Chemical Reactions

5 reactions: synthesis, decomposition,
single replacement,
double replacement, and combustion.
Tables F and J

Chemical Reactions BASICS

There are 5 simple reactions in this chemistry class (but more are coming later in the year).

They are synthesis, decomposition, single replacement, double replacement, and combustion.

You will be expected to recognize them with real chemistry symbols, or with "abstract" letters that stand in for actual chemicals. Examples for each are below.

Each reaction has certain characteristics that make it different from the other types of reactions.

Memorize these five, along with their example reactions so that you can draw upon this later in the year.

Word equations describe the chemical reaction in words only. The "skeleton" equation is when you introduce the chemical symbols, all written with proper ion to ion - or atom to atom ratios - but the equation is NOT balanced.

Balancing reactions takes practice. It converts the skeleton into proper final form, so that the law of conservation of matter is taken into consideration (the number of atoms or moles in the reactants equals the number of atoms or moles in the products). You can never finish with an unbalanced equation and be correct.

Balanced equations include PHASE SYMBOLS, indicating what phase of matter (S, L, G or AQ) that the substance is in during that part of the reaction.
Abbreviations S, L, G, and AQ, get put into <u>subscript</u> parenthesis.

At room temperature…

All metals are SOLID (except Hg).

Most nonmetals are gases: H_2, He, Ne, Ar, Kr, Xe, Rn, F_2, O_2, and Cl_2. Bromine (Br_2) is liquid.

These nonmetals are solids: B, C, Si, P, S, As, Se, Te and I_2.

Ionic compounds are SOLIDS, unless dissolved into water which makes them aqueous (Table F)

Phase symbol examples:

$H_2O_{(L)}$ for liquid water, $H_2O_{(S)}$ for ice, or $H_2O_{(G)}$ for steam.

Dissolved into water is aqueous: examples are $HCl_{(AQ)}$ or $NaCl_{(AQ)}$
Hydrogen monochloride dissolved into water is hydrochloric acid,
and sodium chloride dissolved into water, salty water.
$H_2O_{(AQ)}$ is impossible! Water cannot be dissolved in water!

A reminder: All elements on the periodic table exist as single atoms -
except for the HONClBrIF twins, which are the diatomic elements.

THE SYNTHESIS REACTION (1/5)

Are the reactions that combines smaller things into a larger chemical compound. The demo in class was the reaction of hydrogen combining with the oxygen in the air to form water. This reaction had hydrogen gas in a balloon, some invisible oxygen gas in the air, and a candle was used to both melt the balloon and to provide enough energy to start the reaction. The hydrogen combined with the oxygen in an explosion of fire and sound, and the water formed was instantly vaporized by the heat. Reactions that give off heat are called EXOTHERMIC. This was an extremely fast synthesis that was also an exothermic reaction. Sometimes this is called COMBINATION reaction as well.

Word Equation: hydrogen plus oxygen yields water

Skeleton Equation: $H_2 + O_2 \rightarrow H_2O$

BALANCED EQUATION: $2H_{2(G)} + O_{2(G)} \rightarrow 2H_2O_{(G)}$

Other synthesis reactions include: iron rusting by combining with oxygen, magnesium oxide forming when magnesium gets hot enough to combine with oxygen in the air, or ammonia forming from hydrogen and nitrogen gases.

Abstractly, this can be represented by: $X + Y \rightarrow XY$

Remember in class to protect your ears, and try not to blink too much or you miss this…

Another example word equation:

sodium and chlorine make sodium chloride

Skeleton Equation: $Na + Cl_2 \rightarrow NaCl$

BALANCED EQUATION:

$2Na_{(S)} + Cl_{2(G)} \rightarrow 2NaCl_{(S)}$

THE DECOMPOSITION REACTION (2/5)

Defined: the reaction that breaks up larger substances into two or more smaller substances. It is the reverse of synthesis. The demo in class was the reaction of hydrogen peroxide breaking down into water and oxygen gas. This particular reaction was also SO SLOW to watch you could not be sure it was happening. To speed it up the teacher added potassium iodide.

That worked as a **catalyst: a substance that speeds up a chemical reaction but does not affect any other part of the reaction.**

This reaction gave off a lot of heat, making it an EXOTHERMIC reaction. Oddly, that same amount of energy would have been given off without the catalyst, just so slowly that the heat would not be noticeable without a very accurate thermometer.

The heat given off is a constant, the catalyst just made it all be given off in a very short period of time. We will learn much more about heats of reactions (ΔH) later in the year.

Word Equation: hydrogen peroxide decomposes into water & oxygen

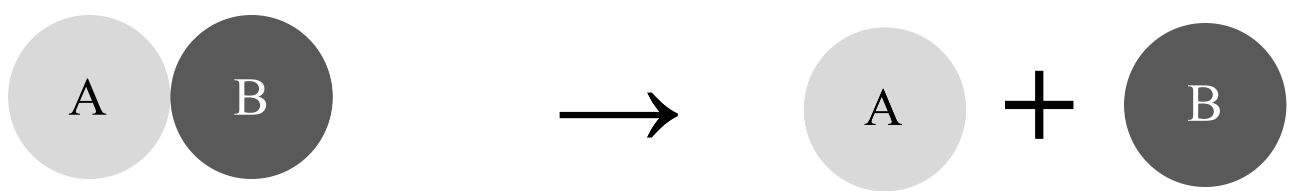
Skeleton Equation: $H_2O_2 \rightarrow H_2O + O_2$

BALANCED EQUATION: $2H_2O_{2AQ)} \xrightarrow{KI_{(S)}} 2H_2O_{(L)} + O_{2(G)}$

The hydrogen peroxide used in the demo was a 30% solution dissolved into water.
PURE hydrogen peroxide could be a LIQUID, but technically speaking, ours was a solution.

Other decomposition reactions include: ammonia breaking down into hydrogen and nitrogen, copper II carbonate breaking down into copper II oxide (black solid) and carbon dioxide (gas).

Abstractly, this can be represented by: $AB \rightarrow A + B$ or, $XY \rightarrow X + Y$



Another common decomposition reaction is when water breaks down into hydrogen and oxygen gases. To do this we'll use a Hoffmann Apparatus, which runs electricity through the water (puts energy in to break the bonds). Water does not conduct electricity by itself. Water can only conduct if there are LOOSE MOBILE IONS in solution. That means an aqueous salt dissolves and then comes apart into cations and anions. There are six examples of salts "ionizing" or "dissociating" near the bottom of table I in your reference tables. From potassium nitrate to lithium bromide. All AQ salts, and all acids ionize this way, they do NOT react with water, but water is shown above the arrow in the symbols.

THE SINGLE REPLACEMENT REACTION (3/5)

To understand this reaction you need a bit more chemistry background. When most ionic compounds are added to water they can ionize, which means that the cation part and the anion part can separate and these ions literally float around dissolved in the water. They form an aqueous solution.

Ex: $NaCl_{(S)} \rightarrow Na^{+1}_{(AQ)} + Cl^{-1}_{(AQ)}$ (loose, mobile ions)

We will learn more how this happens later in the year. Since these ions are now loose from each other, when a new substance is added into the solution, sometimes this new substance can push one of these ions out of solution and take its place.

This gives the reaction its name: the single replacement reaction. One substance replaces ONE PART of the ionic compound in solution. This only happens with an ionic compound in solution.

To further complicate things, depending upon what is in solution and what is added, the reaction can happen or it will not. Lucky for us TABLE J exists to guide us.

Table J is called the ACTIVITY SERIES. It lists in 2 columns, the activity level or better said: the REACTIVITY LEVEL of a lot of substances.

A single replacement reaction has 3 parts, the single substance that gets added into the aqueous solution (which has 2 parts itself). for example:

$$Mg_{(S)} + HCl_{(AQ)} \rightarrow$$

the 3 parts are the **Mg atom**, the **H^{+1} cation** and the **Cl^{-1} anion**.

If we look at Table J, we see that 2 of these 3 parts, are one side of table J.

(this always happens: 2 of 3 parts are on one side - in this case on the left).

Locate both Mg and H on the table. Since Mg is HIGHER UP on the table, that means that magnesium has a higher activity level, it would be able to bump out the hydrogen in a single replacement reaction. So,

the skeleton would be: $Mg + HCl \rightarrow MgCl_2 + H_2$

balanced chemical equation: $Mg_{(S)} + 2HCl_{(AQ)} \rightarrow MgCl_{2(AQ)} + H_{2(G)}$

Mg replaces the H in solution, the chloride is the spectator ion here.
This is a CATION REPLACEMENT single replacement reaction, the Mg atom replaces the H^{+1} cation in solution.

Metals	Non-Metals
most active	
Li	F_2
Rb	Cl_2
K	Br_2
Cs	I_2
Ba	
Sr	
Ca	
Na	
Mg	
Al	
Ti	
Mn	
Zn	
Cr	
Fe	
Co	
Ni	
Sn	
Pb	
H*	
Cu	
Ag	
Au	
least active	
*H is a non metal that acts like a metal in SR reactions	

Some single replacement reactions will not occur, if you add an atom that is LOWER on the list, meaning it is not reactive enough to replace the “higher” ion already in solution.

For example, in class I put my GOLD WEDDING BAND into hydrochloric acid. Since Au is lower than the hydrogen, there is NO REACTION. The proper form for this is:

$$Au_{(S)} + HCl_{(AQ)} \rightarrow X \quad \text{(no reaction)}$$

We use Table J to determine whether or not a single replacement reaction is spontaneous will occur as written, or if it will not. We do not need to do every possible reaction since this table will give us the answer.

Sometimes, **2 of the 3 parts of the reaction will both be on the RIGHT SIDE OF THE TABLE**. The same "rules" apply, if a single part is higher on the right side of table J it can replace itself into the solution. A "standard" example of this is:

$$Cl_{2(G)} + 2NaBr_{(AQ)} \rightarrow 2NaCl_{(AQ)} + Br_{2(G)}$$

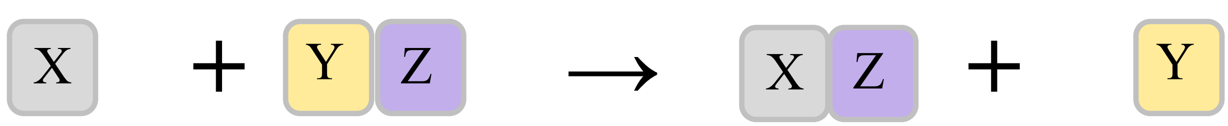
This is an ANION REPLACMENT SINGLE REPLACEMENT reaction, in that chlorine replaces the Br^{-1} anion in solution. The Na+1 is the spectator ion.

Abstractly, this can be represented three different ways…

A + BC → AC + B (when 2 of the three are on the LEFT side of Table J) CATION REPLACEMENT

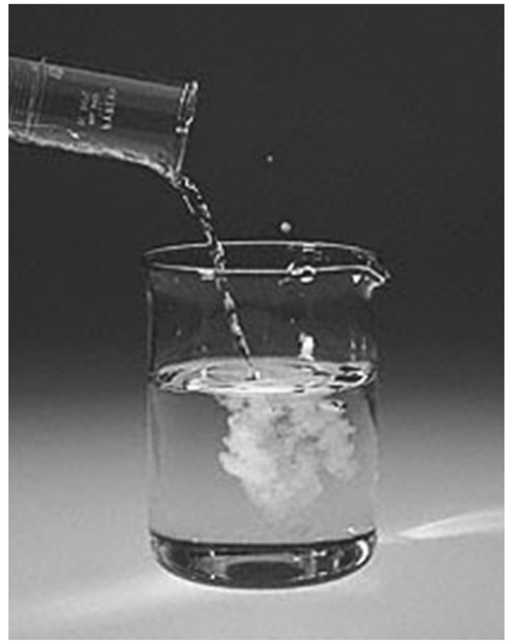
M + NP → no reaction

R + ST → SR + T (when 2 of the 3 are on the RIGHT side of Table J) ANION REPLACEMENT



Atoms + AQ → Different AQ Different atoms

THE DOUBLE REPLACEMENT REACTION (4/5)



This reaction is what it sounds to be, a double switch by two different solutions of ionic compounds. The cations and anions are separated (ionized) from each other in the aqueous solutions as loose, mobile ions.

When two different solutions of separated ions are combined, the cations will trade anions in a double switch. This results in two new ionic compounds forming.

If we get a new aqueous solution, and a solid precipitate forming, that is double replacement. Sometimes the 2 products are both aqueous, and no solid forms.
That is not a chemical reaction, that is just a mixture.

In our class we will balance ALL double replacement reaction set ups, then we'll use Table F to determine the phases of the products.

Table J can show that some possible single replacement reactions cannot occur and therefore no balancing is possible. Not here! For double replacement you will balance and table "F" the products. Only then might you discover that one is a "no reaction". A "no reaction" means the solutions MIXED.

The original two solutions will be ionized into the water - another way to say that they are dissolved in water completely. When the solutions are combined together, and the cations switch their anions, new compounds formed will also be soluble and remain dissolved and the other will precipitate out of solution as a solid. These insoluble compounds will form precipitates which we can see.

The number of potential double replacement reactions is great. TABLE F exists to help us determine which kinds of ionic compounds will be soluble (AQ) or insoluble (S).

Using this table can be difficult at first (not unlike tying one's shoes, or learning how to use a swing at the park) but it is remarkably simple once you practice a bit.

Example word equation…

calcium chloride + sodium carbonate forms calcium carbonate + sodium chloride

The skeleton chemical reaction is...

$$\_CaCl_{2(AQ)} + \_Na_2CO_{3(AQ)} \rightarrow \_CaCO_{3(\ )} + \_NaCl_{(\ )}$$

Next page this continues…

(again) The skeleton chemical reaction is...

$$\_CaCl_{2(AQ)} + \_Na_2CO_{3(AQ)} \rightarrow \_CaCO_{3(\ )} + \_NaCl_{(\ )}$$

The balanced chemical reaction is...

$$CaCl_{2(AQ)} + Na_2CO_{3(AQ)} \rightarrow CaCO_{3(\ )} + 2NaCl_{(\ )}$$

The balanced chemical reaction with PHASES is...

$$CaCl_{2(AQ)} + Na_2CO_{3(AQ)} \rightarrow CaCO_{3(S)} + 2NaCl_{(AQ)}$$

Table F shows that halides (group 17 ions) are usually AQ, but with 3 exceptions. Ca is not an exception so the $CaCl_2$ is aqueous. If you are an ion in group 1, like sodium, you are AQ with no exceptions. Both reactants are clearly AQ.

Product one, table F shows most carbonates are SOLIDS (an exception is the reactant sodium Na_2CO_3). The last product is clearly AQ, sodium ions always are AQ and most halides are too.

The solid precipitate is the PROOF, or EVIDENCE that a double replacement reaction happened.

Occasionally this may happen: $NH_4Br_{(AQ)} + KCl_{(AQ)} \rightarrow NH_4Cl_{(AQ)} + KBr_{(AQ)}$

Both products are AQ, which means this is NOT a chemical reaction. This is just a mixture!

If you are careful to look over the table F, and READ IT SLOWLY, you can't go wrong with deciding if an ionic compound will be AQ or S when in water.

Just remember soluble = dissolves into water, making an aqueous solution.
Insoluble = not able to dissolve into waster. It stays solid—or a solid PRECIPITATE forms.

Abstractly, visualize it this way: $AB + XY \rightarrow AY + XB$

(be sure to trade anions, the cations ALWAYS stay in the front of the compound formula)

Another way to remember this is that it's like a SQUARE DANCE (switch your partners!)

Cation Anion + Cation Anion → Cation Anion + Cation Anion

THE COMBUSTION REACTION (5/5)

This reaction is truly the most basic. A compound containing ONLY hydrogen & carbon must combine with oxygen to form ONLY carbon dioxide and water.
A HYDROCARBON is a compound that has ONLY hydrogen and carbon in it.

Examples of hydrocarbons include methane (CH_4), octane (C_8H_{18}), and butane (C_4H_{10}).

The products must always be carbon dioxide and water. There can be NO OTHER PRODUCTS. This rule makes combustion easy to recognize. Combustion reactions are always rather EXOTHERMIC, they give off lots of heat.

Word Equation: methane plus oxygen yields carbon dioxide and water

Skeleton Equation: $CH_4 + O_2 \rightarrow H_2O + CO_2$

BALANCED EQUATION: $CH_{4(G)} + 2O_{2(G)} \rightarrow CO_{2(G)} + 2H_2O_{(G)}$

Another BALANCED EQUATION: $C_3H_{8(G)} + 5O_{2(G)} \rightarrow 3CO_{2(G)} + 4H_2O_{(G)}$

Abstractly, visualize this reaction this way…
any hydrocarbon reacts with oxygen gas, forming into carbon dioxide and water and heat!

$$HC + O_{2(G)} \rightarrow CO_{2(G)} + H_2O_{(G)} + \text{ENERGY!}$$

Incomplete combustion can occur if there is not enough oxygen to covert all of the carbon into CO_2 Some can be formed into CO, or even just C. There are many variations on this reaction called incomplete combustion, but importantly: not all of the carbon can become carbon dioxide.

Example A: $2CH_{4(G)} + 3O_{2(G)} \rightarrow C_{(S)} + CO_{2(G)} + 4H_2O_{(G)}$

Example B: $2CH_{4(G)} + 3O_{2(G)} \rightarrow 2CO_{(G)} + 4H_2O_{(G)}$

There are many other incomplete combustion reactions in addition to these. They do not occur with enough oxygen to turn all the carbon into CO_2 gas.

At right, friends enjoy a camp fire. This is an example of the burning of a hydrocarbon (wood) by rapidly combining it with oxygen in the air, producing carbon dioxide and water (vapor), and lots of energy is released as light & heat.

These 5 reactions all are BASIC reactions that will help further our study of matter and how it reacts. There are of course some asterisks out there waiting to surprise us. That is okay and we'll keep an eye out for them. There are several other reactions we will cover later on, such as acid base neutralization reactions, and several nuclear reactions (which do not follow all the same rules).

Reactions Notes

1. In a chemical reaction, sometimes ____ and sometimes

_______________________________________, and sometimes both happen.

Every time a reaction occurs ____.

These new substances have their own ________________________________ that are not like the properties of the reactants. There are 5 of kinds of reactions that we learn about.

The first kind of reaction is called the ___________________________________ REACTION.

Sometimes it's called a ____ reaction

2. In a synthesis reaction, ____________________________ reactants combine to form larger products.

3. The "ABSTRACT" is ___________________________________

4. The ____.

Let's review some vocabulary so we can all talk properly

5. ____________________________________ are the substances that we start with, they react together to form the products.

6. _______________________________ are what we end up with at the end of the chemical reaction.

7. Synthesis reaction has 2 or more reactants that form into __________________________________

8. _____________________ is required to start all chemical reactions.

9. ____________________________ reactions emit more energy than was provided to start the reaction.

   __________________________________ reactions absorb more energy than they emit

10. A ____ describes the reaction with words, no symbols, no numbers, as simply as possible.

11. Write out the word equation for the synthesis of water below.

12. The “skeleton” reaction for hydrogen and oxygen make water is

______________________ + ______________________ → ______________________

13. Skip this one!
14. Glinda the Good Witch from the Wizard of Oz tells us the best way to balance an equation. Her advice:

____

15. Rewrite the skeleton reaction from above again. Then we’ll balance it.

______________________ + ______________________ → ______________________

16. There are the ____ of atoms on the reactant side as the product side. Matter can’t be created or destroyed in a chemical reaction (or physical change).

17. Now re write the balanced chemical equation with the “energy” showing the balanced thermochemical equation. We will not need to redo this in steps again.

______________________ + ______________________ → ______________________ + ___________

18. An important chemical adage: ____

19. It’s reverse is cool too: ____

$$2H_{2(G)} + O_{2(G)} \rightarrow 2H_2O_{(G)} + \text{Energy}$$

20	21

Copy word equation: ____

22 skeleton: ____

23 balanced: ____

Copy word equation: ____

24 skeleton: ____

25 balanced: ____

Copy word equation: ____

26 skeleton: ____

27 balanced: ____

Copy word equation: ____

28 skeleton: ____

29 balanced: ____

30. Balance these skeleton reactions, put the coefficients on the dashes. Do NOT write in any "ones".

___C + ___O_2 → ___CO

___Cu + ___O_2 → ___Cu_2O

___Zn + ___O_2 → ___ZnO

___N_2 + ___H_2 → ___NH_3

Decomposition reactions

31. Decomposition reactions are the opposite of synthesis, here

____

Example: Lead II oxide decomposes into lead and oxygen

________________________ → ____________________ + _______________________

32. Abstract for Decomposition: ______________ → ___________ + __________

33. Word equation for the decomposition reaction demo

____

34. Skeleton __$H_2O_{2(L)}$ $\longrightarrow$ __$H_2O_{(L)}$ + __$O_{2(G)}$ (balance this reaction now) do the demo!

35. This reaction was so slow we needed to add a ____

36. ____
as without one, *but when things happen fast, they appear different.*

37. The catalyst is ____!

38. Copy word equation: ____

39. skeleton: ____

40. balanced: ____

41. word: ____

42. Skeleton: ____

43. Balanced: ____

44. word: ____

45. Skeleton: ____

46. Balanced: ____

47. word: ____

48. Skeleton: ____

49. Balanced: ____

50. word: ____

51. Skeleton: ____

52. Balanced: ____

Single Replacement Reactions

52. Single Replacement reactions (SR) start by adding

____

53. When IONIC COMPOUNDS dissolve into water they are ______________________________

54. Ionic compounds form ____ in water if they are soluble. If they are insoluble the compounds just fall to the bottom of the beaker like rocks.

55. A simple ionic compound, NaCl does this when placed into water:

56. First the salt disappears, it dissolves.
At the particle level, the NaCl separates into positive + negative ions,

which are now loose in the water, creating a ____ of

loose ____.

57. This is not a chemical reaction. It's a ____S → AQ

58. When salts dissolve into water, there are no reactants or products because it is *not a chemical reaction.*

Most salts into water form a ____

Because the salt dissolves into water, and it is homogenous, it forms an aqueous solution

We have lots of aqueous solutions in chem. Examples include… (look at table I)

SALT	Goes into water	Forms this	And	that
SOLID	Goes into water	And forms LOOSE MOBILE IONS in water		
$KNO_{3(S)}$	$\xrightarrow{water}$	$K^{+1}_{(AQ)}$	+	$NO_3^{-1}{}_{(AQ)}$
$NaOH_{(S)}$	$\xrightarrow{water}$	$Na^{+1}_{(AQ)}$	+	$OH^{-1}_{(AQ)}$
$NH_4Cl_{(S)}$	$\xrightarrow{water}$		+	

59. Another ionic compound that dissolves and ionizes in water is SILVER NITRATE. This is a setup for a single replacement reaction.

____ → ____

60. In a single replacement reaction there are always 3 parts, the atoms, cations and the anions.

61. 2 of these 3 are ALWAYS on one side of table J or the other side of ___________________________

LOOK at table J: Put your fingers in the left side of table J, touch COPPER and SILVER.

63. COPPER is "higher" than silver on table J. See top left and bottom left of the table.
It says MOST ACTIVE at top, which means more reactive. Metals lower are less reactive.

The copper has the chemical strength to ________________________________ the silver in the solution, the

____.

64. The copper ________________________________ the silver's place in the solution,

the silver ____.

65. The nitrate anion basically hangs out in solution, unchanged. The nitrate is called the…

____

66. A single replacement reaction has 3 parts: ________________, _________________ & ______________

67. Two/three are ALWAYS on one side of table J. The 3rd part is on the other side, or not on the table at all.

The two metals, COPPER and SILVER are on the LEFT SIDE. Nitrate is NOT on table J.

68. Copper is MORE REACTIVE than silver, so it bumps the silver out and takes its place in the solution.

69. ____ form _____________________________________

Look at Table K now (acids you need to find when you need them)

Acids are weird compounds. They are molecular, they do not form ions to bond, but in water they "unbond" like cations do, forming loose mobile ions. The more H^{+1} ions in solution, the stronger the acid. The chlorides sort of are just there.				
70. Remember when ionic compounds go into water, they dissolve, and IONIZE, like this:				
compound	goes into water	forms cations	and	anions
$NaCl_{(S)}$	$\xrightarrow{\text{water}}$	$Na^{+1}{}_{(AQ)}$	+	$Cl^{-1}{}_{(AQ)}$
$HCl_{(G)}$	$\xrightarrow{\text{water}}$		+	

71. This is our "set up" $Mg_{(S)} + HCl_{(AQ)} \rightarrow$ label the parts

72. Write out the skeleton: ____

73. Balance: ____

74. The _____ replaces the _____ in solution, the ______________ precipitates as

a gas, and the ______________________________ anions are the spectators.

75. ____

76. Because Au is lower than H on table J, gold is not active enough to bump out the hydrogen from solution!

____ happens!

Write the set up on the left, then to balance single replacement reactions you must….
first SWITCH 'em, then FIX 'em, and finally BALANCE 'em! PHASE SYMBOLS ARE A MUST!

77. magnesium metal and zinc nitrate solution

____ → ____

78. sodium metal and tin (II) nitrate solution

____ → ____

78. chlorine gas and potassium bromide solution

____ → ____

79. This is special. It's called and ____ reaction, a kind of SR.

80. zinc and sulfuric acid…

__________________________________ → ____

81. Zinc is higher than H is on table J, so

_____ replaces the ________ in solution, _______ gas escapes, the ____________ is our spectator here.

81. Lithium metal and cobalt (III) hydrogen carbonate solution… balance this…

____ → ____

Lithium replaces the cobalt in solution, hydrogen carbonate is our spectator ion.

82. silver metal and potassium chloride solution… balance this…

____ → ____

??? ____

Double Replacement Reactions

84. Two AQ solutions starts a double replacement reaction.

AQ + AQ →

85. You end up with a DIFFERENT AQ and a SOLID (precipitate)

86. ________________________________ → ______________________________

86. 87. Abstract: ______________________________ → __________________________________

88. Copper (II) nitrate + lithium chromate solutions combine… *(you must write the ions, always!)*

___________________+ _____________________→___________________+ ____________________

Let's first look at Table F now, we'll finish up 88 soon.

Finish the equation with 2 phase symbols now.

Aqueous (AQ) means this compound dissolves into water as loose mobile ions
Solid (S) means the compound will not dissolve into water, it's insoluble
Double replacement reactions have 2 AQ to start, and 1 AQ and 1 SOLID as products.

What would happen if there were two AQ products??? (think)

89. Sodium chloride + lead (II) acetate solutions combine… *(write out the ions!)*

____________________ + ______________________ → ____________________ + ______________________

Let's first look at Table F now, finish up the MANDATORY PHASES

90. Write the IONS and FORMULAS. Are these AQ or S in water?			
Compound	IONS	FORMULA	AQ or S ?
Silver chloride	Ag^{+1} Cl^{-1}	$AgCl$	S
Magnesium nitrate			
Sodium hydroxide			
Strontium sulfate			
Calcium nitrate			
Barium acetate			
Aluminum chlorate			
Lead (II) bromide			
Lithium sulfide			
Ammonium chromate			
Barium sulfate			

91. Potassium phosphate + calcium chloride solutions combine into… write out the reactant symbols, and then switch em', fix 'em, and table F 'em! Write small, ALL ON ONE LINE!

____________________+ ______________________→____________________+ _____________________

92. ___$BaCl_{2(AQ)}$ + ___$RbOH_{(AQ)}$ → ________________________+_______________________

What happened here? ____

Combustion Reactions

93. Combustion reactions require a

_______________________________________ → ____

94. Hydrocarbon is a compound made ____ only.

95. There are 1000's of different hydrocarbons, ______________________________________ is the smallest

96. Abstract: ____

Examples:

97. Methane combusts. Since methane is a hydrocarbon, and combustion ALWAYS has a hydrocarbon and oxygen making carbon dioxide and water, that is ENOUGH of a word equation (if you are smart).

_______________________________________ → ____

98. Propane combusts.

___________________ + ____________________ → ____________________ + _______________________

99. Ethane combusts.

_____$C_2H_{6(G)}$ + ______$O_{2(G)}$ → ___________________________ + ____________________________

100. Oxygenated hydrocarbon: a hydrocarbon that also has ____________________________ ("HCO")

These include sugars, acids, alcohols, and many other compounds.
They combust too, but the balancing is a little trickier. There's oxygen in all reactants and all products.

101. Methanol $CH_3OH_{(L)}$ combusts.

_____$CH_3OH_{(L)}$ + ______$O_{2(G)}$ → ___________________________ + ____________________________

102. Glucose combusts.

$$\_C_6H_{12}O_{6(S)} + \_O_{2(G)} \rightarrow \_CO_{2(G)} + \_H_2O_{(G)}$$

103. Octane combusts.

$$\_C_8H_{18(G)} + \_\_O_{2(G)} \rightarrow \_CO_{2(G)} + \_\_H_2O_{(G)}$$

Review of All Five Chemical Reactions…

Synthesis Reactions: 2 or more small things make one larger product

104. Phosphorous + chlorine gas form into phosphorous pentachloride gas.

_________________ + ______________________ → ______________________

Decomposition Reactions: One larger reactant forms 2 or more smaller products.

105. Manganese VII oxide forms manganese and oxygen gas

______________________ → ______________________ + _____________________

Single Replacement Reactions (3 varieties, cation replacement, anion replacement, no reaction)

106. Sodium metal goes into aluminum acetate solution.

____→ ____

107. Bromine is added to lithium iodide solution.

____→ ____

107. Tin is added to barium chlorate solution.

____→ ____

Double Replacement Reactions

Start with two AQ ionic solutions, end with a different AQ solution and a precipitate
If your 2 AQ solutions → 2 new AQ's, then you formed a mixture, no reaction occurred

109. Lithium nitrate + potassium chloride solutions are poured together… (phases MANDATORY, ions too)

____________________ + ____________________ → ____________________ + ____________________

110. Lead (II) hydrogen carbonate and Cobalt (III) sulfate solutions are poured together…
(phases MANDATORY, ions too)

____________________ + ____________________ → ____________________ + ____________________

111. Calcium hydroxide and ammonium chromate solutions mix together…

____________________ + ____________________ → ____________________ + ____________________

Combustion are always a hydrocarbon + oxygen forming water and carbon dioxide with heat.
Oxygenated hydrocarbons can also combust.

112. Hexane combusts (C_6H_{14})

____________________ + _____________________ → _____________________ + ________________________

114. Propanol combusts (C_3H_5OH) this is a type of alcohol.

____________________ + _____________________ → _____________________ + ________________________

115. In combustion of hydrocarbons, or combustion or oxygenated hydrocarbons occurs, the products are ALWAYS carbon dioxide and water. But if there is not enough oxygen for this to happen, sometimes burning still happens, but it is not combustion that occurs, rather,

____ can happen instead.

116. Incomplete combustion examples…

____________________ + _____________________ → _____________________ + ________________________

____________________ + _____________________ → _____________________ + ________________________

____________________ + _____________________ → _____________________ + ________________________

solid carbon is SOOT, carbon monoxide is a poison

Reaction type	Define	Abstract/Example	Tables needed
Synthesis	2 or more smaller substances bond into one larger product	$A + B \rightarrow AB$	Periodic Table for formula writing
Decomposition	one larger reactant breaks down into 2 or more smaller products.	$AB \rightarrow A + B$	Periodic Table for formula writing
Single replacement	Atoms get added to one AQ solution Cation replacement Anion Replacement No Reaction	$A + CD \rightarrow AD + C$ $R + ST \rightarrow SR + T$ $G + HL \rightarrow X$ no reaction	Periodic Table for formulas, Table J
Double replacement	Two aqueous solutions get mixed together Reaction has $_{(S)}$ precipitate If 2 new AQ solutions form it is NOT a reaction	$AB + CD \rightarrow AD_{(AQ)} + CB_{(S)}$ $EF + GH \rightarrow EH_{(AQ)} + GF_{(AQ)}$	Periodic Table for formulas, Table F
Combustion	Hydrocarbon & oxygen form carbon dioxide & water Oxygenated hydrocarbon & oxygen form carbon dioxide & water ALSO: Incomplete combustion	"HC" + O2 $\rightarrow CO_2 + H_2O$ "HCO" + O2 $\rightarrow CO_2 + H_2O$ Incomplete has other products, like solid carbon, or carbon monoxide as well.	Periodic Table for formulas