MOLES AND STOICHIOMETRY WS 1
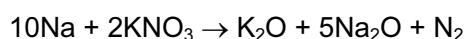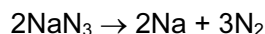
For each question there are four possible answers, **A**, **B**, **C**, and **D**. Choose the **one** you consider to be correct.

1 A pure hydrocarbon is used in bottled gas for cooking and heating.

When 10 cm³ of the hydrocarbon is burned in 100 cm³ of oxygen (an excess), the final gaseous mixture contains 30 cm³ of carbon dioxide and 20 cm³ of unreacted oxygen. All gaseous volumes were measured at room temperature and pressure.

What is the formula of the hydrocarbon?

A C₂H₆ **B** C₃H₆ **C** C₃H₈ **D** C₄H₁₀

5 Nickel makes up 20% of the total mass of a coin. The coin has a mass of 10.0 g.

How many nickel atoms are in the coin?

A 2.05 × 10²² **B** 4.30 × 10²² **C** 1.03 × 10²³ **D** 1.20 × 10²⁴

2 On collision, airbags in cars inflate rapidly due to the production of nitrogen.

Which ion has more electrons than protons and more protons than neutrons?

[H = ¹H ; D = ²H ; O = ¹⁶O]

A D⁻ **B** H₃O⁺ **C** Na⁺ **D** OH⁻

The Haber process for the manufacture of ammonia is represented by the following equation.

7 How many moles of nitrogen gas are produced from 1 mol of sodium azide, NaN₃?

The use of the Data Booklet is relevant to this question.

3 What is the number of molecules in 1 dm³ of oxygen under room conditions?

A 1.3 × 10²² **B** **C** **D**

4 Analytical chemists can detect very small amounts of antimony down to 3 × 10⁻²¹ mol.

What is metal X?

A 8 **B** 20000 **C** 35000 **D** 47000

A garden fertiliser is said to have a phosphorus content of 30.0% 'P₂O₅ soluble in water'.

What is the percentage by mass of phosphorus in the fertiliser?

A **B** **C** 26.2% **D** 30.0%

A sample of the hydrocarbon C₆H₁₂ is completely burned in dry oxygen and the product gases are collected as shown.

[A : H ; C : 12 ; O : 16]

Which equation that includes the formation of diphosphane is balanced?

A 2Na₃ + 12H₂O → 6Mg(OH)₂ + P₂H₄ + 2PH₃

B Mg₃P₂ + 6H₂O → 3Mg(OH)₂ + P₂H₄ + H₂

C 8.0 g SO₂ gas

D 11.0 g CO₂ gas

A 4.2 g O₂ gas

B 5.6 g N₂ gas

C $2Mg_3P_2 + 12H_2O \rightarrow 6Mg(OH)_2 + P_2H_4 + 2PH_3$
D $2Mg_3P_2 + 12H_2O \rightarrow 6Mg(OH)_2 + 3P_2H_4$

3 *Use of the Data Booklet is relevant to this question.*

Most modern cars are fitted with airbags. These work by decomposing sodium azide to liberate nitrogen gas, which inflates the bag.
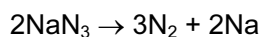
$$2NaN_3 \rightarrow 3N_2 + 2Na$$

For each question there are four possible answers, **A**, **B**, **C**, and **D**. Choose the **one** you consider to be correct.

Section A

1 Granular urea, $CO(NH_2)_2$, can be used to remove the oxides of nitrogen from the flue gases of power stations, producing nitrogen and other harmless substances.

8 In leaded petrol there is an additive composed only by lead, carbon, and hydrogen only. This compound contains lead, carbon and hydrogen only.

What is the value of x in the empirical formula PbC_xH_y?

What is the maximum volume of $0.5\,mol\,dm^{-3}$ NaOH(aq) needed to dispose of $0.02\,mol$ of N_2O_4?

A $12.5\,cm^3$ B $12.5\,cm^3$ C $40\,cm^3$ D $80\,cm^3$

9 A household bleach contains sodium chlorate(I), $NaClO$, as its active ingredient. The concentration of chlorate in the bleach can be determined by reacting a known amount with an excess of aqueous hydrogen peroxide, H_2O_2.

$$NaClO(aq) + H_2O_2(aq) \rightarrow NaCl(aq) + O_2(g) + H_2O(l)$$
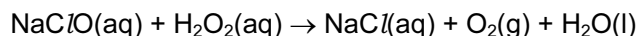
When $25.0\,cm^3$ of bleach is treated with an excess of aqueous H_2O_2, $0.0350\,mol$ of oxygen gas is liberated.

What is the concentration of $NaClO$ in the bleach?

3 Gallium nitride, GaN, could revolutionise the design of electric light bulbs because only a small length used as a filament gives excellent light at low cost.

Gallium nitride is an ionic compound containing the Ga^{3+} ion.

What is the electron arrangement of the nitrogen ion in gallium nitride?

1 *Use of the Data Booklet is relevant to this question.*

10 Titanium(IV) oxide, TiO_2, is brilliantly white and much of the oxide produced is used in the manufacture of paint.

The successive ionisation energies of an element between lithium and neon in the Periodic Table are as follows:

What is the maximum amount of TiO_2 obtainable from 19.0 tonnes of the ore ilmenite, $FeTiO_3$?

A   10.0 tonnes   B   12.7 tonnes   C   14.0 tonnes   D   17.7 tonnes

11 The todoactive shape of the spray is due to a number of damage in heart muscles after a heart attack, which burns in oxygen according to the following equation.

A sample of $10\,cm^3$ of methanethiol was exploded with $60\,cm^3$ of oxygen. After measuring the volume of gas remaining, the product was treated with an excess of aqueous sodium hydroxide and the volume of gas again measured. All measurements were made at the same temperature and pressure, under such conditions that carbon disulphide was gaseous.

What were the measured volumes?

A $20\,cm^3$ B $30\,cm^3$ C $50\,cm^3$ D $70\,cm^3$

D dolomite, $CaCO_3.MgCO_3$

14 *Use of the Data Booklet is relevant to this question.*

12 The reaction between aluminium powder and anhydrous barium nitrate is used as the propellant in some fireworks. The metal oxides and nitrogen are the only products.

Which volume of nitrogen, measured under room conditions, is produced when 0.783 g of anhydrous barium nitrate reacts with an excess of aluminium?

A $46.8\,cm^3$ **B** $72.0\,cm^3$ **C** $93.6\,cm^3$ **D** $144\,cm^3$

13 The amount of calcium ions in a sample of natural water can be determined by using an ion-exchange column as shown in the diagram.

water sample
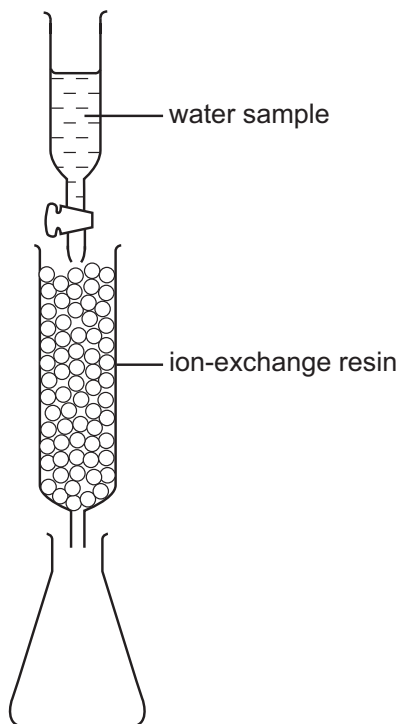
ion-exchange resin

A 50 cm³ sample of water containing dissolved calcium sulphate was passed through the ion-exchange resin. Each calcium ion in the sample was exchanged for two hydrogen ions. The resulting acidic solution collected in the flask required 25 cm³ of $1.0 \times 10^{-2}\,mol\,dm^{-3}$ potassium hydroxide for complete neutralisation.

What was the concentration of the calcium sulphate in the original sample?

A $2.5 \times 10^{-3}\,mol\,dm^{-3}$

B $1.0 \times 10^{-2}\,mol\,dm^{-3}$

C $2.0 \times 10^{-2}\,mol\,dm^{-3}$

D $4.0 \times 10^{-2}\,mol\,dm^{-3}$

14 Tetraethyl lead, $Pb(C_2H_5)_4$, has been used as a petrol additive.

What is the percentage by mass of carbon in tetraethyl lead?

A   10.2   **B**   14.9   **C**   29.7   **D**   32.0

15 A piece of rock has a mass of 2.00 g. It contains calcium carbonate, but no other basic substances. It neutralises exactly 36.0 cm^3 of 0.500 mol dm^{-3} hydrochloric acid.

What is the percentage of calcium carbonate in the 2.00 g piece of rock?

A 22.5%   **B** 45.0%   **C** 72.0%   **D** 90.1%

16 In China, the concentration of blood glucose, $C_6H_{12}O_6$, is measured in mmol / l. In Pakistan, the concentration of blood glucose is measured in mg / dl.

The unit l is a litre (1 dm^3). The unit dl is a decilitre (0.1 dm^3).

A blood glucose concentration of 18.5 mmol / l indicates a health problem.

What is 18.5 mmol / l converted to mg / dl?

A 33.3 mg / dl **B** 178 mg / dl **C** 333 mg / dl **D** 3330 mg / dl

17 A 0.005 mol sample of anhydrous calcium carbonate was completely thermally decomposed to give 100 cm^3 of gas measured at a certain temperature and pressure.

In a separate experiment carried out at the same temperature and pressure, a 0.005 mol sample of anhydrous calcium nitrate was completely thermally decomposed. The volume of gaseous products was measured.

What total volume of gaseous products was produced from the calcium nitrate?

A 50 cm^3 **B** 100 cm^3 **C** 200 cm^3 **D** 250 cm^3

18 Which mass of urea, $CO(NH_2)_2$, contains the same mass of nitrogen as 101.1 g of potassium nitrate?

A 22 g   **B** 30 g   **C** 44 g   **D** 60 g

$\rightleftharpoons$

19 Anhydrous magnesium nitrate, $Mg(NO_3)_2$, will decompose when heated, giving a white solid and a mixture of two gases X and Y.

Y is oxygen.

What is the ratio $\dfrac{\text{mass of X released}}{\text{mass of Y released}}$?

A $\dfrac{1}{0.174}$ **B** $\dfrac{1}{0.267}$ **C** $\dfrac{1}{0.348}$ **D** $\dfrac{1}{3.43}$

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www.youtube.com/megalecture