ex 1) Given: ^{63}Cu mass = 62.93 u
^{65}Cu mass = 64.93 u

Find: Average Meet

$$\left(\frac{69.09\ \text{Atoms}}{1}\right)\left(\frac{62.93\ u}{\text{Atom}}\right) + \left(\frac{30.91\ \text{Atoms}}{1}\right)\left(\frac{64.93\ u}{\text{Atom}}\right) = 6355\ u$$

Average Mass $\frac{6355\ u}{100\ \text{Atoms}} = \boxed{63.55\ u/\text{Atom}}$

ex 2/ Given: 6 Atoms of Am Atomic mass 243g

Find: ? g

$$\left(\frac{6\ \text{Atoms Am}}{1}\right)\left(\frac{1\ \text{mole Am}}{6.022\times10^{23}\ \text{Atoms Am}}\right)\left(\frac{243\ \text{g Am}}{1\ \text{mole Am}}\right) = \boxed{2.42\times10^{-21}\ \text{g Am}}$$

ex 3/ Given: Al 10.0g

Find: ? moles Al
? number Atoms

Soln:

$$\left(\frac{10.0\ \text{g Al}}{1}\right)\left(\frac{1\ \text{mole A}}{26.98\ \text{g Al}}\right) = \boxed{.371\ \text{mole Al}}$$

$$\left(\frac{.371\ \text{mole Al}}{1}\right)\left(\frac{6.022\times10^{23}\ \text{Atoms Al}}{1\ \text{mole A}}\right) = \boxed{2.23\times10^{23}\ \text{Atoms Al}}$$

ex 4/ Given: Co 5.00×10^{20} Atoms

Find: ? moles ? g

Soln: $$\left(\frac{5.00\times10^{20}\ \text{Atoms Co}}{1}\right)\left(\frac{1\ \text{mole Co}}{6.022\times10^{23}\ \text{Atoms Co}}\right) = \boxed{8.50\times10^{-4}\ \text{moles Co}}$$

$$\left(\frac{8.30\times10^{-4}\ \text{moles Co}}{1}\right)\left(\frac{58.93\ \text{g Co}}{1\ \text{mole Co}}\right) = \boxed{.0489\ \text{g Co}}$$

ex5/ Given: $C_{10}H_6O_3$

Find: A) ? molar mass

B) 1.56×10^{-2} g $C_{10}H_6O_3$? moles

Soln: A)

C $10 \times 12.01\text{g} = 120.1\text{g}$

H $6 \times 1.008\text{g} = 6.048\text{g}$

O $3 \times 16.00\text{g} = 48.00$

174.148

$174.1\text{g}\ C_{10}H_6O_3$

B)

$$\left(\frac{1.56\times10^{-2}\text{g}\ C_{10}H_6O_3}{1}\right)\left(\frac{1\text{ mole}\ C_{10}H_6O_3}{174.1\text{g}\ C_{10}H_6O_3}\right) = 8.96\times10^{-5}\text{ moles}\ C_{10}H_6O_3$$

ex6/ Given: $CaCO_3$

Find: A) ? molar mass (MM)

B) 4.86 moles $CaCO_3$

? g $CaCO_3$? g CO_3^{-2} ions

Soln:

Ca $1 \times 40.08\text{g} = 40.08\text{g}$

C $1 \times 12.01\text{g} = 12.01\text{g}$

O $3 \times 16.00\text{g} = 48.00\text{g}$

$100.09\text{g}\ CaCO_3$

$$\left(\frac{4.86\text{ moles}\ CaCO_3}{1}\right)\left(\frac{100.09\text{g}\ CaCO_3}{1\text{ mole}\ CaCO_3}\right) = 486\text{g}\ CaCO_3$$

$$\left(\frac{4.86\text{ moles}\ CaCO_3}{1}\right)\left(\frac{1\text{ mole}\ CO_3^{-2}}{1\text{ mole}\ CaCO_3}\right)\left(\frac{60.01\text{g}\ CO_3^{-2}}{1\text{ mole}\ CO_3^{-2}}\right) = 292\text{g}\ CO_3^{-2}$$

ex7/ Given: 1×10^{-6} g $C_7H_{14}O_2$

Find: A) ? molecules $C_7H_{14}O_2$ B) ? of C atoms

C $7 \times 12.01 = 84.07$

H $14 \times 1.008 = 14.11$

O $2 \times 16.00 = 32.00$

130.18

Soln:

(A) $$\left(\frac{1\times10^{-6}\text{g}\ C_7H_{14}O_2}{1}\right)\left(\frac{1\text{ mole}\ C_7H_{14}O_2}{130.18\text{g}\ C_7H_{14}O_2}\right)\left(\frac{6.022\times10^{23}\text{ molecules}\ C_7H_{14}O_2}{1\text{ mole}\ C_7H_{14}O_2}\right) = 5\times10^{15}\text{ molecules}\ C_7H_{14}O_2$$

(B) $$\left(\frac{1\times10^{-6}\text{g}\ C_7H_{14}O_2}{1}\right)\left(\frac{1\text{ mole}\ C_7H_{14}O_2}{130.18\text{g}\ C_7H_{14}O_2}\right)\left(\frac{7\text{ moles C}}{1\text{ mole}\ C_7H_{14}O_2}\right)\left(\frac{6.022\times10^{23}\text{ Atoms C}}{1\text{ mole C}}\right) = 3\times10^{16}\text{ Atoms C}$$

ex8/ Given: $C_{10}H_{14}O$

Find: ? mass % of each element

Soln:

C	$10 \times 12.01g = 120.1g$	$C = \frac{120.1g}{150.2g} \times 100 =$	79.96% C
H	$14 \times 1.008g = 14.11g$	$H = \frac{14.11g}{150.2g} \times 100 =$	9.394% H
O	$1 \times 16.00g = 16.00g$	$O = \frac{16.00g}{150.2g} \times 100 =$	10.65% O
	$150.2g$		

ex9/ Given: $C_{14}H_{20}N_2SO_4$

Find: ? mass % each Element

Soln:

C	$14 \times 12.01g = 168.1g$	$\frac{168.1g}{312.3g} \times 100 =$	53.83% C
H	$20 \times 1.008g = 20.16g$	$\frac{20.16g}{312.3g} \times 100 =$	6.453% H
N	$2 \times 14.01g = 28.02g$	$\frac{28.02g}{312.3g} \times 100 =$	8.972% N
S	$1 \times 32.06g = 32.06g$	$\frac{32.06g}{312.3g} \times 100 =$	10.27% S
O	$4 \times 16.00g = 64.00g$	$\frac{64.00g}{312.3g} \times 100 =$	20.49% O

$312.34 \Rightarrow 312.3g$

ex10/ Given: 71.65% Cl, 24.27% C, 4.07% H molar mass = 98.96g/mol

Find: empirical & molecular Formulas

Soln: $\left(\frac{71.65g\,Cl}{1}\right)\left(\frac{1\,mole\,Cl}{35.45g\,Cl}\right) = 2.021\,mole\,Cl$ / div by smallest Ratio 2.021 ∴ Cl

$\left(\frac{24.27g\,C}{1}\right)\left(\frac{1\,mole\,C}{12.01g\,C}\right) = 2.021\,mole\,C$ / 2.021 ∴ C

$\left(\frac{4.07g\,H}{1}\right)\left(\frac{1\,mole\,H}{1.008g\,H}\right) = 4.04\,mole\,H$ / 2.021 ∴ H_2

∴ CH_2Cl

ex 10 cont'd

CH_2Cl

C $1 \times 12.01 = 12.01g$ C

H $2 \times 1.008g = 2.016g$ H

Cl $1 \times 35.45g = 35.45g$ Cl

$49.48g$ CH_2Cl

$\frac{98.96g}{49.48g} = 2$

$\therefore C_2H_4Cl_2$

ex 11/ Given: 43.64% P, 56.36% O molar mass = 283.88 g/mole

Find: Empirical & molecular Formula's

Soln:

$\left(\frac{43.64g\ P}{1}\right)\left(\frac{1\ mole\ P}{30.97g\ P}\right) = 1.409\ mole\ P \quad /1.409 = 1\ mole\ P$

$\left(\frac{56.36g\ O}{1}\right)\left(\frac{1\ mole\ O}{16.00g\ O}\right) = 3.523\ mole\ O \quad /1.409 = 2.5\ mole\ O$

$\therefore \boxed{P_2O_5}$

mmol of P_2O_5

P $2 \times 30.97g = 61.94g$ P

O $5 \times 16.00g = 80.00g$ O

$141.94g$ P_2O_5

$\frac{283.88g}{141.94g} = 2$

$\therefore P_4O_{10}$

ex 13/ $(NH_4)_2Cr_2O_{7(s)} \xrightarrow{\Delta} Cr_2O_{3(s)} + N_{2(g)} + 4H_2O_{(g)}$

ex 14/ $4NH_{3(g)} + 5O_{2(g)} \rightarrow 4NO_{(g)} + 6H_2O_{(g)}$

ex 15/ $2LiOH_{(s)} + CO_{2(g)} \rightarrow Li_2CO_{3(s)} + H_2O_{(\ell)}$

1.00 kg 1000g ?g

$\left(\frac{1000g\ LiOH}{1}\right)\left(\frac{1\ mole\ LiOH}{23.95g\ LiOH}\right)\left(\frac{1\ mole\ CO_2}{2\ mole\ LiOH}\right)\left(\frac{44.0g\ CO_2}{1\ mole\ CO_2}\right) = \boxed{919g\ CO_2}$

ex 16/ Find: most effective Antiacid per gram?

10.0g $NaHCO_{3(s)}$ vs 10.0g $Mg(OH)_{2(s)}$

A) $NaHCO_{3(s)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(\ell)} + CO_{2(g)}$

10.0g ? g

$$\left(\frac{10.0\text{g } NaHCO_3}{1}\right)\left(\frac{1\text{ mole } NaHCO_3}{84.01\text{g } NaHCO_3}\right)\left(\frac{1\text{ mole HCl}}{1\text{ mole } NaHCO_3}\right)\left(\frac{36.46\text{g HCl}}{1\text{ mole HCl}}\right) = 4.34\text{g HCl}$$

B) $Mg(OH)_{2(s)} + 2HCl_{(aq)} \rightarrow 2H_2O_{(\ell)} + MgCl_{2(aq)}$

$$\left(\frac{10.0\text{g } Mg(OH)_2}{1}\right)\left(\frac{1\text{ mole } Mg(OH)_2}{58.32\text{g } Mg(OH)_2}\right)\left(\frac{2\text{ mole HCl}}{1\text{ mole } Mg(OH)_2}\right)\left(\frac{36.46\text{g HCl}}{1\text{ mole HCl}}\right) = 12.5\text{g HCl}$$

$Mg(OH)_2$ neutralizes almost 3x HCl as $NaHCO_3$

ex 17/ Situation 1

Before

$$\frac{15\,H_2}{5\,N_2} \Rightarrow \frac{3\,H_2}{N_2}$$

After

Yields complete Rxn

Also Ratio $3H_2 : 1N_2$ matches $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$

Situation 2

Before

$$\frac{9\,H_2}{5\,N_2}$$

After

Yields Excess Amount of N_2

$\therefore H_2$ is limiting

ex 13/ $2NH_3(g) + 3CuO(s) \rightarrow 3Cu(s) + N_2(g) + 3H_2O(g)$

18.1g 90.4g ?g

(1st) Ag to moles

$$\left(\frac{18.1\text{g } NH_3}{1}\right)\left(\frac{1\text{ mole } NH_3}{17.03\text{g } NH_3}\right) = 1.06\ NH_3$$

$$\left(\frac{90.4\text{g CuO}}{1}\right)\left(\frac{1\text{ mole CuO}}{79.55\text{g CuO}}\right) = 1.14\text{ mole CuO}$$

2nd Table

(3) Solve for X

	$2NH_3$	$3CuO$	N_2	
I	1.06m	1.14m	0	
C	$-2x$	$-3x$	x	
	$-2(.380) = -.76$	$-3(.380) = 1.14$	.380	
E	.30M	0	.380	
	Excess	Limiting	Produced	

NH_3 $1.06 - 2x = 0$ $x = .530$

CuO $1.14 - 3x = 0$ $x = .380$ ← limiting

CuO Limiting

$$\left(\frac{.380\ N_2}{1}\right)\left(\frac{28.02\text{g } N_2}{1\text{ mole } N_2}\right) = 10.6\ N_2$$

ex 19/

$CO_{(g)} + 2H_{2(g)} \longrightarrow CH_3OH$

68.5kg 8.60kg ?g ← Also Theoretical yield

3.75×10^4g Actual yield

? % yield

$\left(\frac{68.5\text{kg CO}}{1}\right)\left(\frac{1000\text{g}}{1\text{kg}}\right)\left(\frac{1\text{mole CO}}{28.01\text{g CO}}\right) = 2450\text{ mole CO}$

$\left(\frac{8.60\text{kg } H_2}{1}\right)\left(\frac{1000\text{g}}{1\text{kg}}\right)\left(\frac{1\text{mole } H_2}{2.016\text{g } H_2}\right) = 4270\text{ mole } H_2$

	CO	$2H_2$	CH_3OH	
I	2450 mole	4270 mole	0	CO $2450 - X = 0$, $X = 2450$
C	$-1X$	$-2X$	X	H_2 $4270 - 2X = 0$, $X = 2140$
	-2140 M	$-2(2140) = -4270$M	2140M	
	310 M	∅	2140M	
	Excess	Limiting	Produced	

12.01
3.024
16.00
1.008
32.042

$\left(\frac{2140\text{ mole } CH_3OH}{1}\right)\left(\frac{32.04\text{g } CH_3OH}{1\text{ mole } CH_3OH}\right) = \boxed{68600\text{g or } 6.86 \times 10^4\text{g } CH_3OH}$

$\frac{\text{Actual}}{\text{Theor}} \times 100 \Rightarrow \frac{3.75 \times 10^4\text{g } CH_3OH}{6.86 \times 10^4\text{g } CH_3OH} \times 100 = \boxed{52.0\%\text{ yield } CH_3OH}$