Stoichiometry Dry Lab

A 32

1a $12.0112 + 4 \times 1.00797 = 16.0438$ g/mol

1f $12.0112 + 3 \times 1.00797 + 15.9994 + 1.00797 = 32.04248$ g/mol

1j $2 \times (14.0067 + 4 \times 1.00797) + 2 \times 51.996 + 7 \times 15.9994 = 252.065 \frac{g}{mol}$

A33

1a grams OK $[(2 \times 10.811) + (3 \times 15.9994)] \frac{g}{mol} \times 4.86 \text{ mol} = 338 \text{ grams}$

1d grams OK (use 1j from previous page)

$\times 19.2 \text{ mol} = 4840 \text{ grams}$

1e grams OK

A34 $[(6 \times 12.0112) + (12 \times 1.00797) + (6 \times 15.9994)] \frac{g}{mol} \times 0.136 \text{ mol} = 24.5 \text{ grams}$

2a

$Al(OH)_3$: $78.00361 \frac{g}{mol} \cdot 3.75 \text{ grams} \times \frac{1 \text{ mol}}{78.00361 \text{ g}} = 0.0481 \text{ mol}$

2b

Mg_3N_2: $100.9494 \frac{g}{mol}$ $0.272 \text{ kg} \times \frac{10^3 \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ mol}}{100.9494 \text{ g}} = 2.69 \text{ mol}$

2c

$$42.42 \text{ g} \times \frac{1 \text{ mol}}{39.948 \text{ g}} = 1.062 \text{ mol}$$

3a $0.136 \text{ mol} \times \frac{6.022 \times 10^{23} \text{ molecules}}{\text{mol}} = 8.19 \times 10^{22}$ molecules

3c $7.85 \text{ g} \times \frac{1 \text{ mol}}{4.0026 \text{ g}} \times \frac{6.022 \times 10^{23} \text{ atoms}}{\text{mol}} = 1.18 \times 10^{24}$ atoms

3d (tricky)

$229.6 \text{ mg} \times \frac{1 \text{ g}}{1000 \text{ mg}} \times \frac{1 \text{ mol } I_2}{126.904 \text{ g} \times 2} \times \frac{6.022 \times 10^{23} \text{ molecules } I_2}{1 \text{ mol } I_2} \times \frac{2 \text{ atoms I}}{1 \text{ molecule } I_2} = \boxed{1.09 \times 10^{21} \text{ atoms I}}$

A35

2 $1.4 \text{ mol } (NH_4)_3PO_4 \times \frac{3 \text{ mol N}}{1 \text{ mol } (NH_4)_3PO_4} = 4.2 \text{ mol N}$

3a $1.4 \text{ mol } (NH_4)_3PO_4 \times \frac{12 \text{ mol H}}{1 \text{ mol } (NH_4)_3PO_4} = 17 \text{ mol H}$

A36 $12.7 \text{ g } CO_2 \times \frac{1 \text{ mol } CO_2}{44.01 \text{ g } CO_2} \times \frac{2 \text{ mol O}}{1 \text{ mol } CO_2} \times \frac{16.00 \text{ g}}{1 \text{ mol O}} = 9.23 \text{ g O}$

2

answer this question for moles of O2 also

3

answer this question for mass of N2 in grams

Stoichiometry

Just as the subscripts in the formula of a compound tell us how the quantities of atoms are related within a molecule, the stoichiometric coefficients in a balanced reaction tell us about how the quantities of reactant and product molecules (or formula units) are related to each other. These can also be setup as ratios or equalities to allow us to solve chemical calculations.

For example, in the reaction:

$$Al_2(SO_4)_3 + 3\ Ba(OH)_2 \rightarrow 3\ BaSO_4 + 2\ Al(OH)_3$$

The following 12 mole-mole relationships can be established:

$$\frac{1\ mol\ Al_2(SO_4)_3}{3\ mol\ Ba(OH)_2} \quad \frac{1\ mol\ Al_2(SO_4)_3}{3\ mol\ BaSO_4} \quad \frac{1\ mol\ Al_2(SO_4)_3}{2\ mol\ Al(OH)_3} \quad \frac{3\ mol\ Ba(OH)_2}{3\ mol\ BaSO_4} \quad \frac{3\ mol\ Ba(OH)_2}{2\ mol\ Al(OH)_3} \quad \frac{3\ mol\ BaSO_4}{2\ mol\ Al(OH)_3}$$

Plus the 6 reciprocals

1. Determine at least 3 possible mole-mole relationships that can be derived from the following equation.

   ____ NH_3 + ____ O_2 → ____ N_2 + ____ H_2O

2. Given: 2 $KClO_3$ (s) → 3 O_2 (g) + 2 KCl (s) How many moles of KCl is produced when 12.5 mol $KClO_3$ is decomposed?

$$12.5\ mol\ KClO_3 \times \frac{2\ mol\ KCl}{2\ mol\ KClO_3} = 12.5\ mol\ KCl$$

$$12.5\ mol\ KClO_3 \times \frac{3\ mol\ O_2}{2\ mol\ KClO_3} = 18.8\ mol\ O_2$$

3. The reaction ____ N_2(g) + 3 H_2(g) → 2 NH_3(g) is used to produce NH_3. How many moles of H_2(g) are required to produce 2.50 g of NH_3(g)?

$$2.50\ g\ NH_3 \times \frac{1\ mol\ NH_3}{17.03061\ g} \times \frac{3\ mol\ H_2}{2\ mol\ NH_3} = 0.220\ mol\ H_2$$

$$2.50\ g\ NH_3 \times \frac{1\ mol\ NH_3}{17.03061\ g} \times \frac{1\ mol\ N_2}{2\ mol\ NH_3} \times \frac{2 \times 14.0067\ g}{1\ mol\ N_2} = 2.06\ g\ N_2$$

4. Given: $MgCO_3$(s) → MgO(s) + CO_2(g) Calculate the grams of CO_2(g) produced from the decomposition of 17.2 g of $MgCO_3$(s).