Chemistry 11

Stoichiometry III

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1. Stoichiometry → All Conversions

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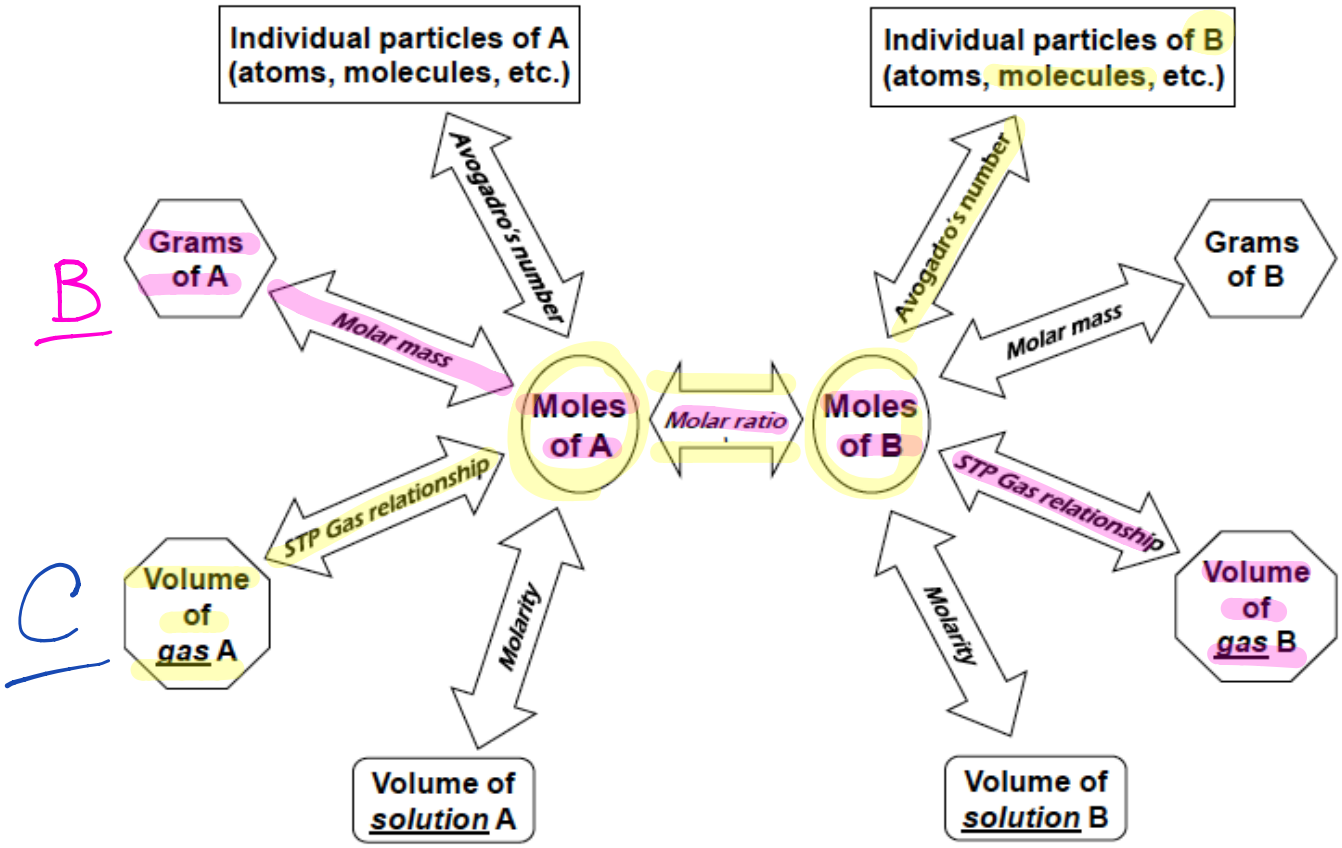
The Mole Wheel



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C

Aluminum metal reacts with the oxygen gas in the air to produce aluminum oxide.

a) Write out the balanced equation below:

$$4\,Al + 3O_2 \longrightarrow 2Al_2O_3$$

b) If 4.71 grams of aluminum reacted, how many liters of oxygen reacted at STP?

$$4.71\,g_{Al} \times \frac{1\,mol_{Al}}{26.98\,g_{Al}} \times \frac{3\,mol_{O_2}}{4\,mol_{Al}} \times \frac{22.4\,L_{O_2}}{1\,mol_{O_2}} = \boxed{2.93\,L_{O_2}}$$

c) If 6.14 L of oxygen reacted at STP, how many molecules of the aluminum oxide were produced?

$$6.14\,L_{O_2} \times \frac{1\,mol_{O_2}}{22.4\,L_{O_2}} \times \frac{2\,mol_{Al_2O_3}}{3\,mol_{O_2}} \times \frac{6.022\times10^{23}\,molecules_{Al_2O_3}}{1\,mol_{Al_2O_3}}$$

$$= \boxed{1.10\times10^{23}\,molecules_{Al_2O_3}}$$

Sodium metal reacts with the oxygen gas in the air to produce sodium oxide.

a) Write out the balanced equation below:

$$4\,Na + O_2 \longrightarrow 2\,Na_2O$$

b) If 9.11 moles of sodium reacted, how many liters of oxygen reacted at STP?

$$9.11\,mol\,Na \times \frac{1\,mol\,O_2}{4\,mol\,Na} \times \frac{22.4\,L\,O_2}{1\,mol\,O_2} = \boxed{51.0\,L\,O_2}$$

c) If 1.38 grams of sodium reacted, how many grams of sodium oxide were produced?

$$1.38\,g\,Na \times \frac{1\,mol\,Na}{22.99\,g\,Na} \times \frac{2\,mol\,Na_2O}{4\,mol\,Na} \times \frac{61.98\,g\,Na_2O}{1\,mol\,Na_2O} = \boxed{1.86\,g\,Na_2O}$$

Chromium(II) oxide reacts with barium metal in a single replacement reaction.

a) Write out the balanced equation below:

$$CrO + Ba \longrightarrow BaO + Cr$$

b) If 1.11 grams of chromium(II) oxide reacted, how many atoms of barium reacted?

$$1.11\,g\,CrO \times \frac{1\,mol\,CrO}{68.00\,g\,CrO} \times \frac{1\,mol\,Ba}{1\,mol\,CrO} \times \frac{6.022\times10^{23}\,atoms\,Ba}{1\,mol\,Ba} = \boxed{9.83\times10^{21}\,atoms\,Ba}$$

c) If 2.34 grams of chromium metal were produced, how many grams of the barium reacted?

$$2.34\,g\,Cr \times \frac{1\,mol\,Cr}{52.00\,g\,Cr} \times \frac{1\,mol\,Ba}{1\,mol\,Cr} \times \frac{137.33\,g\,Ba}{1\,mol\,Ba} = \boxed{6.18\,g\,Ba}$$

Lead(III) oxide reacts with calcium metal in a single replacement reaction.

a) Write out the balanced equation below:

$$Pb_2O_3 + 3\,Ca \longrightarrow 3\,CaO + 2\,Pb$$

b) If 1.67 grams of lead(III) oxide reacted, how many grams of lead metal is produced?

$$1.67\,g\,Pb_2O_3 \times \frac{1\,mol\,Pb_2O_3}{462.40\,g\,Pb_2O_3} \times \frac{2\,mol\,Pb}{1\,mol\,Pb_2O_3} \times \frac{207.20\,g\,Pb}{1\,mol\,Pb} = \boxed{1.50\,g\,Pb}$$

c) If 4.34 grams of CaO were produced, how many grams of calcium metal reacted?

$$4.34\,g\,CaO \times \frac{1\,mol\,CaO}{56.08\,g\,CaO} \times \frac{3\,mol\,Ca}{3\,mol\,CaO} \times \frac{40.08\,g\,Ca}{1\,mol\,Ca} = \boxed{3.10\,g\,Ca}$$

$M = \frac{mol}{L} \times L$

With a special focus on MOLAR CONCENTRATION…

Nickel reacts with silver nitrate to produce nickel (II) nitrate and silver metal. What mass of nickel reacts with silver nitrate in 1.25 L of a 0.15 M solution? Begin by writing a balanced equation.

$Ni + 2AgNO_3 \rightarrow Ni(NO_3)_2 + 2Ag$

? g 1.25 L 0.15 M

$$1.25\,L_{AgNO_3} \times \frac{0.15\,mol_{AgNO_3}}{1\,L_{AgNO_3}} \times \frac{1\,mol_{Ni}}{2\,mol_{AgNO_3}} \times \frac{58.69\,g_{Ni}}{1\,mol_{Ni}}$$

$$= \boxed{5.5\,g_{Ni}}$$

What volume of hydrogen gas is formed at STP with 150. mL of 0.185M HI acid?

$2\,HI + Zn \rightarrow H_2 + ZnI_2$

0.185M ? L

150. mL

$$150.\,mL_{HI} \times \frac{1\,L_{HI}}{1000\,mL_{HI}} \times \frac{0.185\,mol_{HI}}{1\,L_{HI}} \times \frac{1\,mol_{H_2}}{2\,mol_{HI}} \times \frac{22.4\,L_{H_2}}{1\,mol_{H_2}}$$

$$= \boxed{0.311\,L\,H_2}$$

A flask containing 450. mL of 0.500M HBr was accidentally knocked to the floor. How many grams of potassium chromate would you need to put on the spill to completely neutralize the acid? Begin by writing a balanced equation.

$2HBr + K_2CrO_4 \rightarrow H_2CrO_4 + 2KBr$

450. mL ? g

0.500M

$$0.450\,L_{HBr} \times \frac{0.500\,mol_{HBr}}{1\,L_{HBr}} \times \frac{1\,mol_{K_2CrO_4}}{2\,mol_{HBr}} \times \frac{194.20\,g_{K_2CrO_4}}{1\,mol_{K_2CrO_4}}$$

$$= \boxed{21.8\,g\,K_2CrO_4}$$

Practice:

Potassium permanganate reacts with oxalic acid ($H_2C_2O_4$) in sulphuric acid (H_2SO_4) to produce manganese (II) sulphate, carbon dioxide, water and potassium sulphate.

- Balanced Reaction:

$$2KMnO_4 + 5H_2C_2O_4 + 3H_2SO_4 \rightarrow 2MnSO_4 + 10CO_2 + 8H_2O + K_2SO_4$$

- How many mL of 0.250M $KMnO_4$ are needed to react with 3.225g of oxalic acid? (57.3 mL $KMnO_4$)

$$3.225\,g_{H_2C_2O_4} \times \frac{1\,mol_{H_2C_2O_4}}{90.04\,g_{H_2C_2O_4}} \times \frac{2\,mol_{KMnO_4}}{5\,mol_{H_2C_2O_4}} \times \frac{1\,L_{KMnO_4}}{0.250\,mol_{KMnO_4}} \times \frac{1000\,mL}{1\,L}$$

$$= \boxed{57.3\,mL\ KMnO_4}$$

How many litres of CO_2 would be formed at STP if 1.500L of 1.75M phosphoric acid (H_3PO_4) were reacted with potassium carbonate? (88.2 L CO_2)

$$\underline{2}\ H_3PO_4 + \underline{3}\ K_2CO_3 \rightarrow \underline{3}\ CO_2 + \underline{2}\ K_3PO_4 + \underline{3}\ H_2O$$

$$1.500\,L_{H_3PO_4} \times \frac{1.75\,mol_{H_3PO_4}}{1\,L} \times \frac{3\,mol_{CO_2}}{2\,mol_{H_3PO_4}} \times \frac{22.4\,L_{CO_2}}{1\,mol_{CO_2}}$$

$$= \boxed{88.2\,L_{CO_2}}$$