Name_____Period_____Date _____

Lab #24: Single Replacement

This procedure will allow the student to develop a basic activity series through an exploration of single replacement reactions.

Aim: To place selected metals in order of decreasing chemical activity.

Vocabulary (8 points)
Single Replacement Reaction:

Balanced Equation:

Reactant:

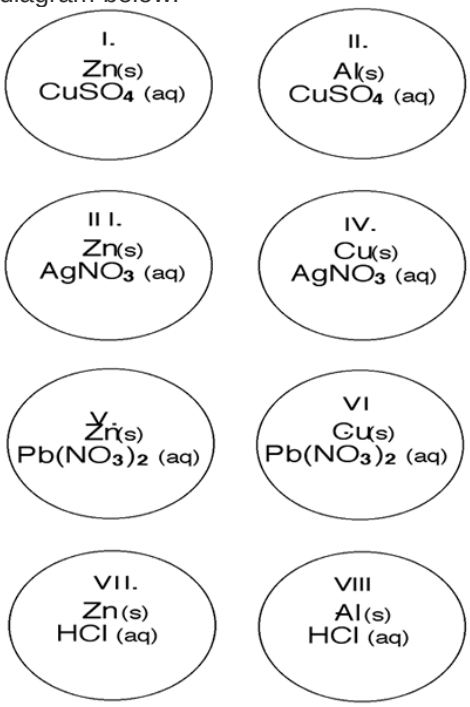
Product:

Materials

Zinc	
Aluminum foil	
Copper	1 M HCl
0.1 M $CuSO_4$	Spot plate
0.1 M $AgNO_3$	8 pipets
0.1 M $Pb(NO_3)_2$	

Procedure

1. Using either a spot plate or 8 watch-glasses, arrange the solids (one small piece or the amount that would fit on the tip of a spatula) in the respective wells as show on the diagram below:



2. Add approximately 10 drops of each required solution into each well.
3. In data table below, describe any changes observed.
4. Dispose of all chemicals per instructions.

Table 1: Data (Observations) (8 pts):

I	II
III	IV
V	VI
VII	VIII

5. In the analysis table below, indicate whether or not a reaction occurred by writing the term "reaction" or "no reaction".

Table 2: Analysis – Reactions (8 pts).

I	II
III	IV
V	VI
VII	VIII

6. Determine the products and write a balanced equation for any reactions that occurred. Include physical state symbols for the reactants and products. **USE A SEPARATE PAPER TO BALANCE THE EQUATIONS**; NEATLY RECORD THE FINAL BALANCED EQUATION IN THE CHART.

Table 3: Analysis – Reaction Equations (24 pts)

I.	__Zn(s) + ___$CuSO_4$(aq)→
II.	__Al(s) + ___$CuSO_4$(aq)→
III.	__Zn(s) + ___$AgNO_3$(aq)→
IV.	__Cu(s) + ___$AgNO_3$(aq)→
V.	__Zn(s) + ___$Pb(NO_3)_2$(aq)→
VI.	__Cu(s) + ___$Pb(NO_3)_2$(aq)→
VII.	__Zn(s) + ___HCl(aq)→
VIII.	__Al(s) + ___HCl(aq)→

*For Copper in compounds, use the Cu^{+2} ion.

7. Table 4: Activity Comparison. If no reaction occurred, the metal in the original compound is more reactive than the single element. If a reaction occurred, the metal which was not in the compound originally is more reactive. In the chart below, circle the more reactive metal (8 pts)

I.	Zn vs. Cu
II.	Al vs. Cu
III.	Zn vs. Ag
IV.	Cu vs. Ag
V.	Zn vs. Pb
VI.	Cu vs. Pb
VII.	Zn vs. H_2
VIII.	Al vs. H_2

8. Using the activity comparisons from Table 4, list the 6 metals (include H_2 even though it is not really a metal) in decreasing order of activity (most active to least active). (5 pts).

	Most Active
	Least Active

Name: _____

Analysis - Experimental vs. Accepted : (10 points)

Experimental Activity Series:
(most active to least active)

Most Active:

Least Active:

Actual Activity Series (see Table J):
(most active to least active)

CONCLUSION: (30 points)

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Teacher's Notes

Anticipated reactions are:

I. $Zn\ (s) + CuSO_4\ (aq) \text{--------} > Cu\ (s) + ZnSO_4\ (aq)$
Copper forms on zinc. Solution color becomes less blue.

II. $2Al\ (s) + 3CuSO_4\ (aq) \text{--------} > 3Cu\ (s) + Al_2(SO_4)_3\ (aq)$
Copper forms on aluminum.

III. $Zn\ (s) + AgNO_3\ (aq) \text{---------} > Ag\ (s) + ZnSO_4\ (aq)$
Silver crystals form on zinc.

IV. $Cu\ (s) + 2AgNO_3\ (aq) \text{--------} > 2Ag\ (s) + Cu(NO_3)_2\ (aq)$
Silver crystals grow on copper.

V. $Zn\ (s) + Pb(NO_3)_2\ (aq) \text{---------} > Pb\ (s) + Zn(NO_3)_2\ (aq)$
Dull gray lead forms on zinc.

VI. $Cu\ (s) + Pb(NO_3)_2\ (aq) \text{---------} >$ No Reaction.
Copper will not replace lead.

VII. $Zn\ (s) + 2HCl\ (aq) \text{---------} > ZnCl_2\ (aq) + H2\ (g)$
Zinc reacts with the acid, and hydrogen gas is released.

VIII. $2Al\ (s) + 6HCl\ (aq) \text{---------} > 2AlCl_3\ (aq) + 3H_2\ (g)$
Aluminum reacts with the acid, and hydrogen gas is released.

Activity series that is achievable by the reactions in this experiment:
Zn (Al)
Pb (Al)
H
Cu
Ag

Note that the position of aluminum in this series cannot be precisely determined. It is MORE ACTIVE than hydrogen.

Disposal

Aqueous solutions of HCl, $Zn(NO_3)_2$, $AgNO_3$, and $Cu(SO_4)_2$ may be flushed down the sink. Solutions of $Pb(NO_3)_2$ and $Cu(NO_3)_2$ should be evaporated, and the solid residue should be placed in a solid waste disposal container. Solid metals should also be placed in a solid waste container.