AQA Chemistry GCSE

Topic 3: Quantitative Chemistry

Flashcards

What is the law of conservation of mass?

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The law of conservation of mass states that no atoms are lost or made during a chemical reaction so the mass of the products equals the mass of the reactants.

Write a balanced equation of magnesium reacting with hydrochloric acid.

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$$Mg_{(s)} + 2\,HCl_{(aq)} \rightarrow MgCl_{2(aq)} + H_{2(g)}$$

Define relative atomic mass and relative formula mass.

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RAM - average mass of atoms in an element taking into account masses and abundance of its isotopes, relative to ^{12}C.

RFM - sum of RAM's of all atoms in the formula.

What is the relative formula mass of:

A) CaF_2

B) $C_6H_{12}O_6$

What is the relative formula mass of:

CaF_2 - (A_r values: Ca = 40, F = 19)

40 + 19 + 19 = 78

$C_6H_{12}O_6$ - (A_r values: C = 12, H = 1, O = 16)

(12 x 6) + (1 x 12) + (16 x 6) = 180

The following reaction occurs in a test tube under a Bunsen Burner:

$$4\ MgO(s) + CH_4(g) \rightarrow 4\ Mg(s) + 2\ H_2O(g) + CO_2(g)$$

The carbon dioxide and water escape from the test tube.

Use the equation to explain why.

Use equation to explain why carbon dioxide and water escape from the test tube.

They are both gases

The experiment was repeated three times. Calculate the mean mass of magnesium produced and suggest how you could increase the precision of the results.

	Experiment		
	1	2	3
Mass of magnesium oxide used in g	4.0	4.0	4.0
Mass of magnesium produced in g	3.3	3.5	3.2

Calculate the mean of magnesium produced and suggest how you could increase the precision of the results

(3.3 + 3.5 + 3.2) / 3 = 3.3

Measure to more decimal places **or** use a more sensitive balance / apparatus

What is Avogadro's constant?

Higher tier only

What is Avogadro's constant?

The number of atoms, molecules or ions in a mole of a given substance.

The value of the constant is 6.02×10^{23}.

Higher tier only

What is the formula that links mass, molecular mass and moles together

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Mass = Mr x Moles

Higher tier only

What is the mass of: 20 moles of calcium carbonate, $CaCO_3$

Higher tier only

What is the mass of 20 moles of calcium carbonate, $CaCO_3$

Mass = Mr x Moles

Mr = 100

100 x 20 = 2000 g

Higher tier only

Calculate the amount of carbon dioxide in moles in 0.32 g of carbon dioxide.

Relative atomic masses (A_r): carbon = 12, oxygen = 16

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Relative atomic masses (A_r): carbon = 12, oxygen = 16

Moles = Mass / Mr

0.32 / 44 = **0.007**

Higher tier only

Nitrogen and hydrogen form ammonia shown by the following equation:

$$N_{2(g)} + 3\,H_{2(g)} \rightleftharpoons 2\,NH_{3(g)}$$

Calculate the mass of nitrogen needed to form 6.8 tonnes of ammonia.

Relative atomic masses (A_r): H = 1; N = 14

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Calculate the mass of nitrogen needed to form 6.8 tonnes of ammonia

Step 1 - Work out the number of number of moles of ammonia (Mr of ammonia = 17)

6800000 / 17 = 400000 moles of ammonia

Step 2 - Use the balanced equation and number of moles of ammonia to work out the number of moles of nitrogen

The ratio of nitrogen to ammonia is 1:2

Therefore the number of moles of nitrogen is 400000/2 = 200000

Step 3 - Work out the mass of nitrogen (Mr of N_2 is 28)

200000 x 28 = 5600000 g = 5.6 tonnes.

Higher tier only

State what we mean by a limiting reactant in a chemical reaction

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In a chemical reaction involving two reactants, it is common to use an excess of one of the reactants to ensure that all of the other reactant is used. The reactant that is completely used up is called the limiting reactant because it limits the amount of products.

Higher tier only

Hydrogen peroxide decomposes in water to form water and oxygen. How many grams of oxygen gas will be given off from 40.8 g of hydrogen peroxide?

Higher tier only

How much oxygen will be given off from 40.8 g of hydrogen peroxide?

Step 1: Write the balanced equation $2\ H_2O_{2(l)} \rightarrow 2\ H_2O + O_{2(g)}$ Mr of H_2O_2 = 34

Step 2: Number of moles in 40.8 g : 40.8/34 = 1.2 moles

Ratio in the balanced equation of H_2O_2 : O_2 = 2:1

Step 3 :Therefore number of moles of O_2 = 0.6 moles

Step 4: Mass of oxygen = 0.6 x 32 (Mr of O_2) = **19.2**

Higher tier only

Write down the two formulae that link concentration, mass and volume together.

Write down the two formulae that link concentration, mole/mass and volume together.

Concentration (g per dm^3) = Mass (g)/Volume (dm^3)

Concentration (mol per dm^3) = nr of moles/volume (dm^3)

31.0 cm^3 of potassium hydroxide solution neutralised 25.0 cm^3 of 2.0 $moldm^{-3}$ nitric acid.

$$HNO_3 + KOH \rightarrow KNO_3 + H_2O$$

Calculate the concentration of the potassium hydroxide solution in $moldm^{-3}$

Higher tier only

Calculate the concentration of the potassium hydroxide solution in $moldm^{-3}$

Step 1: Calculate the moles of HNO_3 used = Concentration x volume

2 x 0.025 dm^3 (25/1000 to convert the units) = 0.05 moles

Step 2 : Calculate the moles of KOH

Ratio is 1:1 therefore number of moles of KOH = 0.05

Step 3 : Calculate the concentration of KOH

Volume = Moles/concentration; 0.05 / 0.031 = 1.61

Higher tier only

What is the molar volume of a gas at room temperature and pressure?

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1 mole of a gas at room temperature and pressure occupies 24 dm^3

What is titration?

What is titration?

A technique for finding the concentration of a solution by reacting a known volume of this solution with a solution of known concentration.

How do you conduct a titration?

How do you conduct a titration?

a) Rinse the pipette with a solution of unknown concentration. Use the pipette to measure out the known volume of this solution.
b) Add an indicator (a substance that changes colour at the end of titration)
c) Rinse the burette with a solution of known concentration. Discard the liquid. Use a burette to gradually add the solution of a known concentration.
d) When indicator changes colour (at the end point), the volume added is recorded
e) It is important to get concordant volume results - they have to lie close to each other
f) Suitable calculations are performed to find the concentration.

Why is it not always possible to obtain the theoretical amount of product in a chemical reaction?

Why is it not always possible to obtain the theoretical amount of product in a chemical reaction?

- The reaction may not go to completion because it is reversible.
- Some of the product may be lost when it is separated from the reaction mixture.
- Some of the reactants may react in ways different to the expected reaction (side reactions may occur).

How is the percentage yield of a product in a chemical reaction?

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$$\% \text{ Yield} = \frac{\text{Actual mass of a product}}{\text{Maximum theoretical mass of product}} \times 100\%$$

Calculate the percentage yield from the following data

Actual Yield (g)	Predicted Yield (g)	Percentage Yield (%)
45	100	
12	50	
8	40	

Calculate the percentage yield from the following data:

Actual Yield (g)	Predicted Yield (g)	Percentage Yield (%)
45	100	45
12	50	24
8	40	20

What is the % yield of NH_3 if 40.5 g NH_3 is produced from 20.0 mol H_2 and excess N_2?

Higher tier only

What is the % yield of NH_3 if 40.5 g NH_3 is produced from 20.0 mol H_2 and excess N_2?

Step 1 - Write the balanced equation

$N_2 + 3\ H_2 \rightarrow 2\ NH_3$

Step 2 - Calculate the theoretical amount of NH_3. Moles NH_3 (ratio of H_2 to NH_3 is 3:2); of 20/1.5 = 13.3 moles

13.3 X 17 (Mr of NH_3) = 227

Step 3 - Calculate percentage yield of NH_3

40.5/227 x 100 = 17.8%

Higher tier only

What is atom economy?

What is atom economy?

A measure of the amount of starting materials that end up as useful products.

It is a ratio of the relative formula mass of desired product to the sum of relative formula masses of reactants.

Look at the equations for the two reactions that produce $CuCl_2$

Reaction I: $CuCO_{3(s)} + 2\ HCl_{(aq)} \rightarrow CuCl_{2(aq)} + H_2O_{(l)} + CO_{2(g)}$

Reaction II: $CuO_{(s)} + 2\ HCl_{(aq)} \rightarrow CuCl_{2(aq)} + H_2O_{(l)}$

Reactive formula masses: CuO = 79.5; HCl = 36.5; $CuCl_2$ = 134.5; H_2O = 18

Which reaction has a better atom economy?

Which reaction has a better atom economy?

Reaction II (look at the reactants):

Total formula mass of reactants = 152.5

Formula mass of $CuCl_2$ = 134.5

(134.5/152.5) x 100% = **88.2%**