Unit #5 Review: Chemical Reactions

1. State the Law of Conservation of Mass.
2. Explain why it is necessary to balance chemical equations.
3. Be able to identify chemical and physical changes. Review the examples from our earlier notes.
4. Be able to use the concepts of net nuclear attraction (effective nuclear charge, Z*eff*) and shielding effect to explain the general trends in the reactivity of metals and non-metals.
5. Be able to describe an experiment that could be used to compare the relative reactivity of metals. Be able to interpret the results of such an experiment.
6. Balance and classify the following reactions as synthesis, decomposition, single displacement, double displacement, or combustion reactions:

a) $N_2 + 3\ H_2 \rightarrow 2\ NH_3$ synthesis

b) $4\ KC\ell O_3 \rightarrow 3\ KC\ell O_4 + KC\ell$ decomposition

c) $2\ N_2 + O_2 \rightarrow 2\ N_2O$ synth/combust'n

d) $2\ H_3PO_4 \rightarrow H_4P_2O_7 + H_2O$ decomposition

e) $C_{10}H_{16} + 8\ C\ell_2 \rightarrow 10\ C + 16\ HC\ell$ single displacmt

f) $S_8 + 12\ O_2 \rightarrow 8\ SO_3$ synth/combust'n

g) $2\ A\ell(OH)_3 + 3\ H_2SO_4 \rightarrow A\ell_2(SO_4)_3 + 6\ H_2O$ double displacmt

h) $Fe_2(SO_4)_3 + 6\ KOH \rightarrow 3\ K_2SO_4 + 2\ Fe(OH)_3$ double displacmt

i) $2\ C_7H_6O_2 + 15\ O_2 \rightarrow 14\ CO_2 + 6\ H_2O$ combustion

j) $2\ A\ell + 3\ FeO \rightarrow A\ell_2O_3 + 3\ Fe$ single displacmt

k) $Fe_2O_3 + 3\ H_2 \rightarrow 2\ Fe + 3\ H_2O$ single displacmt

l) $P_4 + 5\ O_2 \rightarrow 2\ P_2O_5$ synth/combust'n

m) $2\ C_2H_2 + 5\ O_2 \rightarrow 4\ CO_2 + 2\ H_2O$ combustion

n) $K_2O + H_2O \rightarrow 2\ KOH$ synthesis

o) $2\ H_2O_2 \rightarrow 2\ H_2O + O_2$ decomposition

p) $C_7H_{16} + 11\ O_2 \rightarrow 7\ CO_2 + 8\ H_2O$ combustion

q) $SiO_2 + 4\ HF \rightarrow SiF_4 + 2\ H_2O$ double displacmt

r) $2\ KC\ell O_3 \rightarrow 2\ KC\ell + 3\ O_2$ decomposition

s) $A\ell_4C_3 + 12\ HC\ell \rightarrow 4\ A\ell C\ell_3 + 3\ CH_4$ double displacmt

t) $2\ H_3AsO_4 \rightarrow As_2O_5 + 3\ H_2O$ decomposition

u) $A\ell_2(SO_4)_3 + 3\ Ca(OH)_2 \rightarrow 2\ A\ell(OH)_3 + 3\ CaSO_4$ double displacmt

v) $P_4O_{10} + 6\ H_2O \rightarrow 4\ H_3PO_4$ synthesis

w) $FeC\ell_3 + 3\ NH_4OH \rightarrow Fe(OH)_3 + 3\ NH_4C\ell$ double displacmt

x) $4\ Sb + 3\ O_2 \rightarrow Sb_4O_6$ synth/combust'n

y) $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$ combustion

z) $Au_2S_3 + 3\ H_2 \rightarrow 2\ Au + 3\ H_2S$ single displacmt

aa) $Fe_2(C_2O_4)_3 \rightarrow 2\ FeC_2O_4 + 2\ CO_2$ decomposition

7. Balance these reactions (some are tricky):

a) $SiC\ell_4 + 4\ H_2O \rightarrow H_4SiO_4 + 4\ HC\ell$

b) $2\ Na + 2\ H_2O \rightarrow 2\ NaOH + H_2$

c) $2\ Ca_3(PO_4)_2 + 6\ SiO_2 \rightarrow P_4O_{10} + 6\ CaSiO_3$

d) $2\ Na_2O_2 + 2\ H_2O \rightarrow 4\ NaOH + O_2$

e) $4\ Si_2H_3 + 11\ O_2 \rightarrow 8\ SiO_2 + 6\ H_2O$

f) $CO_2 + 2\ NH_3 \rightarrow CO(NH_2)_2 + H_2O$

g) $H_2SO_4 + 8\ HI \rightarrow H_2S + 4\ I_2 + 4\ H_2O$

h) $4\ FeS_2 + 11\ O_2 \rightarrow 2\ Fe_2O_3 + 8\ SO_2$

i) $Na_2CO_3 + 2\ HC\ell \rightarrow 2\ NaC\ell + H_2O + CO_2$

j) $3\ NaBH_4 + 4\ A\ell F_3 \rightarrow 3\ NaF + 3\ BF_3 + 2\ A\ell_2H_6$

k) $4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$

l) $PC\ell_5 + 4\ H_2O \rightarrow H_3PO_4 + 5\ HC\ell$

m) $POC\ell_3 + 3\ H_2O \rightarrow H_3PO_4 + 3\ HC\ell$

n) $2\ CuC\ell_2 + 4\ KI \rightarrow 2\ CuI + 4\ KC\ell + I_2$

o) $B_2H_6 + 3\ O_2 \rightarrow B_2O_3 + 3\ H_2O$

8. Review the naming rules for chemical compounds and acids. You must be able to write the chemical formulas of ionic, covalent and acidic compounds from their IUPAC names.

9. Refer to the activity series for metals on page 126 of your text (the Activity Series for metals will be given to you on the test). Predict the products, if any, between the following reactants. If there is no reaction, write "NR". If the reaction will proceed, write the formulas for the products that will form and include their state at SATP. Balance the equations.

a) $Ca\ (s) + Cu(NO_3)_2\ (aq) \rightarrow Ca(NO_3)_2\ (aq) + Cu\ (s)$

b) $Ni\ (s) + A\ell PO_4\ (aq) \rightarrow$ NR

c) $Ag\ (s) + FeC\ell_2\ (aq) \rightarrow$ NR

d) $2\ K\ (s) + 2\ H\text{-}OH\ (l) \rightarrow 2\ KOH\ (aq) + H_2\ (g)$

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

10. Given a pure non-metal element and a compound containing a non-metal (eg. $NaC\ell$, KI, MgS), predict whether or not a reaction will occur. If a reaction will occur, predict what the products of the reaction will be and balance the equation. (**You must know the order of the reactivity of the non-metal elements- it is the same order that we learned during the atomic theory unit).

a) $Br_2\ (l) + KC\ell\ (aq) \rightarrow$ NR

b) $2\ Br_2\ (l) + SnI_4\ (aq) \rightarrow SnBr_4\ (aq) + 2\ I_2\ (s)$

c) $3\ C\ell_2\ (g) + 2\ A\ell Br_3\ (aq) \rightarrow 2\ A\ell C\ell_3\ (aq) + 3\ Br_2\ (l)$

d) $I_2\ (g) + BaF_2\ (aq) \rightarrow$ NR

e) $C\ell_2\ (g) + CaS\ (aq) \rightarrow CaC\ell_2\ (aq) + S\ (s)$

11. From a description of a chemical reaction, write its balanced chemical equation, using chemical formulas. Include the state of each reactant and product. Use the solubility rules to predict if a precipitate will form.

a) Propane gas (C_3H_8) burns in air.

$C_3H_8\ (g) + 5\ O_2\ (g) \rightarrow 3\ CO_2\ (g) + 4\ H_2O\ (v)$

b) Sulfur trioxide gas is formed when sulfur is burned in air.

$2\ S\ (s) + 3\ O_2\ (g) \rightarrow 2\ SO_3\ (g)$

c) Carbonic acid (in pop) decomposes in your stomach to form carbon dioxide (burps) and liquid water.

$H_2CO_3\ (aq) \rightarrow CO_2\ (g) + H_2O\ (l)$

d) Aluminum oxide is broken down into its elements by electrolysis.

$2\ A\ell_2O_3\ (s) \rightarrow 4\ A\ell\ (s) + 3\ O_2\ (g)$

e) Lithium metal reacts with water (H-OH) in a single displacement reaction.

$2\ Li\ (s) + 2\ H_2O\ (l) \rightarrow 2\ LiOH\ (aq) + H_2\ (g)$

f) Iron (II) sulfide is formed from its elements.

$S\ (s) + Fe\ (s) \rightarrow FeS\ (s)$

g) When sodium metal is dropped into pure bromine, there is a synthesis reaction.

$2\ Na\ (s) + Br_2\ (l) \rightarrow 2\ NaBr\ (s)$

h) A solution of calcium nitrate is mixed with aqueous sodium sulfide.

$Ca(NO_3)_2\ (aq) + Na_2S\ (aq) \rightarrow CaS\ (aq) + 2\ NaNO_3\ (aq)$

i) A solution of silver hypobromite is mixed with a solution of ammonium chloride.

$AgBrO\ (aq) + NH_4C\ell\ (aq) \rightarrow NH_4BrO\ (aq) + AgC\ell\ (s)$

j) A solution of potassium sulfide is mixed with a solution of lead (II) nitrate.

$K_2S\ (aq) + Pb(NO_3)_2\ (aq) \rightarrow PbS\ (s) + 2\ KNO_3\ (aq)$

k) Solid calcium carbonate reacts with hydrochloric acid in a double displacement reaction.

$CaCO_3\ (s) + 2\ HC\ell\ (aq) \rightarrow H_2CO_3\ (aq) + CaC\ell_2\ (aq)$

l) Sulfur tetrafluoride gas reacts with water to form sulfur dioxide gas and hydrofluoric acid.

$SF_4\ (g) + 2\ H_2O\ (l) \rightarrow SO_2\ (g) + 4\ HF\ (aq)$

m) Solutions of nickel (II) acetate and ammonium phosphate are mixed.

$3\ Ni(CH_3COO)_2\ (aq) + 2\ (NH_4)_3PO_4\ (aq) \rightarrow Ni_3(PO_4)_2\ (s) + 6\ NH_4CH_3COO\ (aq)$

n) When pure sodium cyanide is added to water, it produces toxic hydrogen cyanide gas and a solution of sodium hydroxide. This is the "death chair" reaction that has been used for executing criminals.

$NaCN\ (s) + H_2O\ (l) \rightarrow HCN\ (g) + NaOH\ (aq)$