MOLES AND STOICHIOMETRY WS 1

1 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 2.05×10^{22}
B 4.30×10^{22}
C 1.03×10^{23}
D 1.20×10^{24}

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

The nitrogen is formed according to the following equations.

$$2NaN_3 \rightarrow 2Na + 3N_2$$

$$10Na + 2KNO_3 \rightarrow K_2O + 5Na_2O + N_2$$

How many moles of nitrogen gas are produced from 1 mol of sodium azide, NaN_3?

A 1.5
B 1.6
C 3.2
D 4.0

3 What is the number of molecules in 500 cm^3 of oxygen under room conditions?

A 1.25×10^{22}
B 1.34×10^{22}
C 3.0×10^{22}
D 3.0×10^{26}

4 Analytical chemists can detect very small amounts of amino acids, down to 3×10^{-21} mol. How many molecules of an amino acid ($M_r = 200$) would this be?

A 9
B 200
C 1800
D 360 000

5 Which of these samples of gas contains the same number of atoms as 1g of hydrogen (M_r : H_2, 2)?

A 22 g of carbon dioxide (M_r : CO_2, 44)
B 8 g of methane (M_r : CH_4, 16)
C 20 g of neon (M_r : Ne, 20)
D 8 g of ozone (M_r : O_3, 48)

6 Which mass of gas would occupy a volume of 3 dm^3 at 25 °C and 1 atmosphere pressure?
[1 mol of gas occupies 24 dm^3 at 25 °C and 1 atmosphere pressure.]

A 3.2 g O_2 gas
B 5.6 g N_2 gas
C 8.0 g SO_2 gas
D 11.0 g CO_2 gas

7 Most modern cars are fitted with airbags. These work by decomposing sodium azide to liberate nitrogen gas, which inflates the bag.

$$2NaN_3 \rightarrow 3N_2 + 2Na$$

A typical driver's airbag contains 50 g of sodium azide.

Calculate the volume of nitrogen this will produce at room temperature.

A 9.2 dm^3 **B** 13.9 dm^3 **C** 27.7 dm^3 **D** 72.0 dm^3

8 N_2O_4 is a poisonous gas. It can be disposed of safely by reaction with sodium hydroxide.

$$N_2O_4(g) + 2NaOH(aq) \rightarrow NaNO_3(aq) + NaNO_2(aq) + H_2O(l)$$

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

A 8 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 $NaClO$ in the bleach can be determined by reacting a known amount with 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 given off.

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

A 8.75×10^{-4} mol dm^{-3}

B 0.700 mol dm^{-3}

C 0.875 mol dm^{-3}

D 1.40 mol dm^{-3}

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

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 foul smell that skunks spray is due to a number of thiols, one of which is methanethiol, CH_3SH, which burns as follows.

$$CH_3SH + 3O_2 \rightarrow CO_2 + SO_2 + 2H_2O$$

A sample of 10 cm^3 of methanethiol was exploded with 60 cm^3 of oxygen.

What would be the final volume of the resultant mixture of gases when cooled to room temperature?

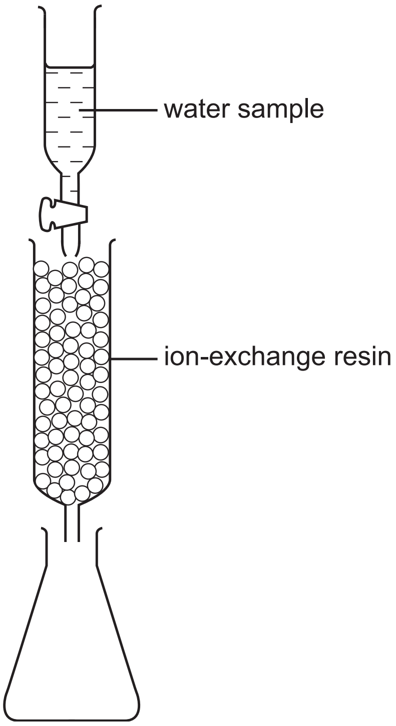
A 20 cm^3 **B** 30 cm^3 **C** 50 cm^3 **D** 70 cm^3

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.



A 50 cm^3 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 cm^3 of 1.0×10^{-2} mol dm^{-3} potassium hydroxide for complete neutralisation.

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

A 2.5×10^{-3} mol dm^{-3}

B 1.0×10^{-2} mol dm^{-3}

C 2.0×10^{-2} mol dm^{-3}

D 4.0×10^{-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

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** $\dfrac{1}{3.43}$