OVERALL CHEMISTRY CALCULATIONS WS 1

1 What is the total number of atoms in 1.80 g of water (H_2O)?

A 6.02×10^{22} **B** 6.02×10^{23} **C** 1.80×10^{23} **D** 1.80×10^{24}

2 88 kg of CO_2 contains

A 2.0 mol **B** 2000 mol **C** 0.50 mol **D** 3872 mol

3 What is the sum of the coefficients when the following equation is balanced with the smallest possible whole numbers?

$CuFeS_2 + O_2 \rightarrow Cu_2S + SO_2 + FeO$

A 7 **B** 8 **C** 11 **D** 12

4 Iron(III) oxide reacts with carbon monoxide according to the equation:

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

How many moles of iron are produced when 180 mol of carbon monoxide react with excess iron(III) oxide?

A 120 mol **B** 180 mol **C** 270 mol **D** 360 mol

5 Propene undergoes complete combustion to produce carbon dioxide and water

$2C_3H_6(g) + 9O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$

What volume of CO_2 is produced when 360 cm^3 of propene reacts with 360 cm^3 of oxygen at 273 K and 1 atm pressure?

A 120 cm^3 **B** 240 cm^3 **C** 540 cm^3 **D** 1080 cm^3

6 What mass of $Na_2S_2O_3.5H_2O$ must be used to make up 200 cm^3 of a 0.100 mol dm^{-3} solution?

A 3.16 g **B** 4.96 g **C** 24.8 g **D** 31.6 g

7 20.00 cm^3 of potassium hydroxide (KOH) is exactly neutralised by 26.80 cm^3 of 0.100 mol dm^{-3} sulfuric acid (H_2SO_4). The concentration of the potassium hydroxide is:

A 0.0670 mol dm^{-3}
B 0.134 mol dm^{-3}
C 0.268 mol dm^{-3}
D 1.34 mol dm^{-3}

8 Barium chloride solution reacts with sodium sulfate solution according to the equation

$$BaCl_2(aq) + Na_2SO_4(aq) \rightarrow BaSO_4(s) + 2NaCl(aq)$$

When excess barium chloride solution is reacted with 25.00 cm^3 of sodium sulfate solution, 0.2334 g of $BaSO_4$ (molar mass 233.4 $g\,mol^{-1}$) is precipitated.

The concentration of sodium ions in the sodium sulfate solution was:

A 0.080 00 mol dm^{-3} **C** 0.001 000 mol dm^{-3}
B 0.040 00 mol dm^{-3} **D** 0.002 000 mol dm^{-3}

9 When potassium chlorate(V) (molar mass 122.6 $g\,mol^{-1}$) is heated, oxygen gas (molar mass 32.0 $g\,mol^{-1}$) is produced:

$$2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$$

When 1.226 g of potassium chlorate(V) is heated, 0.320 g of oxygen gas is obtained. The percentage yield of oxygen is:

A 100% **B** 66.7% **C** 26.1% **D** 17.4%

10 Elemental analysis of a nitrogen oxide shows that it contains 2.8 g of nitrogen and 8.0 g of oxygen.
The empirical formula of this oxide is:

A NO **B** NO_2 **C** N_2O_3 **D** N_2O_5

11 Nitrogen can be prepared in the laboratory by the following reaction:

$$2NH_3(g) + 3CuO(s) \rightarrow N_2(g) + 3H_2O(l) + 3Cu(s)$$

If 224 cm^3 of ammonia, when reacted with excess copper oxide, produces 84 cm^3 of nitrogen, calculate the percentage yield of nitrogen. All gas volumes are measured at STP. **[3]**

12 Manganese may be extracted from its ore, hausmannite, by heating with aluminium.

$$3Mn_3O_4 + 8Al \rightarrow 4Al_2O_3 + 9Mn$$

a 100.0 kg of Mn_3O_4 is heated with 100.0 kg of aluminium. Work out the maximum mass of manganese that can be obtained from this reaction. **[4]**

b 1.23 tonnes of ore are processed and 200.0 kg of manganese obtained. Calculate the percentage by mass of Mn_3O_4 in the ore. **[3]**

13 A hydrocarbon contains 88.8% C. 0.201 g of the hydrocarbon occupied a volume of 98.3 cm^3 at 320 K and 1.00×10^5 Pa.

a Determine the empirical formula of the hydrocarbon. **[3]**

b Determine the molecular formula of the hydrocarbon. **[3]**

14 Limestone is impure calcium carbonate. A 1.20 g sample of limestone is added to excess dilute hydrochloric acid and the gas collected; 258 cm^3 of carbon dioxide was collected at a temperature of 27 °C and a pressure of 1.10×10^5 Pa.

$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$

a Calculate the number of moles of gas collected. **[3]**

b Calculate the percentage purity of the limestone (assume that none of the impurities in the limestone react with hydrochloric acid to produce gaseous products) **[3]**

15 25.0 cm^3 of 0.100 mol dm^{-3} copper(II) nitrate solution is added to 15.0 cm^3 of 0.500 mol dm^{-3} potassium iodide. The ionic equation for the reaction that occurs is:

$2Cu^{2+}(aq) + 4I^-(aq) \rightarrow 2CuI(s) + I_2(aq)$

a Determine which reactant is present in excess. **[3]**

b Determine the mass of iodine produced. **[3]**

16 0.0810 g of a group 2 metal iodide, MI_2, was dissolved in water and made up to a total volume of 25.00 cm^3. Excess lead(II) nitrate solution ($Pb(NO_3)_2(aq)$) was added to the MI_2 solution to form a precipitate of lead(II) iodide (PbI_2). The precipitate was dried and weighed and it was found that 0.1270 g of precipitate was obtained.

a Determine the number of moles of lead iodide formed. **[2]**

b Write an equation for the reaction that occurs. **[1]**

c Determine the number of moles of MI_2 that reacted. **[1]**

d Determine the identity of the metal, M. **[3]**

17 0.4000 g of hydrated copper sulfate ($CuSO_4.xH_2O$) is dissolved in water and made up to a total volume of 100.0 cm^3 with distilled water. 10.00 cm^3 of this solution is reacted with excess barium chloride ($BaCl_2$) solution. The mass of barium sulfate formed was 3.739×10^{-2} g.

a Calculate the number of moles of barium sulfate formed. **[2]**

b Write an equation for the reaction between copper sulfate solution and barium chloride solution. **[1]**

c Calculate the number of moles of copper sulfate that reacted with the barium chloride. **[1]**

d Calculate the number of moles of $CuSO_4$ in 0.4000 g of hydrated copper sulfate. **[1]**

e Determine the value of *x*. **[3]**