

The mass of a carbon atom is 12, the mass of an atom of hydrogen is 1.

(2x12) + (6x1) = 30

Chemists often use the term Molar mass instead of relative formula mass. The molar mass is calculated in the exact same way as relative formula mass, the key difference is that it has units

Molar mass → The mass in grams of a substance needed to have 1 mole of it

What units are used in chemistry to represent the amount of a substance?

Moles → A chemical unit used to refer to the amount of a substance. Essentially it is the number of atoms or molecules in a substance.

1 mole = 6.02×10^{23}

Mass = Mr x mol m = Mr x n

How do chemists or pharmacist know how much of each chemical they need?

The numbers in front of each substance in the balanced chemical equation tell you the number of moles of that substance needed compared to the other and how many moles will be produced

E.g $2Na + Cl_2 \rightarrow 2NaCl$

2 moles of Sodium react with 1 mole of chlorine to produce 2 moles of Sodium Chloride

Example question and answer

How much Magnesium oxide can be produced from 1.2 grams of Magnesium

$2Mg + O_2 \rightarrow 2MgO$

Formula of the two substance mentioned in question including any numbers in front	2Mg	2MgO
mass	1.2	2 grams
Molar mass	24	40
Moles	1.2/24 = 0.05	0.05
Mole ratio	2:2 ie 1:1 moles is the same	

Divide ↓ (mass → Moles)

Multiply ↑ (Moles → 2MgO)

Why do chemists add things to excess?

Reactant in excess → This means there is more of it than is technically needed. At the end of the reaction there will some of this reactant left over
Limiting reactant → This is the reactant that runs out first. It is present in the least number of moles (taking into account mole ratios)

We can't compare things in grams, so you have to get it into moles before you can make the comparison, and you have to remove the mole ratio to identify the limiting reactant easily.

Step by step →

1. Work out the number of moles of each reactant using mole = mass / Molar mass
2. Look at the overall equation, divide the number of moles by any number in front of that substance
3. Identify the smallest number, the substance giving that value is the limiting reactant, the other is in excess

What do we mean by concentration?

Solute → Substance to be dissolved in a liquid. If a substance cannot dissolve it is INSOLUBLE in that particular solvent
Solvent → The liquid that a solute dissolves in. Temperature can affect how much solute dissolves in solvent
Solution → The end mixture once solute has dissolved

Concentration is the amount of substance per unit volume.
If a large amount is dissolved the solution is concentrated
If a very small amount is dissolved the solution is dilute

Concentrated → When a large amount of substance is dissolved per unit volume. Can increase concentration by adding more solute to the same volume, or evaporating off the solvent
Dilute → When a small amount of substance is dissolved per unit volume. Can decrease concentration by adding more solvent to the same amount of solute.

Science Homework 2

Complete the second section of the Exam Practice workbook identified on the front of this Knowledge Organiser ready for the Knowledge Quiz.

Science Homework 3

Complete the third section of the Exam Practice workbook identified on the front of this Knowledge Organiser.

Wider reading

How to get the most out of your knowledge organiser:

- To get the most use out of the knowledge organisers you should be learning sections and then self-testing.

- There are several different things you can do
  - Look, cover, write, check, correct
  - Read through the organisers
  - Mind maps
  - Key spellings
  - Make a glossary
  - Missing out key words
  - Questions/answers answers/questions
  - Flash cards
  - Revision clock learning
  - Mnemonics

Science Learning Tools and wider study:

The Oak Academy – Online Science lessons
BBC Bitesize science
<u>You tube channels:</u>
Fuse school
Ted talks
Free science lessons
Primrose Kitten
<u>Shows on Netfilx</u>
Our planet
Tiny creatures
A life on our planet

Key knowledge question	Answer
How many atoms are in a molecule of CO_2?	3 – 1 carbon atom and 2 oxygen atoms
What is the law of conservation of mass?	The total mass at start of the reaction is equal to the total mass at the end of the reaction. This is because there are the same number and type of atoms in reactants and products
How would you determine the relative formula mass of a compound?	The sum of the relative atomic masses of the atoms in the compound
Why might a chemical reaction seem to have lost mass?	A gas has been produced
Balance the equation: $Li + H_2O \rightarrow LiOH + H_2$	$2Li + 2H_2O \rightarrow 2LiOH + H_2$
What is the equation that links mass, moles and relative formula mass?	Mass = relative formula mass x moles Mass = Mr x mole
What is the equation that links mass, concentration and volume?	Mass = concentration x volume
What does Avogadro's constant represent?	The number of particles in 1 mole of a substance
In the reaction $2H_2 + O_2 \rightarrow 2H_2O$, if 3 moles of hydrogen were used, how many moles of water would be produced?	3 moles