

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) | $4 KClO_3 \rightarrow 3 KClO_4 + KCl$ | 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) | $C_{10}H_{16} + 8 Cl_2 \rightarrow 10 C + 16 HCl$ | single displacmt |
| f) | $S_8 + 12 O_2 \rightarrow 8 SO_3$ | synth/combust'n |
| g) | $2 Al(OH)_3 + 3 H_2SO_4 \rightarrow Al_2(SO_4)_3 + 6 H_2O$ | 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) | $2 Al + 3 FeO \rightarrow Al_2O_3 + 3 Fe$ | 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) | $2 KClO_3 \rightarrow 2 KCl + 3 O_2$ | decomposition |
| s) | $Al_4C_3 + 12 HCl \rightarrow 4 AlCl_3 + 3 CH_4$ | double displacmt |
| t) | $2 H_3AsO_4 \rightarrow As_2O_5 + 3 H_2O$ | decomposition |
| u) | $Al_2(SO_4)_3 + 3 Ca(OH)_2 \rightarrow 2 Al(OH)_3 + 3 CaSO_4$ | double displacmt |
| v) | $P_4O_{10} + 6 H_2O \rightarrow 4 H_3PO_4$ | synthesis |
| w) | $FeCl_3 + 3 NH_4OH \rightarrow Fe(OH)_3 + 3 NH_4Cl$ | 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) $\text{SiCl}_4 + 4 \text{H}_2\text{O} \rightarrow \text{H}_4\text{SiO}_4 + 4 \text{HCl}$
- b) $2 \text{Na} + 2 \text{H}_2\text{O} \rightarrow 2 \text{NaOH} + \text{H}_2$
- c) $2 \text{Ca}_3(\text{PO}_4)_2 + 6 \text{SiO}_2 \rightarrow \text{P}_4\text{O}_{10} + 6 \text{CaSiO}_3$
- d) $2 \text{Na}_2\text{O}_2 + 2 \text{H}_2\text{O} \rightarrow 4 \text{NaOH} + \text{O}_2$
- e) $4 \text{Si}_2\text{H}_3 + 11 \text{O}_2 \rightarrow 8 \text{SiO}_2 + 6 \text{H}_2\text{O}$
- f) $\text{CO}_2 + 2 \text{NH}_3 \rightarrow \text{CO}(\text{NH}_2)_2 + \text{H}_2\text{O}$
- g) $\text{H}_2\text{SO}_4 + 8 \text{HI} \rightarrow \text{H}_2\text{S} + 4 \text{I}_2 + 4 \text{H}_2\text{O}$
- h) $4 \text{FeS}_2 + 11 \text{O}_2 \rightarrow 2 \text{Fe}_2\text{O}_3 + 8 \text{SO}_2$
- i) $\text{Na}_2\text{CO}_3 + 2 \text{HCl} \rightarrow 2 \text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$
- j) $3 \text{NaBH}_4 + 4 \text{AlF}_3 \rightarrow 3 \text{NaF} + 3 \text{BF}_3 + 2 \text{Al}_2\text{H}_6$
- k) $4 \text{NH}_3 + 5 \text{O}_2 \rightarrow 4 \text{NO} + 6 \text{H}_2\text{O}$
- l) $\text{PCl}_5 + 4 \text{H}_2\text{O} \rightarrow \text{H}_3\text{PO}_4 + 5 \text{HCl}$
- m) $\text{POCl}_3 + 3 \text{H}_2\text{O} \rightarrow \text{H}_3\text{PO}_4 + 3 \text{HCl}$
- n) $2 \text{CuCl}_2 + 4 \text{KI} \rightarrow 2 \text{CuI} + 4 \text{KCl} + \text{I}_2$
- o) $\text{B}_2\text{H}_6 + 3 \text{O}_2 \rightarrow \text{B}_2\text{O}_3 + 3 \text{H}_2\text{O}$

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.

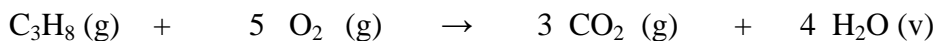
- a) $\text{Ca (s)} + \text{Cu}(\text{NO}_3)_2 \text{ (aq)} \rightarrow \text{Ca}(\text{NO}_3)_2 \text{ (aq)} + \text{Cu (s)}$
- b) $\text{Ni (s)} + \text{AlPO}_4 \text{ (aq)} \rightarrow \text{NR}$
- c) $\text{Ag (s)} + \text{FeCl}_2 \text{ (aq)} \rightarrow \text{NR}$
- d) $2 \text{K (s)} + 2 \text{H-OH (l)} \rightarrow 2 \text{KOH (aq)} + \text{H}_2 \text{ (g)}$
- e) $\text{Zn (s)} + \text{H}_2\text{SO}_4 \text{ (aq)} \rightarrow \text{ZnSO}_4 \text{ (aq)} + \text{H}_2 \text{ (g)}$

10. Given a pure non-metal element and a compound containing a non-metal (eg. NaCl, 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).

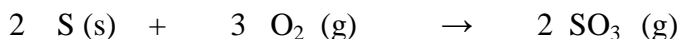
- a) $\text{Br}_2 \text{ (l)} + \text{KCl (aq)} \rightarrow \text{NR}$
- b) $2 \text{Br}_2 \text{ (l)} + \text{SnI}_4 \text{ (aq)} \rightarrow \text{SnBr}_4 \text{ (aq)} + 2 \text{I}_2 \text{ (s)}$
- c) $3 \text{Cl}_2 \text{ (g)} + 2 \text{AlBr}_3 \text{ (aq)} \rightarrow 2 \text{AlCl}_3 \text{ (aq)} + 3 \text{Br}_2 \text{ (l)}$
- d) $\text{I}_2 \text{ (g)} + \text{BaF}_2 \text{ (aq)} \rightarrow \text{NR}$
- e) $\text{Cl}_2 \text{ (g)} + \text{CaS (aq)} \rightarrow \text{CaCl}_2 \text{ (aq)} + \text{S (s)}$

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 (C₃H₈) burns in air.



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



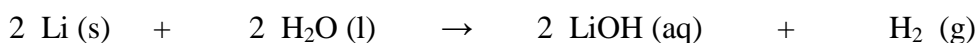
c) Carbonic acid (in pop) decomposes in your stomach to form carbon dioxide (burps) and liquid water.



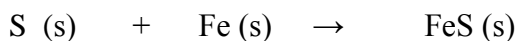
d) Aluminum oxide is broken down into its elements by electrolysis.



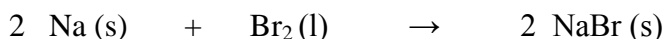
e) Lithium metal reacts with water (H-OH) in a single displacement reaction.



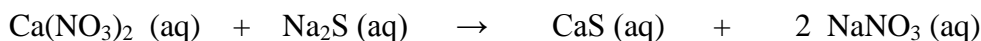
f) Iron (II) sulfide is formed from its elements.



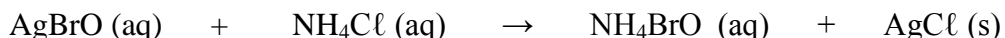
g) When sodium metal is dropped into pure bromine, there is a synthesis reaction.



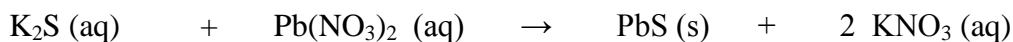
h) A solution of calcium nitrate is mixed with aqueous sodium sulfide.



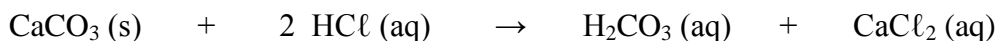
i) A solution of silver hypobromite is mixed with a solution of ammonium chloride.



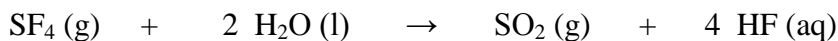
j) A solution of potassium sulfide is mixed with a solution of lead (II) nitrate.



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



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



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



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.

