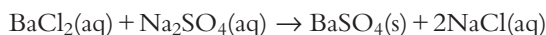


# OVERALL CHEMISTRY CALCULATIONS WS 1

- 1 What is the total number of atoms in 1.80 g of water (H<sub>2</sub>O)?  
A  $6.02 \times 10^{22}$       B  $6.02 \times 10^{23}$       C  $1.80 \times 10^{23}$       D  $1.80 \times 10^{24}$
- 2 88 kg of CO<sub>2</sub> 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<sub>2</sub> + O<sub>2</sub> → Cu<sub>2</sub>S + SO<sub>2</sub> + FeO  
A 7      B 8      C 11      D 12
- 4 Iron(III) oxide reacts with carbon monoxide according to the equation:  
Fe<sub>2</sub>O<sub>3</sub> + 3CO → 2Fe + 3CO<sub>2</sub>  
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<sub>3</sub>H<sub>6</sub>(g) + 9O<sub>2</sub>(g) → 6CO<sub>2</sub>(g) + 6H<sub>2</sub>O(l)  
What volume of CO<sub>2</sub> is produced when 360 cm<sup>3</sup> of propene reacts with 360 cm<sup>3</sup> of oxygen at 273 K and 1 atm pressure?  
A 120 cm<sup>3</sup>      B 240 cm<sup>3</sup>      C 540 cm<sup>3</sup>      D 1080 cm<sup>3</sup>
- 6 What mass of Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>·5H<sub>2</sub>O must be used to make up 200 cm<sup>3</sup> of a 0.100 mol dm<sup>-3</sup> solution?  
A 3.16 g      B 4.96 g      C 24.8 g      D 31.6 g
- 7 20.00 cm<sup>3</sup> of potassium hydroxide (KOH) is exactly neutralised by 26.80 cm<sup>3</sup> of 0.100 mol dm<sup>-3</sup> sulfuric acid (H<sub>2</sub>SO<sub>4</sub>). The concentration of the potassium hydroxide is:  
A 0.0670 mol dm<sup>-3</sup>      C 0.268 mol dm<sup>-3</sup>  
B 0.134 mol dm<sup>-3</sup>      D 1.34 mol dm<sup>-3</sup>

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



When excess barium chloride solution is reacted with  $25.00 \text{ cm}^3$  of sodium sulfate solution,  $0.2334 \text{ g}$  of  $\text{BaSO}_4$  (molar mass  $233.4 \text{ g mol}^{-1}$ ) is precipitated.

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

- A**  $0.08000 \text{ mol dm}^{-3}$                       **C**  $0.001000 \text{ mol dm}^{-3}$   
**B**  $0.04000 \text{ mol dm}^{-3}$                       **D**  $0.002000 \text{ mol dm}^{-3}$

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



When  $1.226 \text{ g}$  of potassium chlorate(V) is heated,  $0.320 \text{ g}$  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  $2.8 \text{ g}$  of nitrogen and  $8.0 \text{ g}$  of oxygen. The empirical formula of this oxide is:

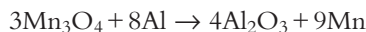
- A** NO                      **B** NO<sub>2</sub>                      **C** N<sub>2</sub>O<sub>3</sub>                      **D** N<sub>2</sub>O<sub>5</sub>

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



If  $224 \text{ cm}^3$  of ammonia, when reacted with excess copper oxide, produces  $84 \text{ cm}^3$  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.



**a**  $100.0 \text{ kg}$  of  $\text{Mn}_3\text{O}_4$  is heated with  $100.0 \text{ kg}$  of aluminium. Work out the maximum mass of manganese that can be obtained from this reaction. [4]

**b**  $1.23 \text{ tonnes}$  of ore are processed and  $200.0 \text{ kg}$  of manganese obtained. Calculate the percentage by mass of  $\text{Mn}_3\text{O}_4$  in the ore. [3]

- 13 A hydrocarbon contains 88.8% C.  $0.201 \text{ g}$  of the hydrocarbon occupied a volume of  $98.3 \text{ cm}^3$  at  $320 \text{ K}$  and  $1.00 \times 10^5 \text{ Pa}$ .

**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<sup>3</sup> of carbon dioxide was collected at a temperature of 27 °C and a pressure of 1.10 × 10<sup>5</sup> Pa.



- 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<sup>3</sup> of 0.100 mol dm<sup>-3</sup> copper(II) nitrate solution is added to 15.0 cm<sup>3</sup> of 0.500 mol dm<sup>-3</sup> potassium iodide. The ionic equation for the reaction that occurs is:
- $$2\text{Cu}^{2+}(\text{aq}) + 4\text{I}^{-}(\text{aq}) \rightarrow 2\text{CuI}(\text{s}) + \text{I}_2(\text{aq})$$
- 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<sub>2</sub>, was dissolved in water and made up to a total volume of 25.00 cm<sup>3</sup>. Excess lead(II) nitrate solution (Pb(NO<sub>3</sub>)<sub>2</sub>(aq)) was added to the MI<sub>2</sub> solution to form a precipitate of lead(II) iodide (PbI<sub>2</sub>). 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<sub>2</sub> that reacted. [1]
- d Determine the identity of the metal, M. [3]
- 17 0.4000 g of hydrated copper sulfate (CuSO<sub>4</sub>.xH<sub>2</sub>O) is dissolved in water and made up to a total volume of 100.0 cm<sup>3</sup> with distilled water. 10.00 cm<sup>3</sup> of this solution is reacted with excess barium chloride (BaCl<sub>2</sub>) solution. The mass of barium sulfate formed was 3.739 × 10<sup>-2</sup> 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<sub>4</sub> in 0.4000 g of hydrated copper sulfate. [1]
- e Determine the value of x. [3]