Name: _____ Date: _____ Period: _____

Single Replacement Reactions: A Step-by-Step Guide

Example	Practice
Magnesium metal is added to copper (II) nitrate	Lithium metal is added to calcium nitrate
1. *Write formulas for the reactants. For any ionic compounds (metal + nonmetal), you have to find the charge of each ion:* Mg: No charge, since it is in its elemental form Cu^{2+}: Copper is a transition metal, so its charge was indicated by the roman numerals NO_3^{1-}: Nitrate is a polyatomic ion that you memorized! *Now put them together and cross the charges into subscripts:* $Mg + Cu^{2+}NO_3^{1-}$ *You will need parentheses around nitrate because it is polyatomic and you have more than one. Reduce the subscripts whenever they have a common denominator.* $Mg + Cu(NO_3)_2$	
2. *Identify the type of reaction by the pattern of the reactants:* A + BX → AX + B is a SR reaction. $Mg + Cu(NO_3)_2 \rightarrow$ *The negative ion could also be replaced. That would have the form of:* Y + BX → BY + X	
3. *Predict the products, based on the reaction type.* *If you have the A + BX pattern, turn the lone metal into an ion (with a charge) and turn the metal ion into a lone metal (with no charge):* A + BX → AX + B $Mg + Cu(NO_3)_2 \rightarrow Mg^{2+}$____ + Cu *Fill in the negative ion with the new metal ion:* A + BX → AX + B $Mg + Cu(NO_3)_2 \rightarrow Mg^{2+}NO_3^{1-}$ + Cu *Now cross the charges into subscripts, using parentheses around the polyatomic ions. Reduce the subscripts if there is a common denominator.* A + BX → AX + B $Mg + Cu(NO_3)_2 \rightarrow Mg(NO_3)_2$ + Cu	
4. *Balance the reaction. Change only the coefficients, NOT subscripts! Just work your way from left to right, balancing each ion you encounter.* *Balance Mg:* $\underline{1}Mg + \_\_Cu(NO_3)_2 \rightarrow \underline{1}Mg(NO_3)_2 + \_\_Cu$ *Balance Cu:* $\underline{1}Mg + \underline{1}Cu(NO_3)_2 \rightarrow \underline{1}Mg(NO_3)_2 + \underline{1}Cu$ *Balance NO_3 and double-check the others:* $\underline{1}Mg + \underline{1}Cu(NO_3)_2 \rightarrow \underline{1}Mg(NO_3)_2 + \underline{1}Cu$	
5. *Now check if the reaction will occur by comparing the activities of the atoms that were competing.* *Here, Mg competed with Cu to bond with NO_3. Mg is higher on the activity series than Cu, so Mg will take its place. This reaction <u>will occur</u>.* *If this were a non-metal replacement reaction, you would compare the activities of the non-metals.*	

6. *Finally, you can determine the movement of the electrons in the reaction.* *Go back to steps 1 & 3 where you determined the charges of the reactants and the products:* $Mg \rightarrow Mg^{2+}$ $Cu^{2+} \rightarrow Cu$ $NO_3^- \rightarrow NO_3^-$ *Here, Mg lost electrons to become a positive ion. Cu^{2+} gained those electrons to become neutral. NO_3^-'s charge did not change, so it did not participate in the electron exchange. The half-reactions can be completed:* $Mg \rightarrow Mg^{2+} + 2e^-$ $Cu^{2+} + 2e^- \rightarrow Cu$	

More Practice!

1. Lead (II) nitrate and cadmium

2. Tin (IV) chloride and silver

3. Barium and Sodium hydroxide

4. Zinc and nickel (III) chloride

5. Magnesium phosphate and aluminum