Chapter 3

① a

③ a) NO_2

⑦ $N_2 + 3H_2 \rightarrow 2NH_3$

4 9

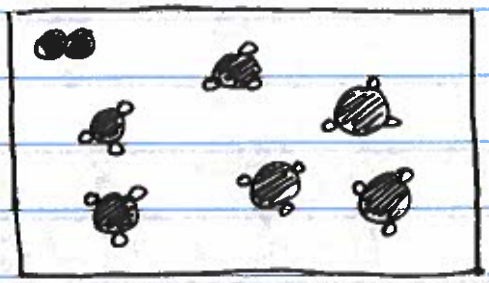
$$\frac{4 \text{ mol } N_2 \mid 2 \text{ mol } NH_3}{1 \text{ mol } N_2} = 8 \text{ mol } NH_3$$

$$\frac{9 \text{ mol } H_2 \mid 2 \text{ mol } NH_3}{3 \text{ mol } H_2} = 6 \text{ mol } NH_3$$

H_2 is limiting reactant so none leftover

$$\frac{6 \text{ mol } NH_3 \mid 1 \text{ mol } N_2}{2 \text{ mol } NH_3} = 3 \text{ mol } N_2 \text{ used}$$

$4 - 3 = 1 \text{ mol } N_2$ left over



⑧ a) $2NO + O_2 \rightarrow 2NO_2$

8 5

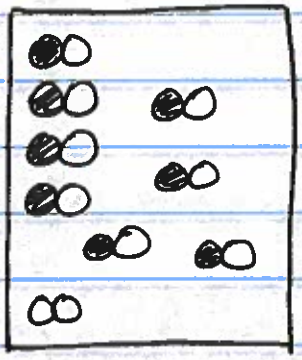
$$\frac{8 \text{ mol } NO \mid 2 \text{ mol } NO_2}{2 \text{ mol } NO} = 8 \text{ mol } NO_2$$

NO is limiting reactant none leftover

$$\frac{5 \text{ mol } O_2 \mid 2 \text{ mol } NO_2}{1 \text{ mol } O_2} = 10 \text{ mol } NO_2$$

$$\frac{8 \text{ mol } NO_2 \mid 1 \text{ mol } O_2}{2 \text{ mol } NO_2} = 4 \text{ mol } O_2 \text{ used}$$

$5 - 4 = 1 \text{ mol } O_2$ left over



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(8) b) $0.75 \times 8 = 6$ mol NO_2

(9) a) Law of Conservation of Matter

b) changing subscripts changes the identity of the compound

c) $H_2O(l)$
$H_2O(g)$
$NaCl(aq)$
$NaCl(s)$

(11) a) $\underline{2}\ CO + \_O_2 \rightarrow \underline{2}\ CO_2$

b) $\_N_2O_5 + \_H_2O \rightarrow \underline{2}\ HNO_3$

c) $\_CH_4 + \underline{4}\ Cl_2 \rightarrow \_CCl_4 + \underline{4}\ HCl$

d) $\_Al_4C_3 + \underline{12}\ H_2O \rightarrow \underline{4}\ Al(OH)_3 + \underline{3}\ CH_4$

e) $\underline{2}\ C_5H_{10}O_2 + \underline{13}\ O_2 \rightarrow \underline{10}\ CO_2 + \underline{10}\ H_2O$

f) $\underline{2}\ Fe(OH)_3 + \underline{3}\ H_2SO_4 \rightarrow Fe_2(SO_4)_3 + \underline{6}\ H_2O$

g) $Mg_3N_2 + \underline{4}\ H_2SO_4 \rightarrow \underline{3}\ MgSO_4 + (NH_4)_2SO_4$

(13) a) $CaC_2(s) + 2\ H_2O(l) \rightarrow Ca(OH)_2(aq) + C_2H_2(g)$

b) $2\ KClO_3(s) \xrightarrow{\Delta} 2\ KCl(s) + 3\ O_2(g)$

c) $Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$

d) $PCl_3(l) + 3\ H_2O(l) \rightarrow H_3PO_4(aq) + 3\ HCl(aq)$

e) $3\ H_2S(g) + 2\ Fe(OH)_3(s) \rightarrow Fe_2S_3(s) + 6\ H_2O(g)$

(19) a) 2, 3, 2 synthesis

b) 1, 3, 2, 2 combustion

c) 6, 1, 2 Synthesis

d) 1, 1, 1 decomposition

e) 1, 8, 7, 4 combustion

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(21) a) 63.0 amu

b) 158.0 amu

c) 310.3 amu

(23) a) $\frac{\text{mass of all O in cmpd}}{\text{mass entire cmpd}} \times 100 = 16.8\%$

b) 16.1%

c) 21.1%

(33) a) $0.105 \text{ mol} \left| \frac{\text{molar mass sucrose}}{1 \text{ mole}} \right. = 35.9 \text{ g}$ 3 s.f.

b) $143.5 \text{ g} \left| \frac{1 \text{ mole}}{\text{molar mass } Zn(NO_3)_2} \right. = 0.7577 \text{ mol}$ 4 s.f.

c) $1.0 \times 10^{-6} \text{ mole} \left| \frac{6.022 \times 10^{23} \text{ molecules}}{1 \text{ mole}} \right. = 6.0 \times 10^{17} \text{ molecules}$ 2 s.f.

d) $0.410 \text{ mol} \left| \frac{6.022 \times 10^{23} \text{ atoms}}{1 \text{ mol}} \right. = 2.47 \times 10^{23} \text{ atoms}$ 3 s.f.

(35) a) $2.50 \times 10^{-3} \text{ mol} \left| \frac{\text{molar mass } (NH_4)_3PO_4}{1 \text{ mol}} \right. = 0.373 \text{ g}$ 3 s.f.

b) $0.2550 \text{ g} \left| \frac{1 \text{ mol } AlCl_3}{\text{molar mass } AlCl_3} \right| \frac{3Cl^-}{1 \text{ mol } AlCl_3} = 5.737 \times 10^{-3} \text{ mol}$ 4 s.f.

c) $7.70 \times 10^{20} \text{ molec.} \left| \frac{1 \text{ mole}}{6.022 \times 10^{23} \text{ molec}} \right| \frac{\text{molar mass } C_8H_{10}N_4O_2}{1 \text{ mole}} = 0.248 \text{ g}$

d) $0.0406 \text{ g} \left| \frac{}{0.00105 \text{ mol}} \right. = 387 \text{ g/mol}$

(45) a) $CSCl_2$

b) C_3OF_6

c) Na_3AlF_6

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	K	P	O
46a.	$\frac{55.3}{39.10}$	$\frac{14.6}{30.97}$	$\frac{30.1}{16}$
	$= \frac{1.414}{0.4714}$	$\frac{0.4714}{0.4714}$	$\frac{1,8812}{0.4714}$
	$= 3$	$= 1$	$= 4$

K_3PO_4 = potassium phosphate

★ you would solve this problem the same if you were given the mass of each element instead of the mass percent

47a. $CH_2 = 12.01 + 2(1.008) = 14.026$ g for the empirical formula

molar mass = 84 $\quad 84/14.026 = 6$

$C_{1\times6}H_{2\times6} = C_6H_{12}$

58a. $0.400 \text{ mol } C_6H_{12}O_6 \left| \frac{2 \text{ mol } CO_2}{1 \text{ mol } C_6H_{12}O_6} \right. = 0.800 \text{ mol } CO_2$

mole ratio from balanced equation

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62a. $CaH_2(s) + 2H_2O(l) \rightarrow Ca(OH)_2(s) + 2H_2(g)$

62b.

$$8.500\ g\ H_2 \left| \frac{1\ mol\ H_2}{2.016\ g\ H_2} \right| \frac{1\ mol\ CaH_2}{2\ mol\ H_2} \left| \frac{42.096\ g\ CaH_2}{1\ mol\ CaH_2} \right.$$

$$= 88.74\ g\ CaH_2$$