BALANCING EQUATIONS NOTES

WHY DO WE NEED TO BALANCE CHEMICAL EQUATIONS?

The LAW OF CONSERVATION OF MASS says that matter cannot be created or destroyed. In other words, you cannot end up with any more or any less than you started with.

WHAT ARE "REACTANTS" & "PRODUCTS"?

In a chemical equation (eqn), reactants are on the left side of the arrow → products are on the right

HOW DO YOU BALANCE AN EQUATION?

1. Count up the number of atoms of each element (or polyatomic ion) on each side of the arrow in the eqn.
2. Use *coefficients* to balance the numbers on either side of the eqn.
3. Do not ever change subscripts (formulas) in a compound!

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EXAMPLE #1: ___ Na + ___ Br_2 → ___ NaBr

STEP 1: Set up a chart with # of atoms of each element on each side of eqn.

	Reactants	Products
Na	1	1
Br	2	1

STEP 2: Balance one of the elements that is not balanced. In this case, that is the Br.
(Reactant side has more than product side, so coefficient should go on the product side.)

___ Na + ___ Br_2 → _2_ NaBr

* Reminder: the coefficient gets multiplied by subscripts of all elements in the compound it is in front of. *

	Reactants	Products
Na	1	2
Br	2	2

STEP 3: Check all elements to see if they are balanced. Na is not balanced, so it needs a coefficient of 2.

_2_ Na + ___ Br_2 → _2_ NaBr

	Reactants	Products
Na	2	2
Br	2	2

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EXAMPLE #2: ___ HgO + ___ Cl_2 → ___ HgCl + ___ O_2

	R	P
Hg		
O		
Cl		

EXAMPLE #3: ___ $CuCl_2$ + ___ H_2S → ___ CuS + ___ HCl

EXAMPLE #4: ___ Al_2O_3 → ___ Al + ___ O_2

EXAMPLE #5:

___ $Fe(NO_3)_2$ + ___ Na_3PO_4 → ___ $Fe_3(PO_4)_2$ + ___ $NaNO_3$

	reactants	products
Fe	1	3
NO_3	2	1
Na	3	1
PO_4	1	2

* because there is oxygen in every compound in the equation, it may be helpful to count the number of a polyatomic ion, rather than splitting the polyatomic ion into its elements and then counting.*

_3_ $Fe(NO_3)_2$ + ___ Na_3PO_4 → ___ $Fe_3(PO_4)_2$ + ___ $NaNO_3$

	reactants	products
Fe	3	3
NO_3	6	1
Na	3	1
PO_4	1	2

_3_ $Fe(NO_3)_2$ + ___ Na_3PO_4 → ___ $Fe_3(PO_4)_2$ + _6_ $NaNO_3$

	reactants	products
Fe	3	3
NO_3	6	6
Na	3	6
PO_4	1	2

_3_ $Fe(NO_3)_2$ + _2_ Na_3PO_4 → ___ $Fe_3(PO_4)_2$ + _6_ $NaNO_3$

	reactants	products
Fe	3	3
NO_3	6	6
Na	6	6
PO_4	2	2

Finished!

EXAMPLE #6: ___ $KClO_3$ → ___ KCl + ___ O_2

EXAMPLE #7: ___ C_3H_8 + ___ O_2 → ___ CO_2 + ___ H_2O
HINT: Balance the H's and O's last.

EXAMPLE #8: ___ C_4H_{10} + ___ O_2 --> ___ CO_2 + ___ H_2O

Now, you try these examples:

1.) ___ $Ca(OH)_2$ + ___ HNO_3 → ___ $Ca(NO_3)_2$ + ___ H_2O

2.) ___ Cl_2 + ___ NaBr → ___ NaCl + ___ Br_2

3.) ___ NaOH + ___ HCl → ___ NaCl + ___ H_2O

4.) ___ H_2O + ___ Fe → ___ Fe_2O_3 + ___ H_2

BALANCING EQUATIONS PRACTICE WORKSHEET

1.) ___ CH_4 + ___ O_2 → ___ CO_2 + ___ H_2O

2.) ___ Na + ___ I_2 → ___ NaI

3.) ___ N_2 + ___ O_2 → ___ N_2O

4.) ___ N_2 + ___ H_2 → ___ NH_3

5.) ___ KI + ___ Cl_2 → ___ KCl + ___ I_2

6.) ___ HCl + ___ $Ca(OH)_2$ → ___ $CaCl_2$ + ___ H_2O

7.) ___ $KClO_3$ → ___ KCl + ___ O_2

8.) ___ K_3PO_4 + ___ HCl → ___ KCl + ___ H_3PO_4

9.) ___ S + ___ O_2 → ___ SO_3

10.) ___ KI + ___ $Pb(NO_3)_2$ → ___ KNO_3 + ___ PbI_2

11.) ___ $CaSO_4$ + ___ $AlBr_3$ → ___ $CaBr_2$ + ___ $Al_2(SO_4)_3$

12.) ___ H_2O_2 → ___ H_2O + ___ O_2

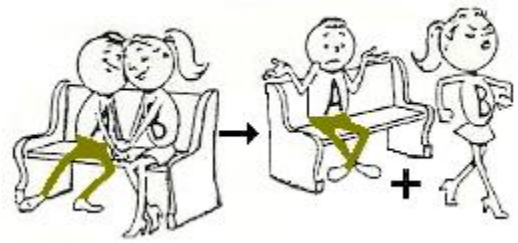
13.) ___ Na + ___ H_2O → ___ NaOH + __ H_2

14.) ___ C_2H_6 + ___ O_2 → ___ CO_2 + ___ H_2O

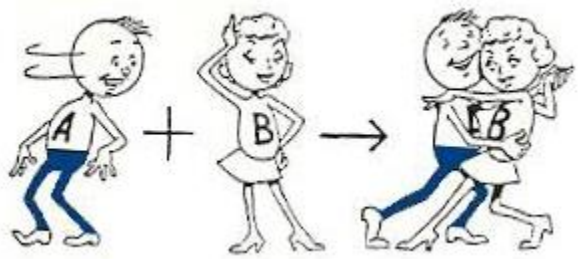
15.) ___ $Mg(NO_3)_2$ + ___ K_3PO_4 → ___ $Mg_3(PO_4)_2$ + ___ KNO_3

TYPES OF EQUATIONS NOTES

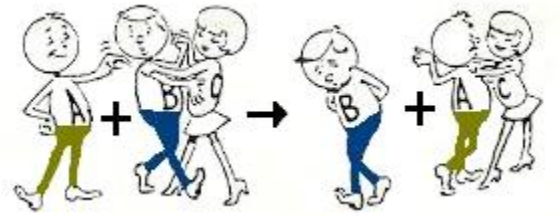
DECOMPOSITION: a compound breaks apart into simpler substances
* To recognize a DECOMPOSITION reaction, look for only 1 REACTANT. *



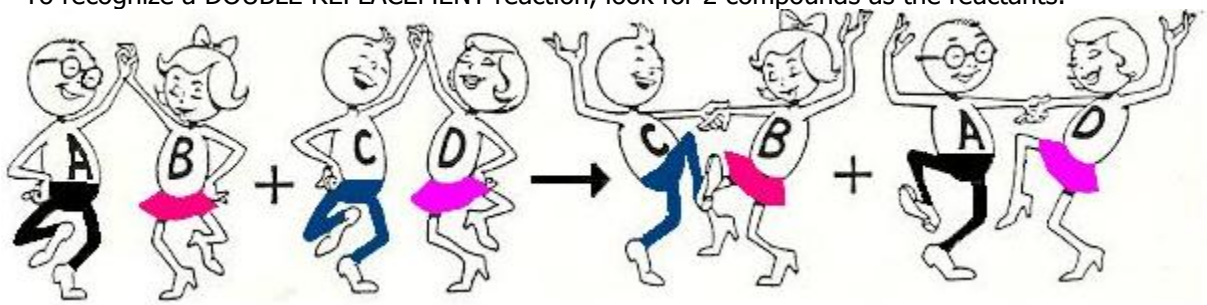
SYNTHESIS: 2 or more simple substances combine to form one compound; opposite of decomposition
* To recognize a SYNTHESIS reaction, look for only 1 PRODUCT. *



SINGLE REPLACEMENT: an element reacts with a compound to form a new element & a new compound
* To recognize a SINGLE REPLACEMENT reaction, look for one element and one compound as the reactants. *



DOUBLE REPLACEMENT: a compound reacts with another compound to form 2 new compounds
* To recognize a DOUBLE REPLACEMENT reaction, look for 2 compounds as the reactants. *



COMBUSTION: a hydrocarbon combines with oxygen to produce carbon dioxide and water

REACTION TYPES WORKSHEET

--> Balance each equation.

--> Identify the type of reaction as: * S - synthesis * D - decomposition
* C – combustion * SR - single replacement * DR - double replacement

TYPE

____ 1. ___ Fe + ___ O_2 → ___ Fe_2O_3

____ 2. ___ Cl_2 + ___ KBr → ___ KCl + ___ Br_2

____ 3. ___ Fe + ___ $Cu(NO_3)_2$ → ___ $Fe(NO_3)_3$ + ___ Cu

____ 4. ___ NaCl → ___ Na + ___ Cl_2

____ 5. ___ $FeCl_3$ + ___ KOH → ___ KCl + ___ $Fe(OH)_3$

____ 6. ___ $KClO_3$ → ___ KCl + ___ O_2

____ 7. ___ Al + ___ O_2 → ___ Al_2O_3

____ 8. ___ Na_2S + ___ $AgNO_3$ → ___ Ag_2S + ___ $NaNO_3$

____ 9. ___ $CaCO_3$ → ___ CaO + ___ CO_2

____ 10. ___ Mg + ___HCl → ___ $MgCl_2$ + ___ H_2

____ 11. ___ $Mg(OH)_2$ + ___ HCl → ___ $MgCl_2$ + ___ H_2O

____ 12. ___ Na_2SO_4 + ___ $BaCl_2$ → ___ $BaSO_4$ + ___ NaCl

____ 13. ___ C_2H_2 + ___O_2 → ___ CO_2 + ___ H_2O

____ 14. ___ CaI_2 + ___ F_2 → ___ CaF_2 + ___ I_2

____ 15. ___ NaOH → ___ Na_2O + ___ H_2O

____ 16. ___ $ZnBr_2$ + ___ $AgNO_3$ → ___ AgBr + ___ $Zn(NO_3)_2$

____ 17. ___ C_4H_{10} + ___ O_2 → ___ CO_2 + ___ H_2O

____ 18. ___ K + ___ Br_2 → ___ KBr

____ 19. ___ $NaHCO_3$ → ___ Na_2CO_3 + ___ H_2O + ___ CO_2

____ 20. ___ $AgNO_3$ + ___ Cu → ___ Ag + ___ $Cu(NO_3)_2$

____ 21. ___ $CuSO_4$ + ___ NaOH → ___ $Cu(OH)_2$ + ___ Na_2SO_4

____ 22. ___ $Ca(ClO_3)_2$ → ___ $CaCl_2$ + ___ O_2

____ 23. ___ PH_3 + ___ O_2 → ___ H_3PO_4

____ 24. ___ H_2O + ___ Fe → ___ H_2 + ___ Fe_3O_4

____ 25. ___ NO + ___ O_2 → ___ NO_2

PREDICTING WHETHER A SINGLE REPLACEMENT REACTION WILL OCCUR

The reactants in a single replacement reaction are an element (by itself) and a compound. Some single replacement reactions will happen, others will not. In order to determine if a single replacement reaction will occur, you must use the Activity Series. (It is located on page 7 of the Reference Tables.)

ACTIVITY SERIES OF METALS

Li	
Rb	
K	
Ba	
Sr	
Ca	
Na	Replace hydrogen from cold water
---	---
Mg	
Al	
Mn	
Zn	
Cr	
Fe	
Cd	Replace hydrogen from steam
---	---
Co	
Ni	
Sn	
Pb	
[H_2]	Replace hydrogen from acids
---	---
Sb	
Bi	
Cu	
Hg	React with oxygen to form oxides
---	---
Ag	
Pt	
Au	

ACTIVITY SERIES OF HALOGENS

F_2
Cl_2
Br_2
I_2

EXAMPLE 1 – Will the following reaction happen or not? **Al + $PbCl_2$ →**

Step 1 – Look at the element by itself. Is this element a metal or a nonmetal? Al (aluminum) is a metal because it is located to the left side of the staircase line on the Periodic Table.

Step 2 – You will compare the type of element by itself to the similar type of element in the compound. In this case, aluminum is a metal, so I will compare it with the metal in the compound (which is Pb).

Step 3 – RULE: The element that is by itself must be HIGHER on (closer to the top of) the Activity Series for the reaction to happen! In this case…

Al	(by itself)	
Mn		
Zn		
Cr		
Fe		
Cd		Replace hydrogen from steam
---	---	---
Co		
Ni		
Sn		
Pb	(in compound)	

Aluminum (Al) is higher than lead (Pb), so the reaction happens.

EXAMPLE 2 – Will the following reaction happen or not? **$Fe + Mg(NO_3)_2 \rightarrow$**

Answer: Iron (Fe) needs to be higher on the Activity Series than magnesium (Mg) in order for the reaction to occur. It is not, so there is no reaction.

EXAMPLE 3 – Will the following reaction happen or not? **$NaCl + Br_2 \rightarrow$**

Answer: Br_2 is the element by itself. It is a nonmetal, so I have to compare it to the nonmetal in the compound – which is Cl. Br needs to be higher than Cl in order for the reaction to happen. It is not, so there's no reaction.

EXAMPLE 4 – Will the following reaction happen or not? **$AlBr_3 + F_2 \rightarrow$**

Answer: F_2 is the element by itself. It is a nonmetal, so I have to compare it to the nonmetal in the compound – which is Br. F needs to be higher than Br in order for the reaction to happen. It is, so the reaction happens. Fluorine and bromine "switch places". Remember to use the oxidation numbers of the elements to write the formulas. Also, remember that fluorine, chlorine, bromine, and iodine are DIATOMIC – that means that these elements will have a subscript of 2 when they are by themselves.

$AlBr_3 + F_2 \rightarrow$ **$Br_2 + AlF_3$** Balanced… $2\ AlBr_3 + 3\ F_2 \rightarrow 3\ Br_2 + 2\ AlF_3$

EXAMPLES:

1. $Al + NiBr_2 \rightarrow$
2. $Fe_2(SO_4)_3 + Ag \rightarrow$
3. $NaCl + F_2 \rightarrow$
4. $Ba(NO_3)_2 + Ni \rightarrow$
5. $I_2 + AlBr_3 \rightarrow$
6. $Ca + KCl \rightarrow$
7. $Mg + Zn_3(PO_4)_2 \rightarrow$
8. $Na + SnCO_3 \rightarrow$

Unit 8 Review Worksheet (Standard level)

(A) Write the formula(s) for the products of the reaction (if they are not already given).
(B) Balance the equation.
(C) Tell the type of reaction.

	Reactants		Products	Type of Equation
1.	silver nitrate + sodium chloride __ $AgNO_3$ + __ NaCl	→	__ AgCl + __ $NaNO_3$	
2.	ammonium sulfide + barium nitrate __ $(NH_4)_2S$ + __ $Ba(NO_3)_2$	→	__ NH_4NO_3 + __ BaS	
3.	lithium carbonate __ Li_2CO_3	→	__ Li_2O + __ CO_2	
4.	zinc + sulfur __ Zn + __ S	→	__ ZnS	
5.	potassium + chlorine __ K + __ Cl_2	→	__ KCl	

6.	magnesium nitride __ Mg_3N_2	→	__ Mg + __ N_2	
7.	aluminum + copper (II) sulfate __ Al + __ $CuSO_4$	→		
8.	aluminum + iron (III) bromide __ Al + __ $FeBr_3$	→		
9.	bromine + silver chloride __ Br_2 + __ AgCl	→		
10.	zinc + nickel (II) nitrate __ Zn + __ $Ni(NO_3)_2$	→		
11.	magnesium + silver sulfate __ Mg + __ Ag_2SO_4	→		
12.	potassium sulfate + aluminum chlorate __ K_2SO_4 + __ $Al(ClO_3)_3$	→	__ $KClO_3$ + __ $Al_2(SO_4)_3$	
13.	ethane (C_2H_6) + oxygen __ C_2H_6 + __ O_2	→		
14.	copper (II) chloride + sodium phosphate __ $CuCl_2$ + __ Na_3PO_4	→	__ $Cu_3(PO_4)_2$ + __ NaCl	
15.	calcium bicarbonate __ $Ca(HCO_3)_2$	→	__ CaO + __ CO_2 + __ H_2O	
16.	strontium nitrate + copper (II) sulfate __ $Sr(NO_3)_2$ + __ $CuSO_4$	→	__ $SrSO_4$ + __ $Cu(NO_3)_2$	
17.	magnesium acetate + iron (III) carbonate __ $Mg(C_2H_3O_2)_2$ + __ $Fe_2(CO_3)_3$	→	__ $MgCO_3$ + __ $Fe(C_2H_3O_2)_3$	
18.	copper (II) phosphate + zinc __ $Cu_3(PO_4)_2$ + __ Zn	→		
19.	potassium + HCl __ K + __ HCl	→		
20.	calcium + potassium chlorate __ Ca + __ $KClO_3$	→		