Exam 1

- Answers are on my website!

Balancing chemical equations!

- Change coefficients!
- Don't alter subscripts!

} Same # + type of atoms on each side

ex: $1\,C_6H_{12}O_6 + 6\,O_2 \longrightarrow 6\,CO_2 + 6\,H_2O$

C: 6	C ✱6
H: 12	H: ~~✱~~ 12
O: ~~✱~~ 18	O: ~~✱~~ ~~✱~~ 18

3.8 Amounts of Reactants + Products.

Stoichiometry

ex: $1\,CH_4 + 2\,O_2 \longrightarrow 1\,CO_2 + 2\,H_2O$

1 molecule CH_4 + 2 molecules O_2 → 1 molecule CO_2 + 2 molecules H_2O

$\times 6.022\times10^{23}$

6.022×10^{23} CH_4 + $2\times6.022\times10^{23}$ O_2 → $1\times6.022\times10^{23}$ CO_2 + $2\times6.022\times10^{23}$ H_2O

or

1 mol CH_4 + 2 mol O_2 → 1 mol CO_2 + 2 mol H_2O

Coefficients in Balanced Chem Eq. = MOLAR RATIOS!

Conversion Factors

1 mol CH_4 = 2 mol O_2	2 mol O_2 = 1 mol CO_2
1 mol CH_4 = 1 mol CO_2	2 mol O_2 = 2 mol H_2O
1 mol CH_4 = 2 mol H_2O	1 mol CO_2 = 2 mol H_2O

Table 3.1 Interpretation of a Chemical Equation

$2H_2$	$+ O_2$	$\longrightarrow$	$2H_2O$
Two molecules	+ one molecule	$\longrightarrow$	two molecules
2 moles	+ 1 mole	$\longrightarrow$	2 moles
$2(2.02\text{ g}) = 4.04\text{ g} + 32.00\text{ g}$		$\longrightarrow$	$2(18.02\text{ g}) = 36.04\text{ g}$
36.04 g reactants			36.04 g product

How many moles of H_2O are formed when 0.42 mol of CH_4 is combusted?

$$1CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$$

$1\text{ mol } CH_4 = 2\text{ mol } H_2O$

$\frac{1\text{ mol } CH_4}{2\text{ mol } H_2O}$ $\quad$ $\frac{2\text{ mol } H_2O}{1\text{ mol } CH_4}$

$$0.42\text{ mol } CH_4 \times \frac{2\text{ mol } H_2O}{1\text{ mol } CH_4} = 0.82\text{ mol } H_2O$$

(2 s.f.) $\quad$ ∞ s.f. $\quad$ ∞ s.f.

$2C_8H_{18} + 25O_2 \longrightarrow 16CO_2 + 18H_2O$

Q. If we burn 3.2mol C_8H_{18}, how many mol O_2 is needed?

$2\ mol\ C_8H_{18} = 25\ mol\ O_2$

(2sf)

$$\frac{3.2\ mol\ C_8H_{18} \mid 25\ mol\ O_2}{2\ mol\ C_8H_{18}} = 40.\ mol\ O_2$$

$4.0 \times 10^1\ mol\ O_2$

(∞sf) (2sf.)

Q. If we burn 18.1g C_8H_{18}, how many moles O_2 is needed?

$18.1g\ C_8H_{18} \xrightarrow[\text{mass}]{\text{molar}} ?\ mol\ C_8H_{18} \xrightarrow[\text{coefficients}]{\text{molar}} ?\ mol\ O_2$

C_8H_{18}

$8 \times C = 8 \times 12.01 = 96.08$

$18 \times H = 18 \times 1.008 = 18.14$

114.22

$1\ mol\ C_8H_{18} = 114.22g\ C_8H_{18}$

$$\frac{18.1g\ C_8H_{18} \mid 1\ mol\ C_8H_{18}}{114.22g\ C_8H_{18}} = 0.158\ mol\ C_8H_{18}$$

$$\frac{0.158\ mol\ C_8H_{18} \mid 25\ mol\ O_2}{2\ mol\ C_8H_{18}} = 1.98\ mol\ O_2$$

$2C_8H_{18} + 25O_2 \longrightarrow 16CO_2 + 18H_2O$

1 BIG conversion!

$$\frac{18.1g\ C_8H_{18} \mid 1\ mol\ C_8H_{18} \mid 25\ mol\ O_2}{114.22g\ C_8H_{18} \mid 2\ mol\ C_8H_{18}} = 1.98\ mol\ O_2$$

$g\ C_8H_{18} \rightarrow mol\ C_8H_{18} \rightarrow mol\ O_2$

$2C_8H_{18} + 25O_2 \longrightarrow 16CO_2 + 18H_2O$.

Q. How many grams of H_2O can be made from 28.0 g C_8H_{18} ?

28.0 g C_8H_{18} $\xrightarrow{\text{molar mass } C_8H_{18}}$ mol C_8H_{18} $\xrightarrow{\text{coefficients}}$ mol H_2O $\xrightarrow{\text{molar mass } H_2O}$ g H_2O

C_8H_{18}

114.22 g C_8H_{18} = 1 mol C_8H_{18}

H_2O

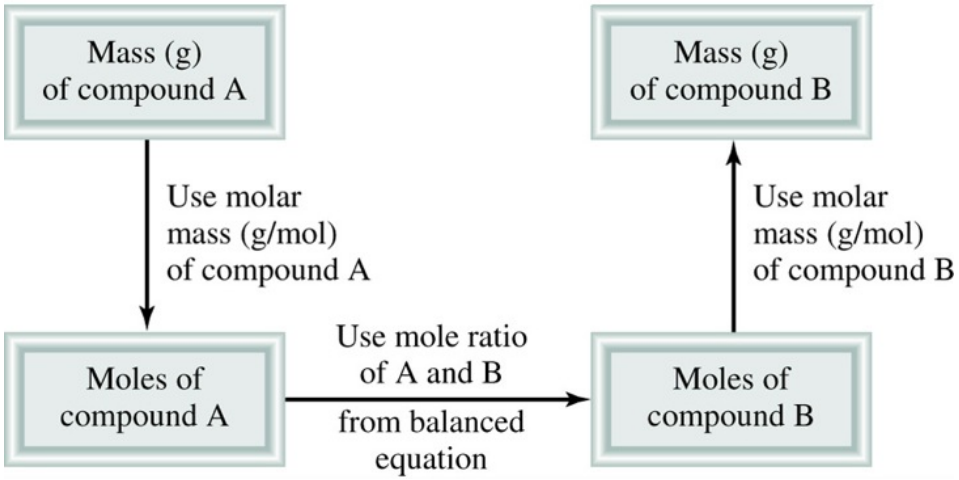
$2 \times H = 2 \times 1.008$
$1 \times O = 1 \times 16.00$
18.02

18.02 g H_2O = 1 mol H_2O

2 mol C_8H_{18} = 18 mol H_2O

$$28.0\text{ g } C_8H_{18} \left| \frac{1\text{ mol } C_8H_{18}}{114.22\text{ g } C_8H_{18}} \right| \frac{18\text{ mol } H_2O}{2\text{ mol } C_8H_{18}} \left| \frac{18.02\text{ g } H_2O}{1\text{ mol } H_2O} \right.$$

$= 39.8$ g H_2O



ex: $2Fe_2O_3 + 3C \longrightarrow 4Fe + 3CO_2$

Q1. How many grams of Fe can be made from 108_g Fe_2O_3

iron(III) oxide
ferric oxide

$108_g\ Fe_2O_3 \xrightarrow[\text{mass } Fe_2O_3]{\text{molar}} \text{mol } Fe_2O_3 \xrightarrow{\text{coefficients}} \text{mol Fe} \xrightarrow[\text{mass Fe}]{\text{molar}} g\,Fe$

Fe_2O_3

$2 \times Fe = 2 \times 55.85$

$3 \times O = 3 \times 16.00$

159.7

Fe

55.85

$2\ mol\ Fe_2O_3 = 4\ mol\ Fe$

$$\frac{108_g\ Fe_2O_3}{1} \left| \frac{1\ mol\ Fe_2O_3}{159.7_g\ Fe_2O_3} \right| \frac{4\ mol\ Fe}{2\ mol\ Fe_2O_3} \left| \frac{55.85_g\ Fe}{1\ mol\ Fe} \right.$$

$= 75.5\ g\ Fe$