Periodic Trends and the Properties of Metals

Activity of Metals

Introduction:

The periodic table is the most recognized symbol of chemistry across the world. It is a valuable tool that allows scientists not only to classify the elements but also to explain and predict their properties. Similarities and differences among the elements give rise to so-called periodic trends, both across rows and within columns of the periodic table. Recognizing periodic trends in the physical and chemical properties of the elements is key to understanding the full value of the periodic table.

The purpose of this experiment is to identify periodic trends in reactivity within a group (Group 2) and also across a period (Period 3). You will compare Mg, Ca, Cu and Al and observe how they react with water and then with acids.

Background Review: Litmus paper is an indicator – it changes colors in the presence of acids and bases. When it is in the presence of acids, it is red (or pink). When it is in the presence of bases, it is blue. Another word for compounds that are bases is *alkaline*

Materials:

Aluminum foil, Al
Calcium turnings, Ca
Copper wire, Cu
Magnesium ribbon, Mg, 1 cm piece
Hydrochloric acid, HCl, 0.5 M
Water, distilled
Litmus paper, red, 3 pieces
Thin stem pipet, 2
Reaction plate, 24 well
Paper, white, 1 sheet
Forceps
Wooden splints
Thermometer

Safety Precautions:

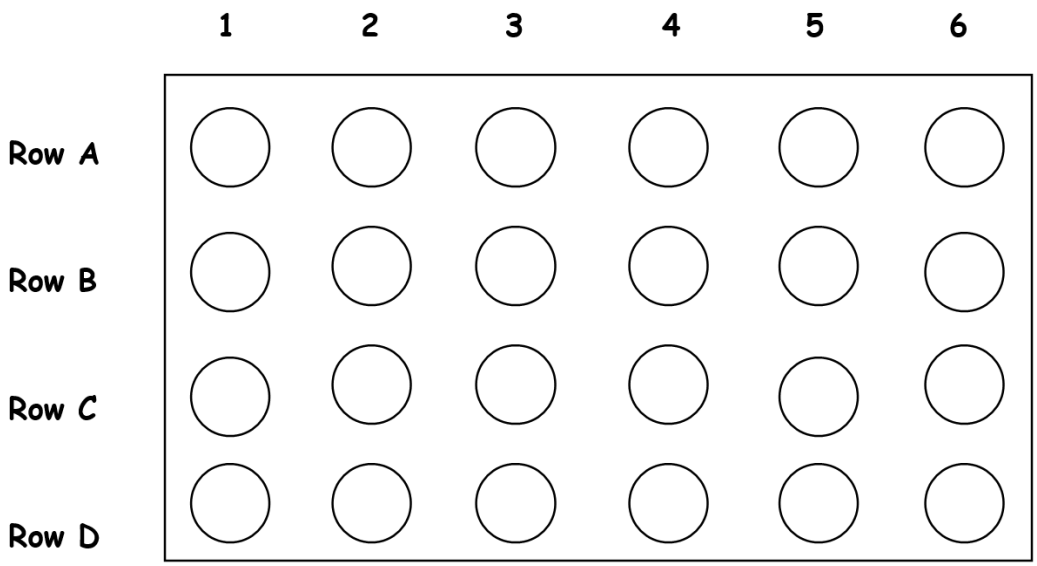
Calcium and magnesium are reactive, flammable solids and possible skin irritants. Use forceps or a spatula to handle these metals. Hydrochloric acid is toxic by ingestion and inhalation and is corrosive to skin and eyes; avoid contact with body tissues. Avoid contact of all chemicals with eyes and skin. Wear chemical splash goggles and chemical-resistant gloves and apron. Always wash hands thoroughly before leaving the laboratory.

Procedure: *Activity of Metals*

1. In a weigh boat, obtain 2 small pieces of calcium turnings.

2. Obtain 2 small pieces of magnesium ribbon, approximately 1 cm each, and a short piece of aluminum foil.

3. Place a 24-well reaction plate on top of a sheet of white paper, as shown in the following figure. Note that each well is identified by a unique combination of a letter and a number, where the letter refers to a horizontal row and the number to a vertical column.



4. Use a pipet to add 20 drops of distilled water to wells A1 and A2-A5.

5. Test the water in wells A1 and A2-A5. with a piece of red litmus paper and record the initial color of the "litmus test" in the Data Table.

6. Use forceps to add one piece of calcium to well A1.

7. Skip a well, and use forceps to add one piece of magnesium ribbon to well A3.

8. Tear off a 2 cm piece of aluminum foil and roll it into a loose ball. Add the aluminum metal to well A4.

9. Use forceps to add one piece of copper wire to well A5.

10. Observe each well and record all immediate observations in the Data Table. If no changes are observed in a particular well, write NR (No Reaction) in the data table.

11. Again, test the water in wells A1 and A2-A5. with a piece of red litmus paper and record the color changes for this litmus test in the Data Table.

12. Continue to watch each well for 1-2 minutes. Record any additional observations comparing the rates of reaction in the Data Table.

13. Use a pipet to add 20 drops of 0.5 M HCl to wells C1 and C3-C5.

14. Measure the initial temperature of the solution in wells C1 and C3-C5 right <u>before</u> you add the metal to the acid and record the temperature values as an "observation" in the Data Table.

15. Use forceps to add one piece of calcium turnings to well C1.

    a) Is there evidence that a gas is being produced? Test the combustion property of the gas by bringing a lighted wooden splint to the space just above the well. ***DO NOT TOUCH THE PLASTIC WELL PLATE OR THE SOLUTION WITH THE LIT WOODEN SPLINT!*** Record any observations for this "match test" in the Data Table.

    b) Using a thermometer, measure the temperature of the solution in the well. Record the temperature of each solution as an observation in the Data Table.

    c) Continue to watch each well for 1-2 minutes. Record any additional observations comparing the rates of reaction in the Data Table.

16. Skip a well and use forceps to add one piece of magnesium ribbon to well C3.

    a) Is there evidence that a gas is being produced? Test the combustion property of the gas by bringing a lighted wooden splint to the space just above the well. ***DO NOT TOUCH THE PLASTIC WELL PLATE OR THE SOLUTION WITH THE LIT WOODEN SPLINT!*** Record any observations for this "match test" in the Data Table.

    b) Using a thermometer, measure the temperature of the solution in the well. Record the temperature of each solution as an observation in the Data Table.

    c) Continue to watch each well for 1-2 minutes. Record any additional observations comparing the rates of reaction in the Data Table.

17. Tear off a 2 cm piece of aluminum foil and roll it into a loose ball. Add the aluminum metal to well C4.

    a) Is there evidence that a gas is being produced? Test the combustion property of the gas by bringing a lighted wooden splint to the space just above the well. ***DO NOT TOUCH THE PLASTIC WELL PLATE OR THE SOLUTION WITH THE LIT WOODEN SPLINT!*** Record any observations for this "match test" in the Data Table.

    b) Using a thermometer, measure the temperature of the solution in the well. Record the temperature of each solution as an observation in the Data Table.

    c) Continue to watch each well for 1-2 minutes. Record any additional observations comparing the rates of reaction in the Data Table.

18. Use forceps to add one piece of copper wire to well C5.

    a) Is there evidence that a gas is being produced? Test the combustion property of the gas by bringing a lighted wooden splint to the space just above the well. ***DO NOT TOUCH THE PLASTIC WELL PLATE OR THE SOLUTION WITH THE LIT WOODEN SPLINT!*** Record any observations for this "match test" in the Data Table.

    b) Using a thermometer, measure the temperature of the solution in the well. Record the temperature of each solution as an observation in the Data Table.

    c) Continue to watch each well for 1-2 minutes. Record any additional observations comparing the rates of reaction in the Data Table.

19. Dispose of the contents of the reaction plate as instructed by your teacher.

Data Table

		Calcium	Magnesium	Aluminum	Copper
Reaction with H_2O	**Observations**				
	Litmus Color Initial				
	Litmus Color Final				
Reaction with HCl	**Observations**				
	Temp. Initial				
	Temp. Final				
	Match Test				

Post-Lab Questions:

1. Based on your lab observations, do you think that left over pieces of calcium and magnesium should be disposed of down the drain? Why or why not?

2. Which group 2 metal, magnesium or calcium, is more active? Cite evidence from your lab data.

3. Which period 3 metal, magnesium or aluminum, is more active? Cite evidence from your lab data.

4. Rank the three metals tested in Part A from most active to least active.

5. Write a general statement that describes the periodic trend in metal activity within a group of the periodic table.

6. Write a general statement that describes the periodic trend in metal activity within a period of the periodic table.

7. Locate the following metals on the periodic table: *magnesium, potassium, and sodium*. Based on your answers to Questions #4 and #5, rank these metals in order of their expected activity, *from most active to least active*.

8. Litmus paper changes color in acidic (red) and basic (blue) solutions. The word alkaline is a synonym for basic. Why are the two words "alkaline" and "earth" used to name the Group 2 metals?