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**Types of Chemical Reactions POGIL** 

Partners' Names

Date \_\_\_\_\_ Period \_\_\_\_\_

## Purpose

Chemists classify chemical equations according to their patterns to help predict products of unknown, but similar, chemical reactions.

## **Model 1 – Types of Reactions**

Set A \_\_\_\_\_

 $4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$   $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$   $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$   $MgO(s) + H_2O(l) \rightarrow Mg(OH)_2(aq)$   $P_2O_5(g) + 3H_2O(l) \rightarrow 2H_3PO_4(aq)$   $SO_3(g) + H_2O(l) \rightarrow H_2SO_4(aq)$ 

Set C \_\_\_\_\_ 2 FeCl<sub>3</sub>(aq) + 3 Zn(s)  $\rightarrow$  2 Fe(s) + 3 ZnCl<sub>2</sub>(aq) 2 Al(NO<sub>3</sub>)<sub>3</sub>(aq) + 3 Ca(s)  $\rightarrow$  3 Ca(NO<sub>3</sub>)<sub>2</sub>(aq) + 2 Al(s) Mg(s) + CuSO<sub>4</sub>(aq)  $\rightarrow$  MgSO<sub>4</sub>(aq) + Cu(s) 2 Al(s) + 6 HCl(aq)  $\rightarrow$  2 AlCl<sub>3</sub>(aq) + 3 H<sub>2</sub>(g) Cl<sub>2</sub>(g) + 2 NaBr(aq)  $\rightarrow$  2 NaCl(aq) + Br<sub>2</sub>(l) ZnBr<sub>2</sub>(aq) + F<sub>2</sub>(g)  $\rightarrow$  ZnF<sub>2</sub>(aq) + Br<sub>2</sub>(l) Set B  $MgCO_{3}(s) \rightarrow MgO(s) + CO_{2}(g)$   $8Li_{2}S(s) \rightarrow 16Li(s) + S_{8}(s)$   $2H_{2}O(l) \rightarrow 2H_{2}(g) + O_{2}(g)$   $2KCIO_{3}(s) \rightarrow 2KCl(s) + 3 O_{2}(g)$   $2Na_{2}O_{2}(s) \rightarrow 2Na_{2}O(s) + O_{2}(g)$   $(NH_{4})_{2}CO_{3}(s) \rightarrow 2 NH_{3}(g) + H_{2}O(l) + CO_{2}(g)$ 

## Set D \_\_\_\_\_

 $AgNO_{3}(aq) + NaCl(aq) \rightarrow AgCl(s) + NaNO_{3}(aq)$   $2 HNO_{3}(aq) + Mg(OH)_{2}(aq) \rightarrow Mg(NO_{3})_{2}(aq) + 2 H_{2}O(l)$   $Na_{2}CO_{3}(aq) + CaCl_{2}(aq) \rightarrow CaCO_{3}(s) + 2 NaCl(aq)$   $FeS(s) + 2 HCl(aq) \rightarrow H_{2}S(g) + FeCl_{2}(aq)$   $HCl(aq) + NaOH(aq) \rightarrow H_{2}O(l) + NaCl(aq)$   $FeBr_{3}(aq) + K_{3}PO_{4}(aq) \rightarrow FePO_{4}(s) + 3 KBr(aq)$ 

1. The chemical equations in Model 1 contain the phase notations (s), (l), (g), and (aq). Match each symbol with its meaning.

dissolved in water/ in solution	liquid	solid	gas

4. Match each description below to one of the reaction sets (A, B, C or D) from Model 1.

\_\_\_\_\_ Ionic compounds dissolved in water switch partners.

\_\_\_\_\_ One compound breaks into elements or smaller compounds.

\_\_\_\_\_ Two or more elements or compounds combine to form one product.

\_\_\_\_\_ Part of an ionic compound is removed and replaced by a new element.

5. Define the following terms as they are commonly used in the English language.

Synth	esis
Deco	mposition
Repla	
5. The f	bur sets of chemical reactions shown in Model 1 have the following general names. Discuss in your group which name belongs to which set of chemical reactions. Write the name in the
appro	Single Replacement Reaction Synthesis Reaction
	Double Replacement Reaction Decomposition Reaction
0. In bo whice	oth single replacement and double replacement reactions, which kind of element replaces ch kind of element?
or _	
2. Iden or d	tify each of the reactions below as synthesis (S), decomposition (D), single replacement (SR) puble replacement (DR).
	$ K_2O(s) + H_2O(l) \rightarrow 2KOH(aq)$
	$\underline{2MgCl_2(aq) + Na_2CO_3(aq) \rightarrow 2NaCl(aq) + MgCO_3(s)}$
	$2Al_2O_3(s) \rightarrow 4Al(s) + 3O_2(g)$
	$\underline{\operatorname{Cu}(\operatorname{NO}_3)_2(aq) + \operatorname{Zn}(s) \to \operatorname{Cu}(s) + \operatorname{Zn}(\operatorname{NO}_3)_2(aq)}$
	$  L_2 Cu(NO_3)_2(aq) + Zn(s) \rightarrow Cu(s) + Zn(NO_3)_2(aq) $ $  L_2 SO_4(aq) + 2NaOH(aq) \rightarrow Na_2 SO_4(aq) + 2H_2O(l) $

- $\underline{\qquad} 2O_2(g) + N_2(g) \rightarrow N_2O_4(g)$
- $\underline{\qquad} 2\operatorname{NaF}(s) \to 2\operatorname{Na}(s) + \operatorname{F}_2(g)$

13. A student writes the following *incorrect* chemical equation for the synthesis of magnesium oxide:

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Mg + O_2 \rightarrow MgO_2
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Another student writes the following *incorrect* synthesis reaction:

$$Mg + O \rightarrow MgO$$

- *a.* What is the correct formula for magnesium oxide? *Hint:* Magnesium oxide is an ionic compound.
- b. What is the correct formula for oxygen as we find it in nature?
- e. Write the correct balanced chemical equation for the synthesis of magnesium oxide.
- 14. A student writes the following *incorrect* chemical equation for a single replacement reaction between lithium bromide and fluorine.

 $2\text{LiBr}(aq) + F_2(g) \rightarrow 2\text{Li}(s) + 2\text{FBr}(g)$ 

- *a.* In a single replacement reaction, part of an ionic compound is removed and replaced by a new element. Which element should fluorine replace in lithium bromide? *Hint:* What kind of element is fluorine? And what kind of element would that replace in a single replacement reaction?
- b. What is wrong with the student's prediction of the products in the above reaction?

*c*. Predict the products and write the correct balanced equation for the single replacement reaction between lithium bromide and fluorine. (*Hint*: The reactants side of the equation is correct in the equation the student wrote.)

15. A student writes the following incorrect chemical equation for a double replacement reaction between iron(III) bromide and sodium hydroxide solutions.

 $FeBr_3(aq) + NaOH(aq) \rightarrow FeOH(s) + NaBr_3(aq)$ 

a. What is wrong with the chemical formula(s) of the product(s) predicted by this student?

*b*. Write the correct balanced chemical equation for the double replacement reaction between iron(III) bromide and sodium hydroxide.

## **Model 2 – Combustion Reactions**

 $2C_8H_{18}(g) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(g)$  (C<sub>8</sub>H<sub>18</sub> = octane – gasoline component)

 $2C_4H_{10}(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(g)$  (C<sub>4</sub>H<sub>10</sub> = butane – lighter fuel)

 $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$  ( $CH_4$  = methane – natural gas)

- 1. What are the products in all of the combustion reactions in Model 2?
- 2. What reactant is common to all of the combustion reactions in Model 2?
- 3. The "fuel" in most combustion reactions is a *hydrocarbon*. (The "fuel" is the compound that reacts with oxygen gas.) Using the examples in Model 2, write a description for the classification of substances known as hydrocarbons.

4. Predict the products of the following combustion reactions, and balance each reaction equation.

*a*. C<sub>5</sub>H<sub>12</sub> + 8O<sub>2</sub>  $\rightarrow$ 

*b*.  $2C_2H_2 + 5O_2 \rightarrow$