C11 - 2.1 - Stoichiometry Moles <-> Moles Notes

Stoichiometry: *the relationship between the amount of reactants used in a chemical reaction and the amounts of products produced by the chemical reaction.*

$2H_2 + O_2 = 2H_2O$

$\boxed{Assume\ Coefficient = \#\ of\ Moles\ or\ \#\ of\ Molecules}$

Reactants *Products*

$2\ Moles\ H_2 : 1\ Mole\ O_2 \quad : \quad 2\ Moles\ H_2O$

$\boxed{Molar\ Ratio}$

$\boxed{\frac{2\ moles\ H_2}{1\ mol\ O_2}}$ $\boxed{\frac{2\ Moles\ H_2}{2\ Moles\ H_2O}}$

$\boxed{\frac{1\ Mole\ O_2}{2\ Moles\ H_2O}}$

How many moles of 0_2 *are required to react with* 20 *moles of* H_2?

$2\ Moles\ H_2 : 1\ Mole\ O_2$

$20\ Moles\ H_2 : 10\ Moles\ O_2$

Choose the fraction to cross off the units you don't want and get the units you do.

$$\#\ moles\ O_2 = 20\ moles\ H_2 \times \frac{1\ moles\ O_2}{2\ mol\ H_2} = 10\ moles\ O_2$$

$$\boxed{Given\ units \times \frac{desired\ units}{given\ units}}$$

How many moles of H_2 *are required to react with* 6 *moles of* O_2?

$$\#\ moles\ H_2 = 6\ moles\ O_2 \times \frac{2\ moles\ H_2}{1\ mol\ O_2} = 12\ moles\ H_2$$

How many moles of H_2 *are required to produce* 14 *moles of* H_2O?

$$\#\ moles\ H_2 = 14\ moles\ H_2O \times \frac{2\ moles\ H_2}{2\ mol\ H_2O} = 14\ moles\ H_2$$

How many moles of H_2O *are produced if* 22 *moles of* O_2 *are reacted*?

$$\#\ moles\ H_2O = 22\ moles\ O_2 \times \frac{2\ moles\ H_2O}{1\ mol\ O_2} = 44\ moles\ H_2O$$

C11 - 2.1 - Stoichiometry Mass <-> Moles Notes

$$2H_2 + O_2 = 2H_2O$$

$What\ mass\ of\ H_2O\ is\ produce\ by\ reacting\ 10\ moles\ of\ O_2?$

$$mass\ H_2O = 10\ moles\ O_2 \times \frac{2\ mol\ H_2O}{1\ mol\ O_2} \times \frac{18\ g\ H_2O}{mol\ H_2O} = 360\ g\ H_2O$$

$$mass\ H_2O = 10\ moles\ O_2 \times \frac{32\ g\ O_2}{mol\ O_2} = Dont\ Do\ This\ Ever\ because\ yo\ would\ have\ to\ go\ back\ to\ moles!$$

$What\ mass\ of\ H_2O\ is\ produced\ by\ reacting\ 10\ grams\ of\ O_2?$

$$mass\ H_2O = 10\ g\ O_2 \times \frac{1\ mol\ O_2}{32\ g\ O_2} \times \frac{2\ mol\ H_2O}{1\ mol\ O_2} \times \frac{18\ g\ H_2O}{mol\ H_2O} = 2.81\ g\ H_2O$$

$What\ mass\ of\ H_2O\ is\ produced\ by\ reacting\ 2\ L\ of\ O_2\ at\ STP?$

$$mass\ H_2O = 2\ L\ O_2 \times \frac{1\ mol\ O_2}{22.4\ L\ O_2} \times \frac{2\ mol\ H_2O}{1\ mol\ O_2} \times \frac{18\ g\ H_2O}{mol\ H_2O} = 3.21\ g\ H_2O$$

$$N_2 + 3H_2 = 2NH_3$$

$What\ is\ the\ mass\ NH_3\ produced\ if\ 5\ moles\ of\ N_2\ is\ reacted?$

$$mass\ NH_3 = 5\ moles\ N_2 \times \frac{2\ mol\ NH_3}{1\ mol\ N_2} = \frac{17g\ NH_3}{1\ mol\ NH_3} = 170\ g\ NH_3$$

$What\ mass\ of\ H_2\ is\ required\ to\ produce\ 50\ g\ of\ NH_3?$

$$mass\ H_2 = 50\ g\ NH_3 \times \frac{1\ mol\ NH_3}{17\ g\ NH_3} \times \frac{3\ mol\ H_2}{2\ mol\ NH_3} \times \frac{2\ g\ H_2}{mol\ H_2} = 8.82\ g\ H_2$$

C11 - 2.2 - Excess Notes

$If\ 10\ g\ of\ H_2\ react\ with\ 50\ g\ of\ O_2\ in\ the\ reaction, which\ element\ is\ in\ excess\ and\ by\ how\ much?$

$$2H_2 + O_2 = 2H_2O$$

$Assume:$

$2\ mol\ H_2 = 2\ g\ H_2$
$1\ mol\ O_2 = 32\ g\ O_2$
$2\ mol\ H_2O = 18\ g\ H_2O$

$Molar\ Ratio$

$2\ mol\ H_2 : 1\ mol\ O_2 : 2\ mol\ H_2O$

$$Molar\ Ratio : \frac{Moles\ of\ reactants}{Moles\ of\ Products}$$

1) $Calculate\ potential\ g\ H_2O\ created\ by\ each\ mass\ (g)\ of\ H_2 and\ O_2$

$$Mass\ H_2O\ (H_2) = 10\ g\ H_2 \times \frac{1 mol\ H_2}{2\ g\ H_2} \times \frac{2\ mol\ H_2O}{2\ mol\ H_2} \times \frac{18\ g\ H_2O}{1\ mol\ H_2O} = 90\ g\ H_2O$$

$Convert\ g\ H_2\ to\ moles\ H_2$ $\quad$ $Molar\ Ratio$ $\quad$ $Molar\ Mass$

$$Mass\ H_2O\ (O_2) = 50\ g\ O_2 \times \frac{1 mol\ O_2}{32\ g\ O_2} \times \frac{2\ mol\ H_2O}{1\ mol\ O_2} \times \frac{18\ g\ H_2O}{1\ mol\ H_2O} = 56.25\ g\ H_2O$$

$Convert\ g\ O_2\ to\ moles\ O_2$

$O_2\ limits\ the\ amount\ of\ H_2O\ that\ can\ be\ created\ so\ it\ is\ te\ Limiting\ Reactant. Therefore\ H_2\ is\ in\ excess.$

2) $Calculate\ how\ much\ element\ in\ Excess\ will\ be\ created\ with\ the\ g\ of\ Limiting\ Reactant$

$$mass\ H_2\ reacted = 50\ g\ O_2 \times \frac{1\ mol\ O_2}{32\ g\ O_2} \times \frac{2\ mol\ H_2}{1\ mol\ O_2} \times \frac{2\ g\ H_2}{(1\ mol\ H_2)} = 6.25\ g$$

$O_2 : Limiting\ Reactant$

$H_2 : Reactant\ in\ Excess$

$\boxed{Start\ with\ the\ Mass\ of\ the\ Limiting\ Reactant}$

3) $$mass\ H_2\ in\ Excess = mass\ H_2\ (given) - mass\ H_2\ (reacted) = 10\ g\ H_2 - 6.25\ g\ H_2 = 3.75\ g\ H_2$$

$Molar\ Mass$	$Assumptions:$
$1\ mol\ H_2 = 2\ g\ H_2$	$2\ mol\ H_2 \times \frac{1\ g}{1\ mol\ H_2} = 2\ g\ H_2$
$1\ mol\ O_2 = 32\ g\ O_2$	$1\ mol\ O_2 \times \frac{32\ g}{1\ mol\ O_2} = 32\ g\ O_2$
$1\ mol\ H_2O = 18\ g\ H_2O$	$2\ mol\ H_2O \times \frac{18\ g}{1\ mol\ H_2O} = 36\ g\ H_2O$

C11 - 2.4 - Percent Yield/Percent Purity p.136

$$\boxed{Percent\ Yield = \frac{mass\ of\ product\ obtained}{mass\ of\ product\ expected} \times 100\%}$$

$$\boxed{Percent\ Purity = \frac{mass\ of\ pure\ reactant}{mass\ of\ impure\ reactant} \times 100\%}$$

$$2H_2 + O_2 = 2H_2O$$

If $20\ g\ of\ O_2$ *is reacted with an excess of* H_2, $7.4\ g\ of\ H_2O$ *is formed. What is the percentage yield?*

$$mass\ H_2O = 20\ g\ O_2 \times \frac{1\ mol\ O_2}{32\ g\ O_2} \times \frac{1 mol H_2O}{1 mol O_2} \times \frac{18\ g\ H_2O}{1\ mol\ H_2O} = 11.25\ g\ H_2O$$

$$Percent\ Yield = \frac{mass\ of\ product\ obtained}{mass\ of\ product\ expected} \times 100\%$$

$$Percent\ Yield = \frac{7.4\ g\ H_2O}{11.25\ g\ H_2O} \times 100\%$$

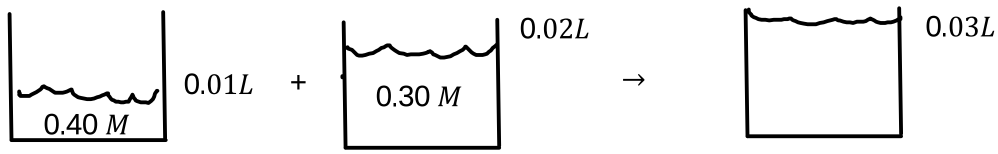
$$Percent\ Yield = 65.8\%$$

C11 - 2.5 - Precipitates

Find the concentration of the ions after the precipitate ends.

$0.01\ L\ of\ 0.40\ M\ Na_2SO_4\ and\ 0.02\ L\ of\ 0.20\ M\ Pb(NO_3)_2$

$$Na_2SO_4 \quad + \quad Pb(NO_3)_2 \quad \rightarrow \quad 2NaNO_3 \quad + \quad PbSO_4$$



$c = \frac{n}{v}$
$n = cv$
$n = 0.40 \times 0.01$
$n = 0.004\ moles$

$c = \frac{n}{v}$
$n = cv$
$n = 0.30 \times 0.02$
$n = 0.006\ moles$

Decompositions (Molar Ratios)

$$Na_2SO_4 \quad \rightarrow \quad 2Na^{+} \quad + \quad SO_4^{2-}$$

0.004 *moles*   0.008 *moles*   0.004 *moles*

$[Na^+] = \frac{0.008\ mol}{0.03\ L}$
$[Na^+] = 0.27\ M$

$$Pb(NO_3)_2 \quad \rightarrow \quad Pb^{2+} \quad + \quad 2NO_3^{1-}$$

0.006 *moles*   0.006 *moles*   0.012 *moles*

$[NO_3^-] = \frac{0.012\ mol}{0.03\ L}$
$[NO_3^-] = 0.40\ M$

Net Ionic Equation (NIE)

$$Pb^{2+} \quad + \quad SO_4^{-2} \quad \rightarrow \quad PbSO_4$$

Pb^{2+}	SO_4^{-2}	$PbSO_4$
0.006	0.004	
−0.004	−0.004	
0.002	0	0.002
Left over	*Used up*	
Reactant in Excess	*Limiting Reactant*	

$[Pb^{2+}] = \frac{0.002\ mol}{0.03\ L}$
$[Pb^{2+}] = 0.067\ M$