Worksheet #1
COMPOSITION (SYNTHESIS) REACTIONS

IF THE REACTANTS ARE:

a. two elements
b. one element and a compound containing that element
c. water and a metal oxide
d. water and a nonmetal oxide

... you probably have a composition reaction.

GENERAL EQUATION: \( A + B \rightarrow AB \)  \[ \text{Element}_1 + \text{Element}_2 \rightarrow \text{Compound} \]

APPLY THESE RULES TO COMPOSITION REACTIONS:

1. metal + nonmetal \( \Rightarrow \) salt
2. nonmetal oxide (acid anhydride) + water \( \Rightarrow \) ternary acid (main versions)
3. metal oxide (basic anhydride) + water \( \Rightarrow \) metal hydroxide
4. metal chloride + oxygen \( \Rightarrow \) metal chlorate
5. nonmetal oxide + metal oxide \( \Rightarrow \) salt (with polyatomic ion)
6. metal oxide + carbon dioxide \( \Rightarrow \) metal carbonate
7. compound + element already in compound \( \Rightarrow \) compound w/ element at higher oxidation state
   \[ \text{note: oxidation numbers never change unless rule 7 applies!} \]
8. metal + oxygen \( \Rightarrow \) metal oxide

STATES OF MATTER IN COMPOSITION REACTIONS:

- nonmetal oxides (g)
- metal oxides (s)
- salts (s)
- water (l)
- acid (aq)
- individual elements (look at periodic chart for state)
- if one reactant is water, then the product could be aqueous (aq)

THE DIATOMICS: \( \text{H}_2, \text{N}_2, \text{F}_2, \text{Cl}_2, \text{Br}_2, \text{I}_2 \)

DIRECTIONS: Determine the products of each reaction and balance the equation. Indicate all states. Place the rule number for each to the right of each problem. \text{Use the main version of the ion.}

1. \( \text{Li} + \text{I}_2 \Rightarrow \)_______________________________
2. \( \text{Mg} + \text{N}_2 \Rightarrow \)_______________________________
3. \( \text{H}_2 + \text{N}_2 \Rightarrow \)_______________________________
4. \( \text{SO}_3 + \text{H}_2\text{O} \Rightarrow \)_______________________________
5. \( \text{Mn} + \text{Cl}_2 \Rightarrow \)_______________________________
6. \( \text{Sb} + \text{Br}_2 \Rightarrow \)_______________________________
7. \( \text{CaCl}_2 + \text{O}_2 \Rightarrow \)_______________________________
8. \( \text{Al} + \text{N}_2 \Rightarrow \)_______________________________
9. \( \text{Pb} + \text{Cl}_2 \Rightarrow \)_______________________________
10. \( \text{FeO} + \text{CO}_2 \Rightarrow \)_______________________________
11. \( \text{Si} + \text{Br}_2 \Rightarrow \)_______________________________
12. \( \text{Cu}_2\text{O} + \text{O}_2 \Rightarrow \)_______________________________
13. \( \text{I}_2 + \text{Cl}_2 \Rightarrow \)_______________________________
14. \( \text{P}_2\text{O}_5 + \text{H}_2\text{O} \Rightarrow \)_______________________________
15. \( \text{Fe} + \text{O}_2 \Rightarrow \)_______________________________
16. \( \text{BaO} + \text{H}_2\text{O} \Rightarrow \)_______________________________
17. \( \text{Ag} + \text{O}_2 \Rightarrow \)_______________________________
18. \( \text{CO} + \text{O}_2 \Rightarrow \)_______________________________
19. \( \text{Na}_2\text{O} + \text{H}_2\text{O} \Rightarrow \)_______________________________
20. \( \text{Cu} + \text{S} \Rightarrow \)_______________________________
Worksheet #2
DECOMPOSITION REACTIONS RULES

IF THE REACTANT IS A SINGLE COMPOUND, THE REACTION IS A DECOMPOSITION REACTION.

GENERAL EQUATION: AB → A + B       [ Compound → Element₁ + Element₂ ]

APPLY THESE RULES TO DECOMPOSITION REACTIONS:
1. salt ⇒ metal + nonmetal
2. ternary acid ⇒ nonmetal oxide (acid anhydride) + water
3. metal hydroxide ⇒ metal oxide (basic anhydride) + water
4. metal chlorate ⇒ metal chloride + oxygen
5. salt (with polyatomic ion) ⇒ nonmetal oxide + metal oxide
6. metal carbonate ⇒ metal oxide + carbon dioxide
7. metal oxide ⇒ metal + oxygen
8. hydrated salts ⇒ anhydrous salt + water

STATES OF MATTER IN DECOMPOSITION REACTIONS:
- nonmetal oxides (g)
- metal oxides (s)
- salts (s)
- water as a product (g)
- water as a reactant (l)
- acids (aq)
- individual elements (look at periodic chart for state)

THE DIATOMICS: H₂, N₂, O₂, F₂, Cl₂, Br₂, I₂

DIRECTIONS: Determine the products of each reaction. Balance the equation. Indicate the states of matter on all reactants and products. Place the rule number for each to the right of each problem.

1. ZnCO₃ ⇒ ____________________________ 11. Ag₂O ⇒ ____________________________
2. Ba(ClO₃)₂ ⇒ ____________________________ 12. Fe(OH)₂ ⇒ ____________________________
3. Sb₂O₅ ⇒ ____________________________ 13. PBr₅ ⇒ ____________________________
4. CaCO₃ ⇒ ____________________________ 14. CuSO₄ • 5H₂O ⇒ ____________________________
5. KClO₃ ⇒ ____________________________ 15. Mg(OH)₂ ⇒ ____________________________
6. H₂CO₃ ⇒ ____________________________ 16. H₃PO₄ ⇒ ____________________________
7. Ba(OH)₂ ⇒ ____________________________ 17. Al(OH)₃ ⇒ ____________________________
8. HgO ⇒ ____________________________ 18. Zn(NO₃)₂ ⇒ ____________________________
9. NaCl ⇒ ____________________________ 19. Ca₃(PO₄)₂ ⇒ ____________________________
Worksheet #3
SINGLE REPLACEMENT REACTIONS (REDOX)

IF THE REACTANTS IN AN EQUATION ARE:
an element and a compound that does not contain the element,
... you probably have a single replacement reaction.

GENERAL EQUATION  \( AX + B \rightarrow BX + A \)  
\( [\text{Compound}_1 + \text{Element}_1 \rightarrow \text{Compound}_2 + \text{Element}_2] \)

APPLY THESE RULES:
1) Check Activity Series chart to determine if reaction will even take place.
2) An active metal will replace the metallic ion in a compound of a less active metal.
3) Active metals, such as zinc, iron, and aluminum (all metals above hydrogen in the series) will replace the hydrogen in acids to give a salt and hydrogen gas.
4) Halogens will replace less active halogens.

STATES OF MATTER IN SINGLE REPLACEMENT REACTIONS:
For reactions to take place, there must be a dissolving medium. This will either be an aqueous solution (acids and others) or liquid (water).
nonmetal oxides (g)
metal oxides (aq)
salts (aq)
water (l) – hint: can be written as \( \text{H(OH)} \)
acid (aq)
individual elements (look at periodic chart for state)
*always have aqueous/liquid as reactant/product

THE DIATOMICS: \( \text{H}_2, \text{N}_2, \text{O}_2, \text{F}_2, \text{Cl}_2, \text{Br}_2, \text{I}_2 \)

Complete and balance the following equations. If the single element is not active enough to replace an element in the compound, put an “\( \times \)” over the arrow. Write all states of matter on each reactant and product. Place the rule number for each to the right of each problem.

1. \( \text{CuCl}_2 + \text{Sr} \rightarrow \)___________________________  13. \( \text{Cu(C}_2\text{H}_3\text{O}_2)_2 + \text{Zn} \rightarrow \)___________________________
2. \( \text{NaF} + \text{Cl}_2 \rightarrow \)___________________________  14. \( \text{Cl}_2 + \text{NaBr} \rightarrow \)___________________________
3. \( \text{Al} + \text{Fe}_2\text{O}_3 \rightarrow \)___________________________  15. \( \text{HCl} + \text{Ag} \rightarrow \)___________________________
4. \( \text{SnCl}_4 + \text{Na} \rightarrow \)___________________________  16. \( \text{PbSO}_4 + \text{Ba} \rightarrow \)___________________________
5. \( \text{HCl} + \text{Cd} \rightarrow \)___________________________  17. \( \text{CdI}_2 + \text{Br}_2 \rightarrow \)___________________________
6. \( \text{Mn} + \text{HgCl}_2 \rightarrow \)___________________________  18. \( \text{H}_2\text{SO}_4 + \text{Fe} \rightarrow \)___________________________
7. \( \text{H}_2\text{O} + \text{Ca} \rightarrow \)___________________________  19. \( \text{Cd} + \text{CuSO}_4 \rightarrow \)___________________________
8. \( \text{Mg} + \text{CuBr}_2 \rightarrow \)___________________________  20. \( \text{Al} + \text{AgNO}_3 \rightarrow \)___________________________
9. \( \text{CuO} + \text{H}_2 \rightarrow \)___________________________  21. \( \text{Zn} + \text{H}_2\text{SO}_3 \rightarrow \)___________________________
10. \( \text{Cu} + \text{AgNO}_3 \rightarrow \)___________________________  22. \( \text{H}_2\text{PO}_4 + \text{Al} \rightarrow \)___________________________
11. \( \text{Co} + \text{Al(NO}_3)_3 \rightarrow \)___________________________  23. \( \text{Zn(NO}_3)_2 + \text{Na} \rightarrow \)___________________________
12. \( \text{HBr} + \text{Ba} \rightarrow \)___________________________  24. \( \text{Hg}_2\text{Cl}_2 + \text{Cu} \rightarrow \)___________________________
Worksheet #4
DOUBLE REPLACEMENT REACTIONS

IF THE REACTANTS IN AN EQUATION ARE TWO IONIC COMPOUNDS
...the reaction is probably a Double Decomposition. Check your solubility charts to determine if the reaction can take place first.

1. In these reactions, the reactants switch “partners.” Example: 2NaCl + H₂SO₄ ⇌ Na₂SO₄ + 2HCl
2. It is important that the formula of the products be written correctly. If they are correct, balancing the equation by inspection is a simple task; if not, the equation will never balance.
3. In these reactions, there is never a change in oxidation state.

GENERAL EQUATION  AX + BY ⇌ BX + AY

[ Compound₁ + Compound₂ ⇌ Compound₃ + Compound₄ ]

APPLY THESE RULES:
1) A reaction between an acid and a base yields a salt and a water.
2) Reaction of a salt with an acid forms a salt of the acid and a second acid, which is volatile.
3) Reaction of some soluble salts produces an insoluble salt and a soluble salt or a non-dissociated compound and a soluble salt.
4) It is not difficult to write the equation, but, what is more important, does the reaction take place?
5) Indicate all gaseous products by marking with a (g) and all or insoluble products with a (s).
6) If the reaction does not take place, mark (NR-No reaction) and indicate the reason.
7) Both reactants have to be aqueous for the reaction to take place.
8) Both products can not be aqueous: along with an aqueous product, there must also be a solid, liquid, or gas come out as product.
9) Reaction does not occur if products are identical to reactants.

A REACTION TENDS TO GO TO COMPLETION IF:

a. One of the products is a gas and is allowed to escape.
   --The most common inorganic gases are: H₂, Cl₂, O₂, N₂, H₂S, HF, HCl, HBr, HI, CO, CO₂, SO₂, SO₃, NH₃, NO, N₂O, NO₂, and HCN.

b. An unionized substance such as H₂O.
c. H₂CO₃ as a product will decompose into H₂O(l) + CO₂(g) instead of being shown as an aqueous product.
d. NH₄OH as an aqueous product will break down into NH₃(g) + H₂O(l)
e. An insoluble substance, a solid, is formed.

STATES OF MATTER DOUBLE REPLACEMENT REACTIONS:

Follow the Solubility Chart to predict the states of each reactant and product.
DOUBLE REPLACEMENT REACTIONS

Complete and balance the following equations. If the reaction doesn’t take place, indicate the reason why. Write the states of matter for each reactant and product.

1. \( \text{MgSO}_4 + \text{Ca} (\text{C}_2\text{H}_3\text{O}_2)_2 \Rightarrow \)
2. \( \text{Cs}_2\text{CO}_3 + \text{ZnBr}_2 \Rightarrow \)
3. \( \text{Pb(NO}_3)_2 + \text{Na}_2\text{CO}_3 \Rightarrow \)
4. \( \text{Na}_2\text{SO}_4 + \text{Hg}_2\text{Cl}_2 \Rightarrow \)
5. \( \text{NH}_4\text{Cl} + \text{Ba(OH)}_2 \Rightarrow \)
6. \( \text{NaBr} + \text{Pb(NO}_3)_2 \Rightarrow \)
7. \( \text{Ca} (\text{C}_2\text{H}_3\text{O}_2)_2 + \text{KNO}_3 \Rightarrow \)
8. \( \text{Ba(OH)}_2 + \text{NH}_4\text{C}_2\text{H}_3\text{O}_2 \Rightarrow \)
9. \( \text{NH}_3\text{OH} + \text{Al(NO}_3)_3 \Rightarrow \)
10. \( \text{MgCl}_2 + \text{Hg}_2\text{SO}_4 \Rightarrow \)
11. \( \text{NH}_4\text{Br} + \text{Ag(C}_2\text{H}_3\text{O}_2) \Rightarrow \)
12. \( \text{H}_2\text{SO}_4 + \text{KCl} \Rightarrow \)
13. \( \text{CaS} + \text{CuSO}_4 \Rightarrow \)
14. \( \text{HCl} + \text{BaCO}_3 \Rightarrow \)
15. \( \text{AgNO}_3 + \text{HNO}_3 \Rightarrow \)
16. \( \text{SrCO}_3 + \text{H}_2\text{SO}_4 \Rightarrow \)
17. \( \text{Ba(OH)}_2 + \text{Na}_2\text{SO}_4 \Rightarrow \)
18. \( \text{Al(OH)}_3 + \text{Fe}_2(\text{SO}_4)_3 \Rightarrow \)
19. \( \text{Pb(C}_2\text{H}_3\text{O}_2)_2 + \text{K}_2\text{SO}_4 \Rightarrow \)
20. \( \text{FeSO}_4 + \text{H}_3\text{PO}_4 \Rightarrow \)
21. \( \text{NaCl} + \text{SrS} \Rightarrow \)
22. \( \text{Pb(ClO}_3)_2 + \text{KHSO}_4 \Rightarrow \)
23. \( \text{AlPO}_4 + \text{CaCO}_3 \Rightarrow \)
24. \( \text{HI} + \text{Hg}_2(\text{NO}_3)_2 \Rightarrow \)
25. \( \text{FeCl}_2 + \text{Ag}_2\text{O} \Rightarrow \)
Worksheet #5
MIXED CHEMICAL REACTIONS

Complete and balance the following reactions. Indicate the type of reaction in the blank using C=composition; D=decomposition, SR=single replacement, DR=double replacement. For the given word problems, write the entire equation in the space provide and balance like the rest. Include states of matter on all equations. For ions with multiple oxidation numbers, use the most common one indicated in bold on the periodic chart.

1. Fe + CuSO₄ ⇒ _______________________________________________________
2. MgCO₃ ⇒ _________________________________________________________
3. KCl + Hg₂SO₄ ⇒ ___________________________________________________
4. S + O₂ ⇒ _________________________________________________________
5. H₂SO₄ + Cd ⇒ ______________________________________________________
6. Zinc + Silver sulfate ⇒ ______________________________________________
7. Sulfur dioxide + water ⇒ ______________________________________________
8. Aluminum sulfite + Sodium hydroxide⇒ ___________________________________
9. Iron + Chlorine gas ⇒ ________________________________________________
10. Decomposition of Potassium chlorate ⇒ _________________________________
11. HCl + CaCO₃ ⇒ ______________________________________________________
12. AgNO₃ + HCl ⇒ _____________________________________________________
13. Zn + O₂ ⇒ _________________________________________________________
14. H₂SO₄ ⇒ ___________________________________________________________
15. Fe₂O₃ + H₂ ⇒ _______________________________________________________
16. Sodium sulfate + Barium bromide ⇒ _________________________________
17. Nitrogen monoxide + oxygen⇒ _________________________________________
18. Heating and decomposition of magnesium sulfate heptahydrate⇒_____________
19. Water + sodium⇒ _____________________________________________________
20. Mercury (I) nitrate + Potassium sulfate ⇒ _______________________________
21. N₂ + H₂ ⇒ __________________________________________________________
22. AgNO₃ + Na₂CO₃ ⇒ __________________________________________________
23. Hg + O₂ ⇒ __________________________________________________________
24. NaOH + BaBr₂ ⇒ ____________________________________________________
25. KNO₃ + KC₂H₃O₂ ⇒ __________________________________________________
26. Combining of iron and water: $\text{Fe} + \text{H}_2\text{O} \rightarrow \text{Fe}_2\text{O}_3 + \text{H}_2$

27. Silicon + Sulfur: $\text{Si} + \text{S} \rightarrow \text{SiS}$

28. Antimony (III) sulfide + Iron: $\text{Sb}_2\text{S}_3 + \text{Fe} \rightarrow \text{Sb}_2\text{O}_3 + \text{Fe}_3\text{S}_4$

29. Potassium chloride + Ammonium chloride: $\text{KCl} + \text{NH}_4\text{Cl} \rightarrow \text{KCl} + \text{H}_2\text{O}$

30. Copper and oxygen: $\text{Cu} + \text{O}_2 \rightarrow \text{CuO}$

31. CuO + H₂: $\text{CuO} + \text{H}_2 \rightarrow \text{Cu} + \text{H}_2\text{O}$

32. CaS + HCl: $\text{CaS} + \text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{S}$

33. AuCl₃: $\text{AuCl}_3 \rightarrow \text{Au} + \text{Cl}_2$

34. Sb + S: $\text{Sb} + \text{S} \rightarrow \text{Sb}_2\text{S}_3$

35. Iron (III) oxide and Aluminum: $\text{Fe}_2\text{O}_3 + \text{Al} \rightarrow \text{Fe}_3\text{Al}_2\text{O}_5$

36. Heating and decomposition of Mercury (II) oxide: $\text{HgO} \rightarrow \text{Hg} + \text{O}_2$

37. Iron (III) bromide + Barium hydroxide: $\text{FeBr}_3 + \text{Ba(OH)}_2 \rightarrow \text{BaBr}_2 + \text{Fe(OH)}_3$

38. Magnesium + Lead (II) sulfate: $\text{Mg} + \text{PbSO}_4 \rightarrow \text{MgSO}_4 + \text{Pb}$

39. Aluminum and nitrogen: $\text{Al} + \text{N}_2 \rightarrow \text{AlN}$

40. Hydrosulfuric acid and Iron (II) chloride: $\text{H}_2\text{S}_2\text{O}_3 + \text{FeCl}_2 \rightarrow \text{H}_2\text{S}_2\text{O}_3 + \text{FeCl}_2$

41. Breakdown of Nitrogen trihydride (ammonia): $\text{NH}_3 \rightarrow \text{N}_2 + 3\text{H}_2$

42. Sodium phosphate and Magnesium sulfate: $\text{Na}_3\text{PO}_4 + \text{MgSO}_4 \rightarrow \text{Mg}_3\text{(PO}_4)_2 + \text{Na}_2\text{SO}_4$

43. Sulfur trioxide and water: $\text{SO}_3 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4$

44. Sodium bromide and chlorine: $\text{NaBr} + \text{Cl}_2 \rightarrow \text{NaCl} + \text{Br}_2$
Worksheet #6
WORD PROBLEMS

Write and balance the equations from the reactant names given below. Note the classifications of the various types of reactants. Name the products of each reaction. Indicate states of matter of all parts.

I. Composition Reactions

A. Reactants – two elements
   1. Strontium + chlorine ⇒
   2. iron + oxygen ⇒
   3. aluminum + fluorine ⇒

B. Reactants – compound + element in the compound
   4. carbon monoxide + oxygen ⇒
   5. antimony III chloride + chlorine ⇒

C. Reactants – non-metallic oxide + water
   6. dinitrogen pentoxide + water ⇒
   7. sulfur dioxide + water ⇒

D. Reactants – metallic oxide + water
   8. lithium oxide + water ⇒
   9. copper II oxide + water ⇒

II. Decomposition Reactions

A. Reactant – Binary compound
   10. mercury II oxide ⇒
   11. ammonia ⇒
   12. calcium oxide ⇒

B. Reactant – Acid
   13. carbonic acid ⇒
   14. sulfuric acid ⇒

C. Reactant – Base
   15. magnesium hydroxide ⇒
   16. iron III hydroxide ⇒
II. Decomposition Reactions  (continued)

D. Reactant – metallic carbonate

17. magnesium carbonate ⇒
18. zinc carbonate ⇒

E. Reactant – metallic chlorate

19. sodium chlorate ⇒
20. beryllium chlorate ⇒

III. Single Replacement Reactions

A. Reactants – acid + metal

21. magnesium + hydrochloric acid ⇒
22. gold + sulfuric acid ⇒

B. Reactants – metal + salt

23. copper + silver nitrate ⇒
24. magnesium + potassium nitrate ⇒
25. potassium + magnesium nitrate ⇒

C. Reactants – nonmetal + salt

26. bromine + sodium chloride ⇒
27. chlorine + sodium bromide ⇒

IV. Double Replacement Reactions

A. Reactants – acid + base

28. sulfurous acid + magnesium hydroxide ⇒
29. carbonic acid + lithium hydroxide ⇒
30. acetic acid + sodium hydroxide ⇒

B. Reactants – two ionic salts

31. lead II chloride + potassium nitrate ⇒
32. potassium acetate + sodium nitrate ⇒
33. silver nitrate + sodium chloride ⇒
Worksheet #7

NET IONIC EQUATIONS

Net Ionic Equations tell you “where the action is” in a Double Replacement Reaction. You only include the ions that go out of solution in the Net Ionic Equation.

1. All common soluble salts should be written as dissociated with the exception of mercury I chloride.

2. Most weak acids are written in the molecular form; common strong acids such as HCl, HBr, HI, (not HF), HNO₃, H₂SO₄, HClO₄, are shown as dissociated ions.

3. Group I and II hydroxides are strong bases and may be shown as aqueous or slightly soluble. A slightly soluble base reacted with an acid can be thought of as aqueous when it is one of the reactants.

4. All insoluble salts should be so designated by (s) and gases indicated by an (g).

5. Ammonium hydroxide as a product will turn into aqueous and gaseous ammonia and liquid water.

6. Carbonic acid as a product will decompose into carbon dioxide and water.

7. Sulfurous acid as a product will decompose into sulfur dioxide and water.

Follow the example problems as you complete this worksheet.

Examples:

a. Complete and Balance the equation:
   \[ 2\text{NH}_4\text{Cl}(aq) + \text{Ba(OH)}_2(aq) \rightarrow \text{BaCl}_2(aq) + 2\text{NH}_3(aq) + 2\text{H}_2\text{O}(l) \]

b. Write the total ionic equation:
   \[ 2\text{NH}_4^+(aq) + 2\text{Cl}^-(aq) + \text{Ba}^{2+}(aq) + 2\text{OH}^-(aq) \rightarrow \text{Ba}^{2+}(aq) + 2\text{Cl}^-(aq) + 2\text{NH}_3(aq) + 2\text{H}_2\text{O}(l) \]

c. Write the net ionic equation (include only those species that change as the reaction takes place):
   \[ 2\text{NH}_4^+ + 2\text{OH}^- \rightarrow 2\text{NH}_3(aq) + 2\text{H}_2\text{O}(l) \]

PROBLEMS:

1. A. H₂SO₄(aq) + NaOH(aq) ⇒
   B. 
   C. 

2. A. AgNO₃(aq) + CaBr₂(aq) ⇒
   B. 
   C. 

3. A. NaI(aq) + Pb(NO₃)₂(aq) ⇒
   B. 
   C. 

4. A. $\text{AgCN}_{(aq)} + \text{HCl}_{(aq)} \rightarrow$
   B. 
   C. 

5. A. $\text{Ba(OH)}_{2(\text{aq})} + \text{Na}_2\text{SO}_4_{(aq)} \rightarrow$
   B. 
   C. 

6. A. $\text{NaNO}_3_{(aq)} + \text{HCl}_{(aq)} \rightarrow$
   B. 
   C. 

7. A. $\text{ZnCl}_2_{(aq)} + \text{H}_2\text{S}_{(aq)} \rightarrow$
   B. 
   C. 

8. A. $\text{HC}_2\text{H}_3\text{O}_2_{(aq)} + \text{Na}_2\text{SO}_3_{(aq)} \rightarrow \underline{\text{_______}} + \text{SO}_2_{(g)} + \underline{\text{_______}}$
   B. 
   C. 

9. A. $\text{NaHCO}_3_{(s)} + \text{HCl}_{(aq)} \rightarrow \underline{\text{_________}} + \underline{\text{_________}} + \underline{\text{_________}}$
   B. 
   C. 

10. A. $\text{HC}_2\text{H}_3\text{O}_2_{(aq)} + \text{KOH}_{(aq)} \rightarrow$
    B. 
    C. 

11. A. $(\text{NH}_4)_2\text{S}_{(aq)} + \text{LiOH}_{(aq)} \rightarrow \underline{\text{_________}} + \underline{\text{_________}} + \underline{\text{_____________}}$
    B. 
    C.
Worksheet #8
COMBUSTION REACTIONS

In the presence of excess oxygen, most hydrocarbons can undergo complete combustion redox reactions to form carbon dioxide and water. Because such combustion reactions release large amounts of heat, many hydrocarbons are used as fuels. Identify as many of these common hydrocarbons and their derivatives as you can. Which of them have you used for heat or light?

1. \( \text{CH}_4 + \text{O}_2 \rightarrow \) ________________________________

2. \( \text{C}_2\text{H}_2 + \text{O}_2 \rightarrow \) ________________________________

3. \( \text{CH}_3\text{OH} + \text{O}_2 \rightarrow \) ________________________________

4. \( \text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2 \rightarrow \) ________________________________

5. \( \text{C}_8\text{H}_{18} + \text{O}_2 \rightarrow \) ________________________________

6. \( \text{C}_2\text{H}_6 + \text{O}_2 \rightarrow \) ________________________________

7. \( \text{C}_6\text{H}_6 + \text{O}_2 \rightarrow \) ________________________________

8. \( \text{C}_8\text{H}_4 + \text{O}_2 \rightarrow \) ________________________________

9. \( \text{C}_{35}\text{H}_{72} + \text{O}_2 \rightarrow \) ________________________________

10. \( \text{C}_3\text{H}_7\text{OH} + \text{O}_2 \rightarrow \) ________________________________
1. A solution of sodium iodide is added to a solution of lead (II) acetate.

2. Pure solid white phosphorus is burned in air.

3. Solid cesium oxide is added to water.

4. Excess concentrated hydrochloric acid is added to a 1.0 M solution of cobalt (II) chloride.

5. Solid sodium hydrogen carbonate is strongly heated.

6. An excess of hydrochloric acid is added to solid zinc sulfide.

7. A solution of potassium hydroxide is added to solid ammonium chloride.

8. Solid zinc carbonate is added to 1.0 M sulfuric acid.

9. A solution of hydrogen peroxide is exposed to strong sunlight.

10. Magnesium ribbon is burned in oxygen.

11. A solution of nickel (II) chloride is added to a solution of sodium hydroxide, forming a precipitate.

12. Propane is burned in excess oxygen.

13. A sample of solid iron (III) oxide is reduced completely with solid carbon.

14. A solution containing silver ion (an oxidizing agent) is mixed with a solution containing iron (II) ion (a reducing agent).

15. Sulfur trioxide gas is bubbled into a glass of water.