PAL Worksheet- Chem 6A

Double-Displacement Reactions

Which of the following reactions is a double-displacement reaction?

a) $MgCO_3\,(s) \rightarrow MgO\,(s) + CO_2\,(g)$

b) $Na\,(s) + CaCl_2\,(aq) \rightarrow NaCl\,(aq) + Ca\,(s)$

c) $K_2SO_4\,(aq) + BaF_2\,(aq) \rightarrow KF\,(aq) + BaSO_4\,(s)$

For the reaction you chose, what makes it a double-displacement reaction? What types of compounds are the two reactants (always)?

Completing double-displacement reactions requires multiple steps and you'll want to perform each step in the correct order. In general, first predict the products, then determine the physical states (using the solubility rules), then balance the reaction. Read through the example below. Then, the first problem will take you through these steps. Lastly, follow the same steps to complete the remaining reactions.

Example: Complete the following double-displacement reaction.

$$SrCl_2 + LiF \rightarrow$$

step 1: Predict the products. To do this, first write the *ions* that make up each compound on the reactant side. (Remember that ions have charges.)

ions: $\underline{Sr^{2+}}\ \underline{Cl^-} + \underline{Li^+}\ \underline{F^-} \rightarrow$

$$SrCl_2 + LiF \rightarrow$$

step 2: To predict the products, the anions switch places with one another. Draw a square around the anion in each compound above.

ions: $\underline{Sr^{2+}}\ \boxed{Cl^-} + \underline{Li^+}\ \boxed{F^-} \rightarrow$

$$SrCl_2 + LiF \rightarrow$$

step 3: To predict each new product, switch the places of these two anions so they are paired up with the other cation. Write the new pairing of ions on the product side of the reaction arrow. (Remember that the cation is always written before the anion.)

step 3: switch the anions (Cl^- and F^-) for the products

ions: $Sr^{2+}\ Cl^-$ + $Li^+\ F^-$ → $Sr^{2+}\ F^-$ + $Li^+\ Cl^-$

$SrCl_2$ + LiF →

step 4: Write the chemical formulas of the two products based on the charge of the ions that are newly paired together. (Do NOT look at any subscripts on the reactant side. Those subscripts are there based on the charges that are paired together in each reactant. Now, you are writing new chemical formulas, which depend on the charges that are now paired together in each product.)

ions: $Sr^{2+}\ Cl^-$ + $Li^+\ F^-$ → $Sr^{2+}\ F^-$ + $Li^+\ Cl^-$

$SrCl_2$ + LiF → SrF_2 + LiCl

step 4: chemical formulas of products

step 5: Determine the physical states of each compound. Use the solubility rules to determine if each compound is soluble or insoluble and label the physical state as aqueous (if soluble) or solid (if insoluble).

$SrCl_2$ (aq) + LiF (aq) → SrF_2 (s) + LiCl (aq)

step 6: If a new solid forms (shown on the product side), then this reaction will happen. Balance the reaction.

$SrCl_2$ (aq) + 2 LiF (aq) → SrF_2 (s) + 2 LiCl (aq)

(This is the complete double-displacement reaction.)

NOTE! If both products are soluble (aq), then there is no reaction. After we mix the two reactants, we only have free ions floating around in solution. In these cases, write "no reaction" on the product side.

Now you try:

Carry out each step to complete the following double-displacement reaction.

$MgBr_2$ + Na_2S →

step 1: Predict the products. To do this, first write the *ions* that make up each compound on the reactant side. (Remember that ions have charges.)

ions: ____ ____ + ____ ____ →

$MgBr_2$ + Na_2S →

step 2: To predict the products, the anions switch places with one another. Draw a square around the anion in each compound above. (Are anions positively or negatively charged?)

step 3: Re-write your work from above. To predict each new product, switch the places of these two anions so they are paired up with the other cation. Write the new pairing of ions on the product side of the reaction arrow. (Remember that the cation is always written before the anion.)

step 3: switch the anions for the products

ions: ____ ____ + ____ ____ → ____ ____ + ____ ____

$MgBr_2$ + Na_2S →

step 4: Re-write your work from above. Write the chemical formulas of the two products based on the charge of the ions that are newly paired together. (Do NOT look at any subscripts on the reactant side. Those subscripts are there based on the charges that are paired together in each reactant. Now, you are writing new chemical formulas, which depend on the charges that are now paired together in each product.)

ions: ____ ____ + ____ ____ → ____ ____ + ____ ____

$MgBr_2$ + Na_2S → _____ + _____

step 5: Re-write the reaction from above, with the reactants and products. (The ions are not necessary at this point.) Determine the physical states of each compound. Use the solubility rules to determine if each compound is soluble or insoluble and label the physical state as aqueous (if soluble) or solid (if insoluble). If both products are soluble, write "no reaction" in place of products.

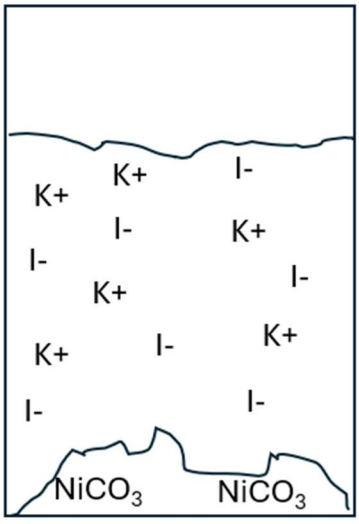
_____ + _____ → _____ + _____

step 6: Re-write your work from above. Balance the reaction.

_____ + _____ → _____ + _____

Follow the steps above to complete each double-displacement reaction. In addition to writing the complete reaction, also provide a drawing of what is present in the solution after the reactants are mixed. See reaction 1 for an example.

1. NiI_2 + K_2CO_3 →



2. $Fe(ClO_3)_2$ + NaOH →

3. Li_2CrO_4 + $ZnSO_4$ →

4. $Co(C_2H_3O_2)_3$ + $Mn(NO_3)_2$ →

Does this reaction happen? (Look at the physical states) Why does/doesn't it happen?

5. $Cr_2(SO_4)_3$ + $Ba(ClO)_2$ →

6. Cs_3PO_4 + $(NH_4)_2SO_3$ →