Stoichiometry – Calculating Quantities in Chemical Reactions

Key

Example: Moles <—> Moles conversion.

1) Aluminum reacts with bromine to form aluminum bromide (used as an acid catalyst in organic synthesis).

$$2\,Al(s) + 3Br_2(l) \rightarrow Al_2Br_6(s) \quad \text{[unbalanced]}$$

How many moles of Al are needed to form 2.43 mol of Al_2Br_6?

$$2.43\ mol\ Al_2Br_6 \times \frac{2\ mol\ Al}{1\ mol\ Al_2Br_6} = 4.86\ mol\ Al$$

Practice/Exploration: Check if you're already in moles, if not, a)find a way to convert to moles, then b)convert to moles of the other substance in the reaction using coefficients from the chemical equations, then c)convert to the infomation/unit requested for your answer.

2) **Mass Stoichiometry**- What mass of nitrogen gas is required to react completely with 2.79 g of hydrogen gas to produce ammonia? 2) _____

$$N_2 + 3H_2 \rightarrow 2NH_3$$

$$2.79\ g\ H_2 \times \frac{1\ mol\ H_2}{2.016\ g} \times \frac{1\ mol\ N_2}{3\ mol\ H_2} \times \frac{28.014\ g\ N_2}{1\ mol\ N_2} = 12.923\ g\ N_2 = 12.9\ g\ N_2$$

3) **Solution Stoichiometry**- What volume (in Liters) of 0.200 *M* H_2SO_4 solution is required to react exactly with 0.050 L of 0.100 *M* KOH? 3) _____

$$H_2SO_4(aq) + 2KOH(aq) \rightarrow 2H_2O(l) + K_2SO_4(aq)$$

$$0.05\ L\ KOH \times \frac{0.100\ mol\ KOH}{1\ L\ KOH} \times \frac{1\ mol\ H_2SO_4}{2\ mol\ KOH} \times \frac{1\ L\ H_2SO_4}{0.200\ mol\ H_2SO_4} = 0.0125\ L\ H_2SO_4$$

4) **Gas Stoichiometry**- What volume of CO_2 gas at STP could be produced by the decomposition of 45.0 g of $CaCO_3$? 4) _____

$$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$$

$$45.0\ g\ CaCO_3 \times \frac{1\ mol\ CaCO_3}{100.088\ g} \times \frac{1\ mol\ CO_2}{1\ mol\ CaCO_3} \times \frac{22.4\ L\ CO_2}{1\ mol\ CO_2} = 10.071\ L$$

↑ @ STP

$$= 10.1\ L\ CO_2$$

5) **Energy Stoichiometry**- Given that $CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(s)$, heat of reaction = −64.8 kJ/mol, how many grams of CaO must react in order to liberate 525 kJ of heat? 5) _____

$$-525\ kJ \times \frac{1\ mol\ CaO}{-64.8\ kJ} \times \frac{56.079\ g\ CaO}{1\ mol\ CaO} = 454.34\ g = 454\ g\ CaO$$