Activity Series Lab CLASS SET

Introduction
When studying the periodic table and trends, we learned about the trend in reactivity of metals, especially in water. In this lab, you will expand your understanding by testing the reactivity of metals (Cu, Zn, Mg) in acid and metal salt solutions. This will help you develop a more comprehensive activity series.

PREDICT:
Predict whether the following reactions will occur (Y/N). Explain your reasoning:
a) $Zn + MgSO_4 \rightarrow$
b) $Cu + HCl \rightarrow$
c) $Mg + CuSO_4 \rightarrow$

Materials: Spotting tray, Metal strips: Cu, Zn, Mg, Sandpaper, Dropper bottles containing: Hydrochloric acid ($HC_{l(aq)}$) , Copper(II) sulfate ($CuSO_4$), Zinc nitrate ($Zn(NO_3)_2$), Magnesium sulfate ($MgSO_4$), Safety glasses

Procedure
1. Safety First: Wear safety glasses at all times.
2. Prepare Metals: Sand each metal strip to remove oxidation.
3. Test with HCl:
   - Dip each metal into hydrochloric acid and record observations.
4. Test with Salt Solutions:
   - Place a few drops of each solution ($CuSO_4$, $ZnSO_4$, $MgSO_4$) into separate wells of the spotting tray.
   - Dip each metal into the solutions and record observations. (Do NOT do reactions with dashed lines in table)
5. Cleanup:
   - Rinse the spotting tray in the sink and **return metals and sandpaper**.

Observation Table: Create this on your own paper to answer the questions

Metal reacting with	Zinc, Zn	Magnesium, Mg	Copper, Cu
$HCl_{(aq)}$			
$Zn(NO_3)_{2(aq)}$	-----------------		
$MgSO_{4(aq)}$		------------------	
$CuSO_{4(aq)}$			---------------

Questions
1. Rank the metals Mg, K and Na from most to least reactive based on prior knowledge (eg reaction with water, trends) .
2. Rank the three metals tested in this lab (Cu, Zn, Mg) by reactivity and integrate them into your ranking from question 1 (NOTE: None of these three react significantly with water).
3. Write balanced single displacement reactions for any metals in the lab that reacted with HCl.
4. Write balanced single replacement reactions for any reactions observed in the salt solutions.
5. Refer to the Activity Series on your periodic table. In each reaction, is the more reactive or less reactive metal doing the displacing? Explain.
6. Explain why gold is often found in its pure form while most other metals are not.
7. a. Would you expect potassium (K) to react with water more or less vigorously than sodium (Na)? Explain.
   b. Predict whether iron (Fe) would react with magnesium sulfate ($MgSO_4$). Justify your answer.
8. Why are aluminum cans (made of Al) resistant to corrosion, even though aluminum is relatively reactive? (Hint: Think about oxide layers.)

Answers and Explanations (Review only after attempting the lab and questions above)

1. Ranking (most to least reactive): K > Na > Mg.
   - Explanation: Group 1 metals (K, Na) are more reactive than Group 2 (Ca, Mg), and reactivity increases down the group.

2. Integrated ranking: K > Na > Mg > Zn > Cu.
   - Explanation: Mg reacts slowly with water, while Zn and Cu show lower reactivity in acid/salt solutions.

3. Reactions with HCl:
   - $Mg + 2HCl \rightarrow MgCl_2 + H_2$
   - $Zn + 2HCl \rightarrow ZnCl_2 + H_2$
   - Explanation: Cu does not react because it is below H in the activity series.

4. Reactions with salt solutions:
   - $Mg + CuSO_4 \rightarrow MgSO_4 + Cu$
   - $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$
   - Explanation: More reactive metals (Mg, Zn) displace less reactive ones (Cu).

5. Displacing metal: The more reactive metal displaces the less reactive one and forms its ion (e.g., Mg displaces Cu in $CuSO_4$, becoming Mg^{2+} ion in $MgSO_4$, this forces the original Cu^{2+} ion to form its neutral solid, $Cu_{(s)}$).

6. Gold's purity: Gold is very unreactive (low in the series), so it resists the reactions such as oxidation and stays pure.

7a. K is more reactive (higher on activity series) than Na, so it would have a more vigorous reaction.
b. No, Fe is less reactive than Mg, so it cannot displace Mg from $MgSO_4$.

8. Aluminum is very reactive and reacts with oxygen in the air to form a protective Al_2O_3 layer that prevents further reaction with the underlying aluminum.