Key - Study Guide for the Reaction Stoichiometry Test.

Chemical Reactions

1. 4 pieces of evidence of a chemical reaction are:
   - gas bubbles form
   - a solid precipitate forms
   - a change in energy (gets hotter or colder)
   - formation of water
   - odor change
   - permanent color change

2. a) $C_3H_8(l) + 5\,O_2(g) \rightarrow 3\,CO_2(g) + 4\,H_2O(g)$

   b) $Al_2(SO_3)_3(s) + 6\,NaOH(aq) \rightarrow 3\,Na_2SO_3(aq) + 2\,Al(OH)_3(s)$

   c) $4\,Al_2O_3(s) + 9\,Fe(s) \rightarrow 3\,Fe_3O_4(s) + 8\,Al(s)$

   d) $2\,KClO_3(s) \rightarrow 2\,KCl(s) + 3O_2(g)$

   e) $NH_4NO_3(aq) \rightarrow N_2O(g) + 2\,H_2O(l)$

   f) $2\,NaHCO_3(aq) \rightarrow Na_2CO_3(aq) + H_2O(l) + CO_2(g)$

   g) $S(s) + 6HNO_3(aq) \rightarrow H_2SO_4(aq) + 6\,NO_2(g) + 2\,H_2O(l)$

3. a.) $C_5H_{12} + O_2 \rightarrow CO_2 + H_2O$

   b) $Ca + Al(OH)_3 \rightarrow Al + Ca(OH)_2$ (2+ 1−)

   c) $Ga_2O_3 \rightarrow Ga + O_2$

   d) $H_2 + S \rightarrow H_2S$ (1+ 2−)

   e) $NaCl + Ag_2CO_3 \rightarrow AgCl + Na_2CO_3$ (1+ 1− / 1+ 2−)

Moles

1. a) $Fe_2(CO_3)_3$

Fe	$2 \times 55.85\,g$	$= 111.70\,g$
C	$3 \times 12.01\,g$	$= 36.03\,g$
O	$9 \times 16.00\,g$	$= + 144.00\,g$
		$291.73\,g$

b) H_3PO_3

H	$3 \times 1.01\,g$	$= 3.03\,g$
P	$1 \times 30.97\,g$	$= 30.97\,g$
O	$3 \times 16.00\,g$	$= + 48.00\,g$
		$82.00\,g$

c) $C_8H_8O_3$

C	$8 \times 12.01\,g$	$= 96.08\,g$
H	$8 \times 1.01\,g$	$= 8.08\,g$
O	$3 \times 16.00\,g$	$= + 48.00\,g$
		$152.16\,g$

2. $\%\,C = \frac{36.03\,g}{291.73\,g} \times 100 = 12.35\%$

3. $\%\,P = \frac{30.97\,g}{82.00\,g} \times 100 = 37.77\%$

4. $\%\,O = \frac{48.00\,g}{152.16\,g} \times 100 = 31.55\%$

5.

59.0% C	7.15% H	26.20% O	7.65% N
$\frac{59.0\,g\,C}{12.01\,g/mol}$	$\frac{7.15\,g\,H}{1.01\,g/mol}$	$\frac{26.20\,g\,O}{16.00\,g/mol}$	$\frac{7.65\,g\,N}{14.01\,g/mol}$
$= \frac{4.9126\,mol\,C}{.5460\,mol}$	$= \frac{7.0792\,mol\,H}{.5460\,mol}$	$= \frac{1.6375\,mol\,O}{.5460\,mol}$	$= \frac{.5460\,mol\,N}{.5460\,mol}$
$= 9\,C$	$= 13\,H$	$= 3\,O$	$= 1\,N$

$EF = C_9H_{13}O_3N$

6. 74.0% C | 8.65% H | 17.35% N

$\frac{74.0\text{ g C}}{12.01\text{ g/mol}}$ $\frac{8.65\text{ g H}}{1.01\text{ g/mol}}$ $\frac{17.35\text{ g N}}{14.01\text{ g/mol}}$

$= \frac{6.1615\text{ mol C}}{1.2384\text{ mol}}$ $= \frac{8.5644\text{ mol H}}{1.2384\text{ mol}}$ $= \frac{1.2384\text{ mol N}}{1.2384\text{ mol}}$

= 5 C = 7 H = 1 N

EF = C_5H_7N

Stoichiometry

1. $2\,Al(OH)_3(s) + 3\,H_2SO_4(aq) \rightarrow Al_2(SO_4)_3(aq) + 6\,H_2O(l)$

a) $.99\text{ mol } Al(OH)_3 \left| \frac{6\text{ mol } H_2O}{2\text{ mol } Al(OH)_3} \right. =$ 2.97 mol H_2O

b) $2.40\text{ mol } H_2SO_4 \left| \frac{2\text{ mol } Al(OH)_3}{3\text{ mol } H_2SO_4} \right. =$ 1.600 mol $Al(OH)_3$

c) $.04466\text{ mol } H_2SO_4 \left| \frac{1\text{ mol } Al_2(SO_4)_3}{3\text{ mol } H_2SO_4} \right. =$ .01489 mol $Al_2(SO_4)_3$

2. $8\,H_2S(g) + 4\,O_2(g) \rightarrow S_8(l) + 8\,H_2O(l)$

a) $2.500\text{ mol } H_2S \left| \frac{1\text{ mol } S_8}{8\text{ mol } H_2S} \right| \frac{256.56\text{ g } S_8}{1\text{ mol } S_8} =$ 80.18 g S_8

b) $2.500\text{ g } O_2 \left| \frac{1\text{ mol } O_2}{32.00\text{ g } O_2} \right| \frac{8\text{ mol } H_2O}{4\text{ mol } O_2} =$ .16 mol H_2O

c) $.776\text{ mol } H_2S \left| \frac{4\text{ mol } O_2}{8\text{ mol } H_2S} \right| \frac{32.00\text{ g } O_2}{1\text{ mol } O_2} =$ 12.42 g O_2

3. $3\,BaSO_4(aq) + 2\,Fe(NO_3)_3(aq) \rightarrow 3\,Ba(NO_3)_2(aq) + Fe_2(SO_4)_3$

a) $50.0\,g\,Fe(NO_3)_3 \left|\frac{1\,mol\,Fe(NO_3)_3}{241.88\,g\,Fe(NO_3)_3}\right|\frac{3\,mol\,Ba(NO_3)_2}{2\,mol\,Fe(NO_3)_3}\left|\frac{261.22\,g\,Ba(NO_3)_2}{1\,mol\,Ba(NO_3)_2}\right. = 81.00\,g\,Ba(NO_3)_2$

b) $34.50\,g\,BaSO_4 \left|\frac{1\,mol\,BaSO_4}{233.27\,g\,BaSO_4}\right|\frac{1\,mol\,Fe_2(SO_4)_3}{3\,mol\,BaSO_4}\left|\frac{399.91\,g\,Fe_2(SO_4)_3}{1\,mol\,Fe_2(SO_4)_3}\right. = 19.72\,g\,Fe_2(SO_4)_3$

c) $34.50\,g\,Fe(NO_3)_3 \left|\frac{1\,mol\,Fe(NO_3)_3}{241.88\,g\,Fe(NO_3)_3}\right|\frac{1\,mol\,Fe_2(SO_4)_3}{2\,mol\,Fe(NO_3)_3}\left|\frac{399.91\,g\,Fe_2(SO_4)_3}{1\,mol\,Fe_2(SO_4)_3}\right. = 28.52\,g\,Fe_2(SO_4)_3$

4. $Fe_2O_3(s) + 3\,CO(g) \rightarrow 3\,CO_2(g) + 2\,Fe(s)$

a) i) $30.00\,g\,Fe_2O_3 \left|\frac{1\,mol\,Fe_2O_3}{159.70\,g\,Fe_2O_3}\right|\frac{2\,mol\,Fe}{1\,mol\,Fe_2O_3}\left|\frac{55.85\,g\,Fe}{1\,mol\,Fe}\right. = 20.98\,g\,Fe$ TY

$20.00\,g\,CO \left|\frac{1\,mol\,CO}{20.01\,g\,CO}\right|\frac{2\,mol\,Fe}{3\,mol\,CO}\left|\frac{55.85\,g\,Fe}{1\,mol\,Fe}\right. = 37.21\,g\,Fe$

ii) LR is Fe_2O_3 iii) ER is CO

iv) $\%\,yield = \frac{11.98\,g}{20.98\,g} \times 100 = 57.10\%$

b) i) $.1000\,g\,Fe_2O_3 \left|\frac{1\,mol\,Fe_2O_3}{159.70\,g\,Fe_2O_3}\right|\frac{2\,mol\,Fe}{1\,mol\,Fe_2O_3}\left|\frac{55.85\,g\,Fe}{1\,mol\,Fe}\right. = .06994\,g\,Fe$ TY

$.1700\,g\,CO \left|\frac{1\,mol\,CO}{20.01\,g\,CO}\right|\frac{2\,mol\,Fe}{3\,mol\,CO}\left|\frac{55.85\,g\,Fe}{1\,mol\,Fe}\right. = .3163\,g\,Fe$

ii) LR is Fe_2O_3 iii) ER is CO

iv) $\%\,yield = \frac{.05880\,g}{.06994\,g} \times 100 = 84.07\%$