

Periodic Trends and the Properties of Elements

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Section 1

Data Tables and Observations

Table 1: Activity of Calcium, Magnesium, and Aluminum when Reacting with Water and Hydrochloric Acid

| | | Calcium | Magnesium | Aluminum |
|---------------------------------|------------------|--|---|---|
| Reaction with Water | Before | Grey and white rock | Silver rectangle | Silver ball |
| | After | Sizzling. Bubbles formed. Gas released. | NR | NR |
| | Rate | Fastest reaction | NR | NR |
| | Litmus Paper (i) | Red | Red | Red |
| | Litmus Paper (f) | Blue | Red | Red |
| Reaction with Hydrochloric acid | Before | Grey and white rock 20.4°C | Silver rectangle 20.5°C | Silver ball 20.4°C |
| | After | Bubbling. No fluid left at the end, only solid. 41.2°C | Turned black. Minor bubbling. Liquid left but no solids. 25.6°C | NR. Aluminum left in HCl with no change. 20.5°C |
| | Rate | Fastest | Slower than Ca | NR |
| | Match Test | Normal fire | Fired burned quicker than normal | Normal fire |

Table 2: Solubility of Magnesium, Calcium, Strontium, and Barium compounds in Na_2CO_3 , Na_2SO_4 , and KIO_3

| | 1 MgCl ₂ | 2 CaCl ₂ | 3 SrCl ₂ | 4 BaCl ₂ | 5 Unknown | 6 |
|------------------------------|------------------------|------------------------|------------------------|------------------------|--------------|---|
| A - Na_2CO_3 | PPT | PPT | PPT | PPT | PPT | |
| B - Na_2SO_4 | NR | NR | PPT | PPT | NR | |
| C - KIO_3 | NR | NR | NR | PPT | NR | |
| D | | | | | | |

Observations:

- Calcium is oxidized
- Ca-H₂O reaction overflowed
- Ca-HCl reaction overflowed
- Well melted in flame test
- Some solids formed blue color
- A1 & A5 showed more black color of table

Conclusions

Results:

Part A Result:

- Overall Reactivity
 - Calcium was the most reactive. It reacted with both water and hydrochloric acid
 - Magnesium was in the middle in terms of reactivity. It reacted with hydrochloric acid but not water
 - Aluminum was the least reactive. It didn't react with either water or hydrochloric acid
- Reactivity of Group 2 Metals
 - Group 2 is called the alkaline earth metals. They are very reactive metals that are not found unbound in nature. In the experiment, calcium was found to be more

reactive than magnesium proving that the reactivity of metals tends to increase down a group.

- Reactivity of Period 3 Metals
 - In Period 3, it was found that magnesium is more reactive than aluminum. This proves that the reactivity of metals tends to decrease going from left to right.

Part B Results:

●

Analysis Questions:

1. The results suggest that calcium is more active than magnesium. Calcium reacted with both water and hydrochloric acid while magnesium only reacted with hydrochloric acid.
2. The results suggest that magnesium is more active than aluminum. Magnesium reacted with hydrochloric acid while aluminum did not react with water or hydrochloric acid.
3. Calcium, Magnesium, Aluminum
4. Reactivity increases as you go down a group
5. Reactivity decreases as you go from left to right across a period
6. Potassium, Sodium, Magnesium
7. Alkaline earth metals are called alkaline because they often form basic solutions when dissolved in water, and they are called earth metals because they are solid at room temperature.
8. Barium produced the most precipitates in Part B. Magnesium, calcium, and the unknown element, tied for the least amount of precipitates formed.
- 9.
- 10.
- 11.

Sources of Error:

- Calcium used in the reaction with water and hydrochloric acid was oxidized possibly affecting the reaction
- There was difficulty detecting if a reaction happened as the table did not offer great contrast.

Connection to Lecture:

This experiment connects to Chapter 5. Chapter 5 includes information on the different groups within the periodic table, one of which is the alkaline earth metals. This experiment worked with the alkaline earth metals and their properties which was a major focus of Chapter 5. Alkaline earth metals are very reactive metals that often form basic solutions. Compared to aluminum (not an alkaline earth metal), magnesium and calcium were found to be significantly

more reactive. Additionally, when calcium reacted with water, a basic solution was formed. This experiment reinforced the lessons regarding the properties of the alkaline earth metals taught in Chapter 5.

Changes:

One thing that could be changed to improve the efficacy of the experiment would be to use wells of a different material. During the flame test, the fire caused the plastic of the wells to melt. A material with a higher melting point would not have this problem.

References

<https://webbook.nist.gov/chemistry/>

<https://www.btps.ca/>

<https://pubchem.ncbi.nlm.nih.gov/>

<https://chemequations.com/en/>

<https://www.quora.com/>

<https://en.intl.chemicalaid.com/>