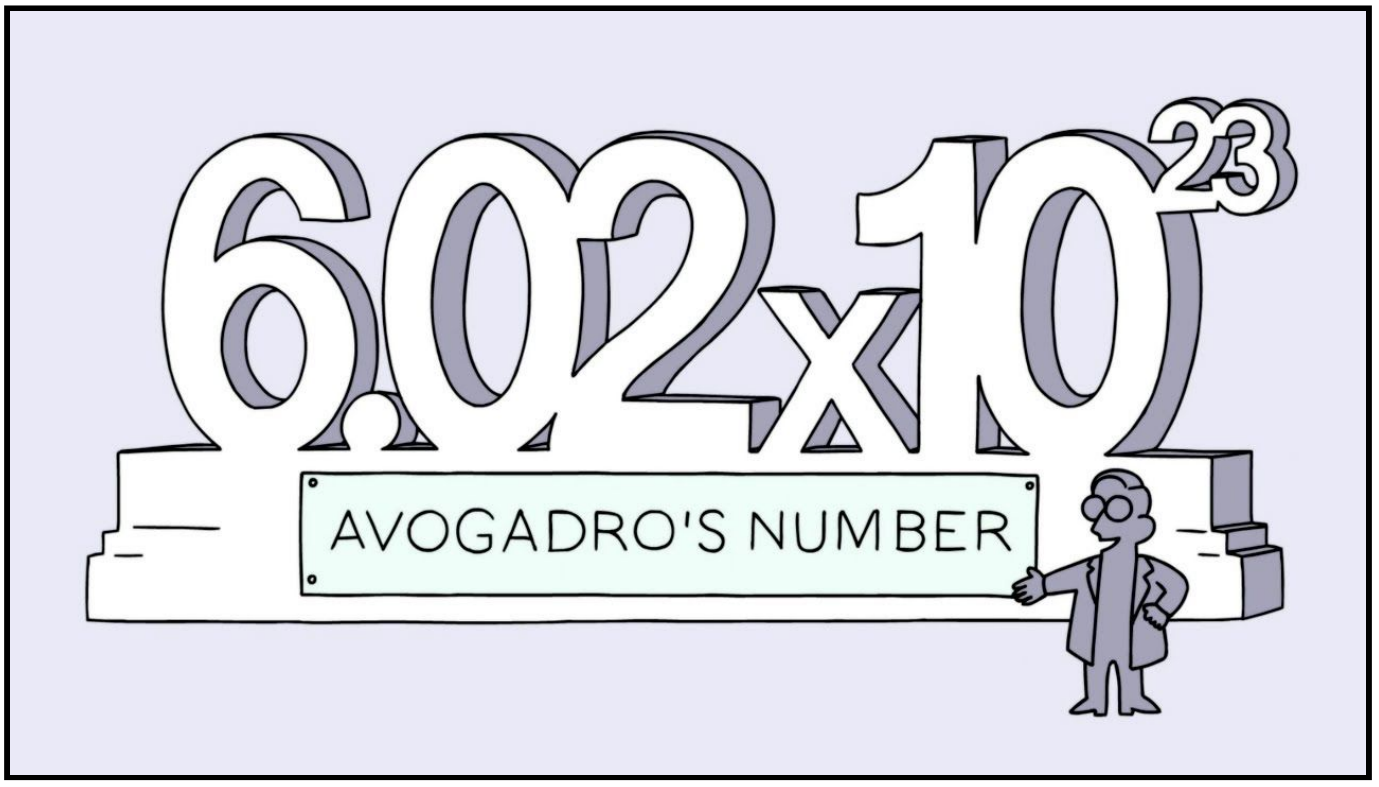
11 into 12 Applied Science Assignment.

Quantitative Chemistry

Name:



Moles

$$Number\ of\ Moles = \frac{mass\ in\ grams}{Mass\ of\ 1\ mole}$$

$$n = \frac{m}{M}$$

1. **How many moles are in 14 grams of lithium?**

2. **How many grams are in 2.5 moles of sulfur?**

3. **How many moles are in 120 grams of argon?**

4. **How many grams are in 84 moles of magnesium?**

5. **How many moles are in 6.2 grams of phosphorus?**

6. **How many grams are in 12 moles of chromium**

7. **How many moles are in 5 grams of calcium?**

Compounds (Find the M_r first)

8. **How many moles are in 234 grams of aluminum hydroxide, $Al(OH)_3$**

9. **How many moles are in 68 grams of copper (II) hydroxide, $Cu(OH)_2$**

Masses from Equations

If you write a formula for a substance in a calculation it is often convenient to take that formula as meaning 1 mole of that substance. This enables you to attach a mass to it and therefore work things out from it.

1. **What mass of CaO (Mr=56) could be obtained by heating 25g of limestone $CaCO_3$ ($CaCO_3$ Mr=100)**

$CaCO_3 \rightarrow CaO + CO_2$

2. **In a blast furnace haematite Fe_2O_3 (Mr=160) is converted to iron.**

$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

What mass of Iron (Ar=56)can be obtained from 16g of iron oxide?

3. **2.67g of aluminium chloride was dissolved in water and silver nitrate added to give a precipitate of silver chloride. What mass of silver chloride would be formed?**

$AlCl_3 + 3AgNO_3 \rightarrow Al(NO_3)_3 + 3AgCl$

(AgCl=143.5, $AlCl_3$ =133.5)

4. $C_7H_6O_3 + C_4H_6O_3 \rightarrow C_9H_8O_4 + CH_3COOH$
   Salicylic acid — *aspirin*

Calculate the maximum mass of aspirin that could be made from 2.00 g of salicylic acid.
The relative formula mass (*Mr*) of salicylic acid, $C_7H_6O_3$, is 138
The relative formula mass (*Mr*) of aspirin, $C_9H_8O_4$, is 180

5. **What mass of sodium chloride will be formed when 4g of sodium hydroxide reacts with excess hydrochloric acid?**

Mr (NaOH) = 40, Mr (NaCl) = 58

$NaOH + HCl \rightarrow NaCl + H_2O$

6. **What mass of silver chloride will be formed when 5.2g of barium chloride reacts with silver nitrate both in solution?**

$BaCl_2 + 2AgNO_3 \rightarrow 2AgCl + Ba(NO_3)_2$

($BaCl_2$ =172.5 AgCl = 143.5)

Yield and atom economy of chemical reactions (chemistry only)

Percentage yield
Even though no atoms are gained or lost in a chemical reaction, it is not always possible to obtain the calculated amount of a product because: **1. the reaction may not go to completion because it is reversible** **2. some of the product may be lost when it is separated from the reaction mixture** **3. some of the reactants may react in ways different to the expected reaction. The amount of a product obtained is known as the yield. When compared with the maximum theoretical amount as a percentage, it is called the percentage yield.** $$\% \text{ Yield} = \frac{\text{Mass of product actually made}}{\text{Maximum theoretical mass of product}} \times 100$$ **Students should be able to:** **1. calculate the percentage yield of a product from the actual yield of a reaction** **2. (HT only) calculate the theoretical mass of a product from a given mass of reactant and the balanced equation for the reaction.**

Key questions

1. **In a reaction a student expected to produce 56g of calcium oxide, they only produced 42g. What is the percentage yield?**

2. **An industrial reaction was expected to give a total of 1.53 tonnes, in the end it was found that 0.95 tonnes was produced, find the percentage yield.**

These questions combine reacting masses and percentage yield.

1. **In the following reaction $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ - 0.95Kg of iron ore yields 0.46kg of iron, calculate the percentage yield.**

2. **1000 tonnes of Cyclohexane (Mr=98) reacts to produce 834 tonnes of methylene cyclohexane (Mr=96) what is the percentage yield. Assume that one mole of Cyclohexane makes one mole of methylene cyclohexane.**

3. **Ethanoic acid (CH_3COOH) is reacted with ethanol (C_2H_5OH) to produce ethyl ethanoate ($CH_3COOC_2H_5$), if we start with 21g of ethanol and produce 36g of ethyl ethanoate, calculate the percentage yield. Assume that one mole of ethanol makes one mole of ethyl ethanoate.**

Concentrations

Using concentrations of solutions in mol/dm^3 (chemistry only) (HT only)
The concentration of a solution can be measured in mol/dm^3 . **The amount in moles of solute or the mass in grams of solute in a given volume of solution can be calculated from its concentration in mol/dm^3 .** **If the volumes of two solutions that react completely are known and the concentration of one solution is known, the concentration of the other solution can be calculated.** **Students should be able to explain how the concentration of a solution in mol/dm^3 is related to the mass of the solute and the volume of the solution.**

Key Questions

1. **What is concentration a measure of?**

2. **What is the formula for the calculation of concentration? Rearrange it for volume and the mass of the substance**

3. **What is the concentration of g/dm^3 of a solution of sodium chloride where 30g of sodium chloride is dissolved in 0.20dm^3 of water?**

4. **What is the concentration in g/dm3 of iron chloride solution where 10g of iron chloride is dissolved in 25 cm^3 of water?**

5. **What is the mass of of copper chloride in 20cm3 of an 80cm3 solution of copper chloride?**

6. **Calculate the concentration of a solution containing 150g of iron chloride in 3dm^3 of solvent.**

7. **Calculate the concentration of a solution containing 48g of hydrochloric acid in 0.4dm^3 of solvent.**

8. **Calculate the concentration of the following solutions in g/dm3.**

a. **60g of sodium hydroxide in 120cm3 of a solvent.**

b. **A solution containing 2.4g of sodium chloride in 8 cm3 of solvent.**

9. **Calculate the mass of solute in the following solutions.**

a. **The mass of sodium carbonate in 2.5 dm^3 of a 60 g/dm^3 solution of sodium carbonate.**

b. **The mass of copper sulphate in 0.35 dm^3 of 60 g/dm^3 solution of copper sulphate.**

10. Calculate the mass of solute in the following solutions.

a. The mass of sulfuric acid in 80 cm^3 of a 200 g/dm^3 solution of sulfuric acid.

b. The mass of magnesium chloride in 15 cm^3 of a 120 g/dm^3.

Using concentrations of solutions in mol/dm^3

1. **What is concentration in mol/dm^3 measure of?**

2. **What is the formula for the calculation of concentration in mol/dm^3? Rearrange it for volume and the number of moles of the substance**

3. **What is the concentration in mol/dm^3 of a solution with 2 moles of sodium chloride in 500cm^3?**

4. **What is the concentration in mol/dm^3 of a solution containing 3.7g of calcium hydroxide $Ca(OH)_2$ in 0.25dm^3?**

5. **What mass of sodium hydroxide (NaOH, Mr=40) is there in 0.450dm3 of a 0.600 mol/dm^3 solution?**

Converting between mol/dm^3 & g/dm^3

1. **State the formula required for coverting g/dm^3 & mol/dm^3**

2. **What is the concentration of a 270 g/dm^3 solution of magnesium sulphate in mol/dm^3 ($MgSO_4$ Mr=120)**

3. **What is the concentration of a 0.15 mol/dm^3 solution of potassium hydroxide in g/dm^3 (KOH Mr=56)**

4. **Calculate the number of moles in 4dm^3 of 1.2 mol/dm^3 HCl.**

5. **Calculate the number of moles in 2dm^3 of 0.3 mol/dm^3 NaOH**

6. **Calculate the number of moles of KOH in 25cm^3 of 0.2 mol/dm^3**

7. **Find the concentration of 3mol HBr in a 2dm^3 solution**

8. **Calculate the concentration in 1mol of NaOH in 30cm^3 of solution.**

9. **Calculate the volume of 2.3 mol/dm^3 solution that contains 0.5mol HCl**

m = n x Mr

m = mass (g), n = number of moles (mol), Mr = relative formula mass

1. **What mass of NaOH is there in 2dm^3 of 0.3 mol/dm^3 solution?**

2. **What mass of H_2SO_4 is there in 3dm^3 of 2 mol/dm^3 solution?**

3. **What is the mass of NaOH in 25cm^3 of 0.3 mol/dm^3 solution?**

4. **What is the mass of HNO_3 that would dissolve in 500cm^3 of water to produce a 2 mol/dm^3 solution?**

Periodic Table.

3. The Periodic Table of Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112 – 116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

* The Lanthanides (atomic numbers 58 – 71) and the Actinides (atomic numbers 90 – 103) have been omitted.

Cu and **Cl** have not been rounded to the nearest whole number.