

## Reactions &amp; Observations

	H <sub>2</sub> SO <sub>4</sub>	AgNO <sub>3</sub>	ZnSO <sub>4</sub>	CuSO <sub>4</sub>	MgSO <sub>4</sub>	Pb(NO <sub>3</sub> ) <sub>2</sub>
Zn	bubbles, H <sub>2</sub> gas	silver forms	<b>X</b>	copper forms	NR	lead forms
Cu	NR	silver forms	NR	<b>X</b>	NR	NR
Mg	bubbles, H <sub>2</sub> gas	silver forms	zinc forms	copper forms	<b>X</b>	lead forms
Pb	bubbles, H <sub>2</sub> gas	silver forms	NR	copper forms	NR	<b>X</b>

ACTIVITIES: Enter the elements in pairs;  $\left( \begin{array}{c} \text{more active} \\ \text{less active} \end{array} \right)$

	H <sub>2</sub> SO <sub>4</sub>	AgNO <sub>3</sub>	ZnSO <sub>4</sub>	CuSO <sub>4</sub>	MgSO <sub>4</sub>	Pb(NO <sub>3</sub> ) <sub>2</sub>
Zn	$\left( \begin{array}{c} \text{Zn} \\ \text{H} \end{array} \right)$	$\left( \begin{array}{c} \text{Zn} \\ \text{Ag} \end{array} \right)$	<b>X</b>	$\left( \begin{array}{c} \text{Zn} \\ \text{Cu} \end{array} \right)$	$\left( \begin{array}{c} \text{Mg} \\ \text{Zn} \end{array} \right)$	$\left( \begin{array}{c} \text{Zn} \\ \text{Pb} \end{array} \right)$
Cu	$\left( \begin{array}{c} \text{H} \\ \text{Cu} \end{array} \right)$	$\left( \begin{array}{c} \text{Cu} \\ \text{Ag} \end{array} \right)$	$\left( \begin{array}{c} \text{Zn} \\ \text{Cu} \end{array} \right)$	<b>X</b>	$\left( \begin{array}{c} \text{Mg} \\ \text{Cu} \end{array} \right)$	$\left( \begin{array}{c} \text{Pb} \\ \text{Cu} \end{array} \right)$
Mg	$\left( \begin{array}{c} \text{Mg} \\ \text{H} \end{array} \right)$	$\left( \begin{array}{c} \text{Mg} \\ \text{Ag} \end{array} \right)$	$\left( \begin{array}{c} \text{Mg} \\ \text{Zn} \end{array} \right)$	$\left( \begin{array}{c} \text{Mg} \\ \text{Cu} \end{array} \right)$	<b>X</b>	$\left( \begin{array}{c} \text{Mg} \\ \text{Pb} \end{array} \right)$
Pb	$\left( \begin{array}{c} \text{Pb} \\ \text{H} \end{array} \right)$	$\left( \begin{array}{c} \text{Pb} \\ \text{Ag} \end{array} \right)$	$\left( \begin{array}{c} \text{Zn} \\ \text{Pb} \end{array} \right)$	$\left( \begin{array}{c} \text{Pb} \\ \text{Cu} \end{array} \right)$	$\left( \begin{array}{c} \text{Mg} \\ \text{Pb} \end{array} \right)$	<b>X</b>

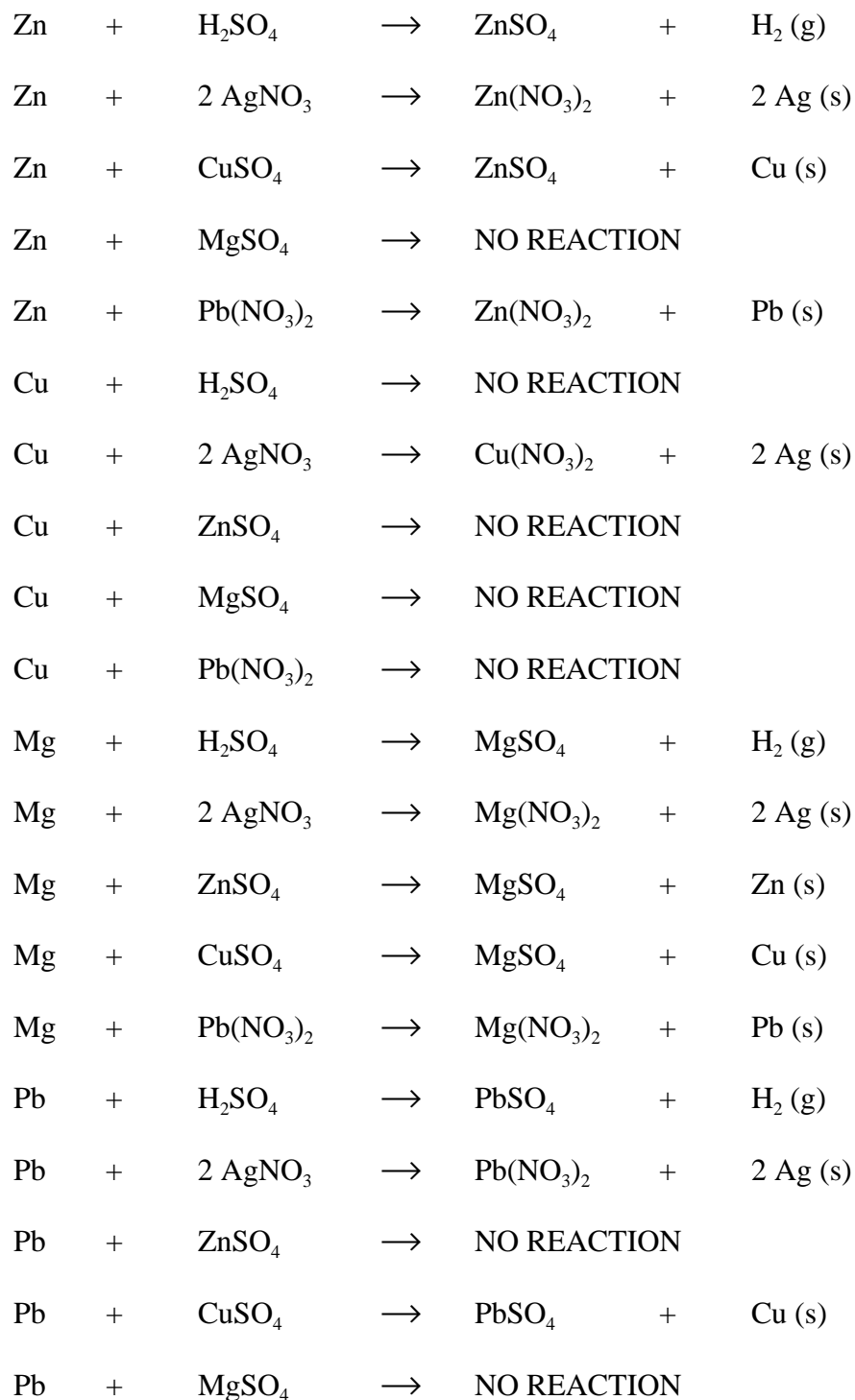
## ACTIVITY SERIES:

Based upon your observations, arrange the elements (Ag, Cu, H, Mg, Pb and Zn) in order from least active to most active.

\_\_\_\_\_ Ag < Cu < H < Pb < Zn < Mg \_\_\_\_\_

**Least Active** **Most Active**

**Note: Pb is more active than H. You may not have noted this due to the fact that Pb and H are very close with regard to their activities.**



**RESULTS:**

1. Arrange the metals in order of activity and write the oxidation half-reactions for the metals you have tested. In addition, assign standard **oxidation potentials** to the half-reactions in your activity table using the **reduction** tables in your textbook.

	Oxidation Half Reaction	$E^0_{\text{half reaction}}$
Most Active	$\text{Mg (s)} \rightarrow \text{Mg}^{2+} + 2 \text{e}^-$ _____	+2.363
	$\text{Zn (s)} \rightarrow \text{Zn}^{2+} + 2 \text{e}^-$ _____	+0.763
	$\text{Pb(s)} \rightarrow \text{Pb}^{2+} + 2 \text{e}^-$ _____	+0.126
	$\text{H}_2(\text{g}) \rightarrow 2 \text{H}^+ + 2 \text{e}^-$ _____	0.000
	$\text{Cu(s)} \rightarrow \text{Cu}^{2+} + 2 \text{e}^-$ _____	-0.337
Least Active	$\text{Ag (s)} \rightarrow \text{Ag}^+ + 1 \text{e}^-$ _____	-0.799

2. Is your arrangement of the activity series consistent with the oxidation potentials from the table in your textbook? \_\_\_\_\_ You may find that Pb and H are reversed \_\_\_\_\_
3. If not, Which species are out of place in your table? \_\_\_\_\_ Pb and H \_\_\_\_\_

If you have observed a problem between lead and hydrogen, then place a piece of lead in a test tube, add about 1 mL of 6 M  $\text{H}_2\text{SO}_4$  and immerse the test tube in a beaker of boiling water. **DO NOT HEAT THE TEST TUBE DIRECTLY IN THE BUNSEN BURNER FLAME.** Leave the test tube in the water for several minutes and note any reaction.

\_\_\_\_\_ You may see a reaction \_\_\_\_\_

4. Complete the activity table based on any new observation.

	Oxidation Half Reaction	$E^0_{\text{half reaction}}$
Most Active	$\text{Mg (s)} \rightarrow \text{Mg}^{2+} + 2 \text{e}^-$ _____	+2.363
	$\text{Zn (s)} \rightarrow \text{Zn}^{2+} + 2 \text{e}^-$ _____	+0.763
	$\text{Pb(s)} \rightarrow \text{Pb}^{2+} + 2 \text{e}^-$ _____	+0.126
	$\text{H}_2(\text{g}) \rightarrow 2 \text{H}^+ + 2 \text{e}^-$ _____	0.000
	$\text{Cu(s)} \rightarrow \text{Cu}^{2+} + 2 \text{e}^-$ _____	-0.337
Least Active	$\text{Ag (s)} \rightarrow \text{Ag}^+ + 1 \text{e}^-$ _____	-0.799

Half Reaction	Oxidation	$E^0_{\text{half-cell}}$
$2 \text{F}^- (\text{aq})$	$\rightarrow \text{F}_2 (\text{g}) + 2 \text{e}^-$	-2.87
$\text{Fe}^{2+} (\text{aq})$	$\rightarrow \text{Fe}^{3+} (\text{aq}) + 1 \text{e}^-$	-0.771
$2 \text{Cl}^- (\text{aq})$	$\rightarrow \text{Cl}_2 (\text{g}) + 2 \text{e}^-$	-1.360
$\text{I}_2 (\text{s}) + 6 \text{H}_2\text{O}$	$\rightarrow 2 \text{IO}_3^- (\text{aq}) + 12 \text{H}^+ (\text{aq}) + 10 \text{e}^-$	-1.195
$\text{Ni} (\text{s})$	$\rightarrow \text{Ni}^{2+} (\text{aq}) + 2 \text{e}^-$	+0.250
$\text{Al} (\text{s})$	$\rightarrow \text{Al}^{3+} (\text{aq}) + 3 \text{e}^-$	+1.66
$\text{Mn}^{2+} (\text{aq}) + 2 \text{H}_2\text{O}$	$\rightarrow \text{MnO}_2 (\text{s}) + 4 \text{H}^+ (\text{aq}) + 2 \text{e}^-$	+1.455
$\text{Ca} (\text{s})$	$\rightarrow \text{Ca}^{2+} (\text{aq}) + 2 \text{e}^-$	+2.89

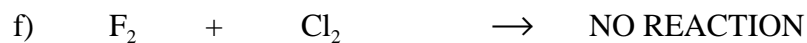
5. Based **only** upon the half-reactions above and your activity table (#4 above), predict whether or not the following reactions will occur. Write a balanced equation for all reactions that do occur. If a reaction does occur, write “**NO REACTION**” and **indicate the reason why not**.



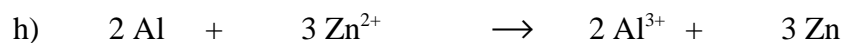
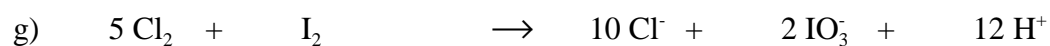
$\text{Fe}^{2+}$  is more active than Ag.



Ag is more active F.



Both  $\text{F}_2$  and  $\text{Cl}_2$  are oxidized forms.



$\text{Mn}^{2+}$  is more active than Ag.



Both  $\text{Mn}^{2+}$   $\text{Fe}^{2+}$  are reduced forms.



Both Mg and  $\text{I}_2$  reduced forms.

