Stoichiometry

-- process that chemists use to determine the relationship between products formed and reactants used in a chemical reaction

Tells us:

-- how much product is formed

-- how much reactant is needed

Dec 6-2:48 PM

Mole Ratios

-- the relationship between the number of moles of any 2 substances in a reaction

$$2H_2 + O_2 \longrightarrow 2H_2O$$

Possible mole ratios:

$\frac{2\ mol\ H_2}{1\ mol\ O_2}$ $\frac{2\ mol\ H_2}{2\ mol\ H_2O}$ $\frac{1\ mol\ O_2}{2\ mol\ H_2O}$

$\frac{1\ mol\ O_2}{2\ mol\ H_2}$ $\frac{2\ mol\ H_2O}{2\ mol\ H_2}$ $\frac{2\ mol\ H_2O}{1\ mol\ O_2}$

Dec 6-2:59 PM

Stoichiometry

1. Complete and balance the chemical equation.
2. Put the quantity (with units) that you know above the element/compound in the chemical equation.
3. Put an x (with units) above the element/compound that you are looking for in the chemical equation.
4. If not already in moles, convert the known quantity to moles.
5. Determine the mole ratios and convert to the new element/compound.
6. If necessary, convert from moles back to grams (depending on what the problem is asking for).

Dec 6-2:59 PM

Stoichiometry

Sodium chloride is decomposed into the elements sodium and chlorine. How many grams of chlorine gas can be obtained from 2.50 mole NaCl?

2.50 mol xg

$2NaCl \longrightarrow 2Na + Cl_2$

$2.50\ mol\ NaCl \times \frac{1\ mol\ Cl_2}{2\ mol\ NaCl} \times \frac{70\ g\ Cl_2}{1\ mol\ Cl_2}$

$Cl = 2 \times 35 = 70\ g/mol$

$= 87.5\ g\ Cl_2$

Dec 6-2:59 PM

Stoichiometry

A solution of potassium chromate reacts with a solution of lead (II) nitrate to produce yellow precipitate of lead (II) chromate and a solution of potassium nitrate. Given 80.8 g $PbCrO_4$, how many moles of potassium chromate are used?

$$K_2CrO_4 + Pb(NO_3)_2 \rightarrow PbCrO_4 + 2\ KNO_3$$

$80.8\ g\ PbCrO_4 \times \frac{1\ mol\ PbCrO_4}{323\ g\ PbCrO_4} \times \frac{1\ mol\ K_2CrO_4}{1\ mol\ PbCrO_4} = .25\ mol\ K_2CrO_4$

Pb = 1 x 207 = 207
Cr = 1 x 52 = 52
O = 4 x 16 = 64
323 g/mol

Dec 6-2:59 PM

Stoichiometry

Given the following equation for the combustion of ethanol, C_2H_5OH, how many moles of O_2 are needed to burn 52.3 g C_2H_5OH?

$$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$$

$52.3\ g\ C_2H_5OH \times \frac{1\ mol\ C_2H_5OH}{46\ g\ C_2H_5OH} \times \frac{3\ mol\ O_2}{1\ mol\ C_2H_5OH} = 3.41\ mol\ O_2$

46

Dec 6-2:59 PM

Stoichiometry

Determine the mass of water produced if 65.2 g of calcium carbonate are allowed to react with excess phosphoric acid according to the following reaction:

$$3\ CaCO_3 + 2\ H_3PO_4 \rightarrow Ca_3(PO_4)_2 + 3H_2O + 3CO_2$$

$65.2\ g\ CaCO_3 \times \frac{1\ mol\ CaCO_3}{100\ g\ CaCO_3} \times \frac{3\ mol\ H_2O}{3\ mol\ CaCO_3} \times \frac{18\ g\ H_2O}{1\ mol\ H_2O} = 11.7\ g\ H_2O$

Ca = 1 x 40 = 40
C = 1 x 12 = 12
O = 3 x 16 = 48
100 g/mol

H = 2 x 1 = 2
O = 1 x 16 = 16
18

Dec 6-2:59 PM

Stoichiometry

Potassium chlorate decomposes to potassium chloride and oxygen. How much oxygen is produced when 49.89 g potassium chlorate decomposes?

$$2KClO_3 \rightarrow 2KCl + 3O_2$$

$49.89\ g\ KClO_3 \times \frac{1\ mol\ KClO_3}{122\ g\ KClO_3} \times \frac{3\ mol\ O_2}{2\ mol\ KClO_3} \times \frac{32\ g\ O_2}{1\ mol\ O_2} = 19.6\ g\ O_2$

Dec 6-2:59 PM

1. If 120. g of sodium carbonate react with an excess of calcium hydroxide, how many grams of sodium hydroxide are formed?

120.g Xg
___Na_2CO_3 + ___$Ca(OH)_2$ ⟶ 2 NaOH + ___$CaCO_3$

$120.\text{g}\,Na_2CO_3 \times \frac{1\ \text{mol}\ Na_2CO_3}{106\,\text{g}\ Na_2CO_3} \times \frac{2\ \text{mol NaOH}}{1\ \text{mol}\ Na_2CO_3} \times \frac{40\,\text{g NaOH}}{1\ \text{mol NaOH}} = 90.6\,\text{g NaOH}$

Dec 7-2:38 PM

2. When 80.0 g of calcium chloride react with an excess of silver nitrate, how many grams of silver chloride are produced?

80.0g Xg
___$CaCl_2$ + 2 $AgNO_3$ ⟶ ___$Ca(NO_3)_2$ + 2 AgCl

$80.0\,\text{g}\,CaCl_2 \times \frac{1\ \text{mol}\ CaCl_2}{110\,\text{g}\ CaCl_2} \times \frac{2\ \text{mol AgCl}}{1\ \text{mol}\ CaCl_2} \times \frac{143\,\text{g AgCl}}{1\ \text{mol AgCl}} = 208\,\text{g AgCl}$

Dec 7-2:43 PM