CHEMISTRY TRANSITION BOOKLET

Name: ______________________________

Amount of Substance

When chemists measure out an amount of a substance, they use an amount in moles. The mole is a useful quantity because one mole of a substance always contains the same number of entities of the substance. An amount in moles can be measured out by mass in grams, by volume in dm^3 of a solution of known concentration and by volume in dm^3 of a gas.

Before you start Year 12 Chemistry, it would be helpful if you can:

- define relative atomic mass (A_r)
- define relative molecular mass (M_r)
- use the Avogadro constant (you will always be given it)
- use mass of substance, M_r, and amount in moles
- use concentration, volume and amount of substance in a solution
- Use balanced equations to calculate:
    - masses
    - volumes of gases
    - percentage yields
    - percentage atom economies
    - concentrations and volumes for reactions in solutions.

At GCSE you were able to do some of this already.

Combined Science (trilogy)	Separate Science

• Calculated Ar and Mr
• Used Avogadro's constant
• Calculated number of moles
• Balanced equations
• Used balanced equations to:
    • masses
    • volumes of gases
    • concentrations and volumes for reactions in solutions
	• Calculated Ar and Mr
	• Used Avogadro's constant
	• Calculated number of moles
	• Balanced equations
	• Used balanced equations to:
	    • masses
	    • volumes of gases
	    • Percentage yields
	    • Percentage atom economies
	    • concentrations and volumes for reactions in solutions

Over the next 10 weeks use this booklet to prepare yourself for the beginning of A level, if you have any questions please email m.dimbylow@hughfaringdon.org

This booklet needs to be handed in (or emailed) by: Thursday 7th September

Define relative atomic mass (A_r) and relative molecular mass (M_r)

Definition for relative atomic mass	Definition for relative formula mass

At GCSE this looked like:

Magnesium reacts with oxygen to produce magnesium oxide.

Calculate the percentage mass of magnesium in magnesium oxide (MgO).

Relative atomic mass (A_r): Mg = 24

Relative formula mass (M_r): MgO = 40

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Percentage mass of magnesium = ________________ %

Calculate the percentage by mass of titanium in titanium(IV) chloride ($TiCl_4$).

Give your answer to 3 significant figures.

Relative atomic masses (A_r): Cl = 35.5; Ti = 48

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Percentage of titanium by mass = ________________ %

This question is about the extraction of metals.

Element **R** is extracted from its oxide by reduction with hydrogen.

The equation for the reaction is:

$$3\ H_2 + \mathbf{R}O_3 \rightarrow \mathbf{R} + 3\ H_2O$$

(a) The sum of the relative formula masses (M_r) of the reactants ($3\ H_2$ + $\mathbf{R}O_3$) is 150

Calculate the relative atomic mass (A_r) of **R**.

Relative atomic masses (A_r): H = 1 O = 16

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Relative atomic mass (A_r) of **R** = ________________

(b) Identify element **R**.

You should use:

- your answer to part (a)
- the periodic table.

Identity of **R** = ________________

Calculate the percentage by mass of chlorine in a molecule of $C_6H_{10}Cl_2$

Relative atomic masses (A_r): H = 1 C = 12 Cl = 35.5

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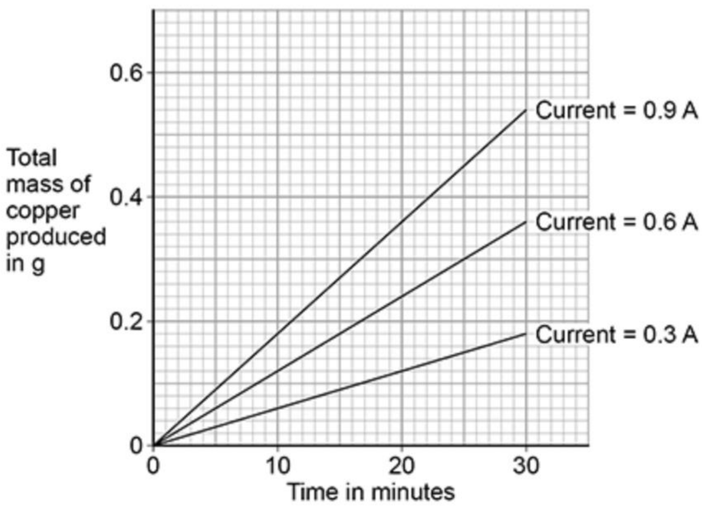
Percentage by mass = ________________ %

Use the Avogadro constant

What does the Avogadro Constant tell you?

At GCSE this looked like:

Figure 2



Determine the number of atoms of copper produced when copper nitrate solution is electrolysed for 20 minutes at a current of 0.6 A

Give your answer to 3 significant figures.

Use **Figure 2**.

Relative atomic mass (A_r): Cu = 63.5

The Avogadro constant = 6.02×10^{23} per mole

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Number of atoms (3 significant figures) = ________________

Use mass of substance, Mr, and amount in moles

How do you calculate moles?

At GCSE this looked like:

Ethanol and butanol can be used as fuels for cars.

(f) A car needs an average of 1.95 kJ of energy to travel 1 m

Ethanol has an energy content of 1300 kilojoules per mole (kJ/mol).

Calculate the number of moles of ethanol needed by the car to travel 200 km

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Number of moles = ______________ mol

A mixture contains 1.00 kg of aluminium and 3.00 kg of iron oxide.

The equation for the reaction is:

$$2\,Al + Fe_2O_3 \rightarrow 2\,Fe + Al_2O_3$$

Show that aluminium is the limiting reactant.

Relative atomic masses (A_r): O = 16 Al = 27 Fe = 56

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	Mass in g
Glass tube	51.56
Glass tube and iron	56.04
Glass tube and iron chloride	64.56

Calculate the simplest whole number ratio of:

moles of iron atoms : moles of chlorine atoms

Determine the balanced equation for the reaction.

Relative atomic masses (A_r): Cl = 35.5 Fe = 56

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Moles of iron atoms : moles of chlorine atoms = ___ : ___

Equation for the reaction ___

Iron reacts with oxygen to produce an oxide of iron.

0.015 moles of iron reacts with 0.010 moles of oxygen gas (O_2).

Determine:

- the formula of the iron oxide produced
- the balanced symbol equation for the reaction.

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Formula of iron oxide = ___

Balanced symbol equation

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Use concentration, volume and amount of substance in a solution

How do you calculate Concentration?
How do you carry out an acid base titration?

At GCSE this looked like:

Ethanedioic acid is a solid at room temperature.

Calculate the mass of ethanedioic acid ($H_2C_2O_4$) needed to make 250 cm^3 of a solution with concentration 0.0480 mol/dm^3

Relative formula mass (M_r): $H_2C_2O_4$ = 90

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Mass = _______________g

A solution of potash alum has a concentration of 258 g/dm^3

Calculate the mass of potash alum needed to make 800 cm^3 of a solution of potash alum with a concentration of 258 g/dm^3

Give your answer to 3 significant figures.

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Mass (3 significant figures) = ________________ g

The student found that 25.0 cm^3 of the sodium hydroxide solution was neutralised by 15.00 cm^3 of the 0.0480 mol/dm^3 ethanedioic acid solution.

The equation for the reaction is:

$$H_2C_2O_4 + 2\ NaOH \rightarrow Na_2C_2O_4 + 2\ H_2O$$

Calculate the concentration of the sodium hydroxide solution in mol/dm^3

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Concentration = ________________ mol/dm^3

The student used a solution of citric acid to determine the concentration of a solution of sodium hydroxide by titration.

(d) The student made 250 cm^3 of a solution of citric acid of concentration 0.0500 mol/dm^3

Calculate the mass of citric acid ($C_6H_8O_7$) required.

Relative atomic masses (A_r): H = 1 C = 12 O = 16

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Mass = ___ g

13.3 cm^3 of 0.0500 mol/dm^3 citric acid solution was needed to neutralise 25.0 cm^3 of sodium hydroxide solution.

The equation for the reaction is:

$$3\ NaOH + C_6H_8O_7 \rightarrow C_6H_5O_7Na_3 + 3\ H_2O$$

Calculate the concentration of the sodium hydroxide solution in mol/dm^3

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Concentration = ___ mol/dm^3

Gas Volumes

How do you calculate the gas volume from moles of a gas?

Iron chloride is produced by heating iron in chlorine gas.

The equation for the reaction is:

$$2\ Fe + 3\ Cl_2 \rightarrow 2\ FeCl_3$$

Calculate the volume of chlorine needed to react with 14 g of iron.

You should calculate:

- the number of moles of iron used
- the number of moles of chlorine that react with 14 g of iron
- the volume of chlorine needed.

Relative atomic mass (A_r): Fe = 56

The volume of 1 mole of gas = 24 dm^3

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Volume of chlorine = ________________ dm^3

Calculate the volume of 150 kg of chlorine gas at room temperature and pressure.

The volume of one mole of any gas at room temperature and pressure is 24.0 dm^3

Relative formula mass (M_r): Cl_2 = 71

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Volume = ___________________________ dm^3

The energy needed for a car powered by a hydrogen fuel cell to travel 100 km is 58 megajoules (MJ).

The energy released when 1 mole of hydrogen gas reacts with oxygen is 290 kJ

The volume of 1 mole of a gas at room temperature and pressure is 24 dm^3

Calculate the volume of hydrogen gas at room temperature and pressure needed for the car to travel 100 km

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Volume of hydrogen gas = _______________ dm^3

Percentage Yield

What is percentage yield?	How do you calculate percentage yield?

At GCSE this looked like:

The reaction produces a maximum theoretical mass of 400 kg of ethanol from 243 kg of ethene and 157 kg of steam.

A company produces 380 kg of ethanol from 243 kg of ethene and 157 kg of steam.

The percentage yield of ethanol is less than 100%

Calculate the percentage yield of ethanol.

Use the equation:

$$\text{percentage yield of ethanol} = \frac{\text{mass of ethanol actually made}}{\text{maximum theoretical mass of ethanol}} \times 100$$

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Percentage yield = ________________ %

60.0 kg of aluminium oxide produces a maximum of 31.8 kg of aluminium.

In an extraction process only 28.4 kg of aluminium is produced from 60.0 kg of aluminium oxide.

Calculate the percentage yield.

Give your answer to 3 significant figures.

Use the equation:

$$\text{percentage yield} = \frac{\text{mass of product actually made}}{\text{maximum theoretical mass of product}} \times 100$$

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Percentage yield = ________________________%

Atom economy

What is atom economy?	How do you calculate atom economy?

At GCSE this looked like:

Carbon is used to extract tin (Sn) from tin oxide (SnO_2).

The equation for the reaction is:

$$SnO_2 + C \rightarrow Sn + CO_2$$

Calculate the percentage atom economy for extracting tin in this reaction.

Relative atomic masses (A_r): C = 12 O = 16 Sn = 119

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Percentage atom economy = ______________ %

Calculate the percentage atom economy for the production of silver iodide in this reaction.

The equation for the reaction is:

$$AgNO_3(aq) + NaI(aq) \rightarrow AgI(s) + NaNO_3(aq)$$

Give your answer to 3 significant figures.

Relative formula masses:

(M_r): $AgNO_3$ = 170 NaI = 150 AgI = 235 $NaNO_3$ = 85

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Percentage atom economy (3 significant figures) = ______________ %