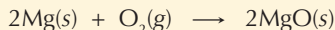


Activity 3D: The mole and chemical equations

Ans p. 8

1. A student weighed out 2.40 g of magnesium and burned it in air. Magnesium burns in air to form magnesium oxide. The equation for the reaction is:



Calculate the mass of magnesium oxide produced in the reaction.

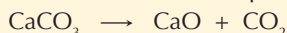
2. The reaction between magnesium carbonate and dilute hydrochloric acid is represented by the equation:



$M(\text{MgCO}_3) = 84.3 \text{ g mol}^{-1}$, $M(\text{MgO}) = 40.3 \text{ g mol}^{-1}$, $M(\text{CO}_2) = 44.0 \text{ g mol}^{-1}$

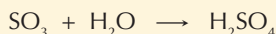
Calculate the mass of magnesium carbonate that will be needed to produce 8.80 g of CO_2 .

3. The reaction for the decomposition of calcium carbonate is:



If 100 kg of calcium carbonate is heated, what mass of calcium oxide will form?

4. When sulfur trioxide dissolves in water, the reaction occurring is:

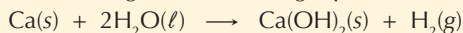


Find the mass of H_2SO_4 formed when 8.0 tonnes of sulfur trioxide dissolves in water.

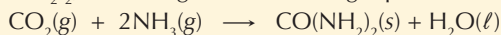
5. $\text{CH}_4(g) + 2\text{O}_2(g) \rightarrow 2\text{H}_2\text{O}(g) + \text{CO}_2(g)$

How many moles of water vapour form when 32 g of methane burns?

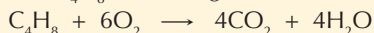
6. Calculate the mass of water that will react completely with 4.00 g of pure calcium metal according to the following equation:



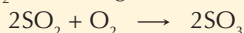
7. Calculate the mass of ammonia that is required to produce 182 kg of urea, $\text{CO}(\text{NH}_2)_2$, according to the following equation:



8. Calculate the mass of CO_2 produced in the complete combustion of 21.2 g of butene, C_4H_8 , according to the following equation:



9. Calculate the mass of sulfur trioxide, SO_3 , produced from 100 kg of sulfur dioxide, SO_2 , according to the following equation:



Activity 3D: The mole and chemical equations (page 7)

$$1. n(\text{Mg}) = \frac{m}{M} = \frac{2.40 \text{ g}}{24.3 \text{ g mol}^{-1}} = 9.88 \times 10^{-2} \text{ mol}$$

$$n(\text{Mg}) = n(\text{MgO}) = 9.88 \times 10^{-2} \text{ mol}$$

$$m(\text{MgO}) = n \times M = 9.88 \times 10^{-2} \text{ mol} \times 40.3 \text{ g mol}^{-1} \\ = 3.98 \text{ g}$$

$$2. n(\text{CO}_2) = \frac{m}{M} = \frac{8.80 \text{ g}}{44.0 \text{ g mol}^{-1}} = 0.200 \text{ mol}$$

$$n(\text{MgCO}_3) = n(\text{CO}_2) = 0.200 \text{ mol}$$

$$m(\text{MgCO}_3) = n \times M = 0.200 \times 84.3 \text{ g} \\ = 16.9 \text{ g}$$

$$3. M(\text{CaCO}_3) = 100.0 \text{ g mol}^{-1}$$

$$n(\text{CaCO}_3) = \frac{m}{M} = \frac{100\,000}{100.1} = 999 \text{ mol}$$

$$n(\text{CaO}) = n(\text{CaCO}_3) = 999 \text{ mol}$$

$$m(\text{CaO}) = n \times M = 999 \text{ mol} \times 56.1 \text{ g mol}^{-1} \\ = 56 \text{ kg}$$

$$4. n(\text{SO}_3) = \frac{m}{M} = \frac{8.0 \times 10^6 \text{ g}}{80.1 \text{ g mol}^{-1}} = 1 \times 10^5 \text{ mol}$$

$$n(\text{H}_2\text{SO}_4) = n(\text{SO}_3) = 1 \times 10^5 \text{ mol}$$

$$m(\text{H}_2\text{SO}_4) = n \times M = 1 \times 10^5 \text{ mol} \times 98.1 \text{ g mol}^{-1} \\ = 9.8 \text{ tonnes}$$

$$5. n(\text{CH}_4) = \frac{m}{M} = \frac{32 \text{ g}}{16.0 \text{ g mol}^{-1}} = 2 \text{ mol}$$

$$n(\text{H}_2\text{O}) = 2n(\text{CH}_4) = 2 \times 2 = 4 \text{ mol}$$

$$6. n(\text{Ca}) = \frac{m}{M} = \frac{4.00 \text{ g}}{40.1 \text{ g mol}^{-1}} = 0.0998 \text{ mol}$$

$$n(\text{H}_2\text{O}) = 2n(\text{Ca}) = 0.198 \text{ mol}$$

$$m(\text{H}_2\text{O}) = 0.198 \text{ mol} \times 18.0 \text{ g mol}^{-1} \\ = 35.6 \text{ g}$$

$$7. n(\text{CO}(\text{NH}_2)_2) = \frac{m}{M} = \frac{182\,000 \text{ g}}{60.0 \text{ g mol}^{-1}} = 3\,033 \text{ mol}$$

$$n(\text{NH}_3) = 2n(\text{CO}(\text{NH}_2)_2) = 2 \times 3\,033 \text{ mol} \\ = 6\,066 \text{ mol}$$

$$m(\text{NH}_3) = n \times M = 6\,066 \text{ mol} \times 17.0 \text{ g mol}^{-1} \\ = 103 \text{ kg}$$

$$8. n(\text{C}_4\text{H}_8) = \frac{m}{M} = \frac{21.2 \text{ g}}{56.0 \text{ g mol}^{-1}} = 0.379 \text{ mol}$$

$$n(\text{CO}_2) = 4n(\text{C}_4\text{H}_8) = 4 \times 0.379 \text{ mol} = 1.52 \text{ mol}$$

$$m(\text{CO}_2) = n \times M = 1.52 \text{ mol} \times 44.0 \text{ g mol}^{-1} \\ = 66.9 \text{ g}$$

$$9. \quad n(\text{SO}_2) = \frac{m}{M} = \frac{100\,000 \text{ g}}{64.1 \text{ g mol}^{-1}} = 1\,560 \text{ mol}$$

$$n(\text{SO}_2) = n(\text{SO}_3) = 1\,560 \text{ mol}$$

$$m(\text{SO}_3) = n \times M = 1\,560 \text{ mol} \times 80.1 \text{ g mol}^{-1} = 125 \text{ kg}$$