5/1/13 Molar Relationships

Avagadro – 1 mole – carbon-12. mass 12.00g of carbon-12 it had 6.022×10^{23} atoms.

1 mole = 6.022×10^{23} atoms / molecules / formula units = molar mass in grams (from the periodic table) = 22.4L (for gases)

2.4 mol (given quantity) ? atoms (need) of carbon

amt given × $\frac{\text{label needed}}{\text{label given}}$

$$2.4\ \text{mol} \times \frac{6.022 \times 10^{23}\ \text{atoms}}{1\ \text{mol}} = 1.4 \times 10^{24}\ \text{atoms}$$

How many grams (need) are in 12.6 L of chlorine gas? (Given)

H N O F Cl Br I

$$12.6\,L\ Cl_2 \times \frac{70.90\ g}{22.4\ L} = \boxed{39.9\,g\ Cl_2}$$

How many moles (need) are in 4.23g of magnesium? (Given)

$$4.23\,g\ Mg \times \frac{1\ mol}{24.31\ g} = \boxed{0.174\ mol\ Mg}$$

Stoichiometry

1. Balance reaction
2. Determine molar ratio (use the coefficients in the reaction)
3. Set up Stoich. equation.

$$\text{given label} \times \frac{1\text{ mol given}}{\text{molar mass given -or- } 22.4\text{L}} \times \underbrace{\frac{\#\text{coef of mol need}}{\#\text{coef. of mol given}}}_{\text{molar Ratio}} \times \frac{\text{molar mass of needed -or- } 22.4\text{L}}{1\text{ mol needed}} =$$

mol → mol   1 step = molar ratio

mol → mass   2 steps = M.R. & last step

mass → mol   2 steps = 1st step & MR

mass → mass   all 3 steps

vol → vol   all 3 steps

$$\underline{2}\ Ag + \underline{1}\ Cl_2 \rightarrow \underline{2}\ AgCl$$

if 52.4g of silver react how many moles of AgCl will be produced?

given: 52.4g of silver

need: moles of AgCl

MR

$$52.4\ g\ Ag \times \frac{1\ mol\ Ag}{107.87\ g\ Ag} \times \frac{2\ mol\ AgCl}{2\ mol\ Ag} =$$

$\underline{3}$ KCl + $\underline{1}$ AlF_3 → $\underline{3}$ KF + $\underline{1}$ $AlCl_3$

How many grams of potassium fluoride will be produced from 7.96g of AlF_3?

$$7.96\text{g } AlF_3 \times \frac{1 \text{ mol } AlF_3}{83.98 \text{ g } AlF_3} \times \frac{3 \text{ mol KF}}{1 \text{ mol } AlF_3} \times \frac{58.10\text{g KF}}{1 \text{ mol KF}} = \boxed{16.5\text{g KF}}$$

$\underline{2}$ KCl + $\underline{1}$ $I_2(g)$ → $\underline{2}$ KI + $\underline{1}$ $Cl_2(g)$

How many liters of chlorine gas will be produced from 56.4L of I_2?

$$56.4\text{L } I_2 \times \frac{1 \text{ mol } I_2}{22.4\text{L } I_2} \times \frac{1 \text{ mol } Cl_2}{1 \text{ mol } I_2} \times \frac{22.4\text{L } Cl_2}{1 \text{ mol } Cl_2} = \boxed{56.4\text{L } Cl_2}$$

Molarity (liters) $M = \frac{n}{L} = \frac{\text{\# mol of solute}}{\text{\# L of solution}}$ if grams of solute → moles

if given mL of solution → L

molality (solid) $m = \frac{n}{Kg} = \frac{\text{\# mol solute}}{\text{\# Kg of solvent}}$ Small mass = solute → moles

Large mass = solvent → Kilograms

grams given $\times \frac{1 \text{ mol}}{\text{molar mass}}$ = # of moles

Acid/Base use pH scale $2H_2O \rightleftharpoons H_3O^+ + OH^-$

(H_3O^+ = hydronium)

$pH = -\log[H_3O^+]$

$[H_3O^+] = 1.0 \times 10^{-9} M$

$pH = 9$

[ ] mean Concentration of

$[H_3O^+] = 1.5 \times 10^{-9}\,M$ $pH = \downarrow 9$ (8.8) $-\log(1.5 \times 10^{-9})$

$[H_3O^+][OH^-] = 1.0 \times 10^{-14}\,M$ $pH + pOH = 14$

$pOH = 8$? pH $pH = 6$