

Factors Affecting the Rate of a Chemical Reaction

Purpose: To investigate the factors affecting reaction rate.

Part A: The influence of the nature of the reactants

Materials: Candle Balance
 Alcohol burner Stopwatch

Procedure: System 1 Combustion of paraffin (wax candle $C_{22}H_{52}$)

1. Place the candle with the support on the scale, and record its mass.
2. Light candle and immediately start the timer.
3. While the candle burns, record the mass every minute, up to 5 minutes

Observations: **Table #1** **SYSTEM 1 (Paraffin)**

| Time (min) | Mass of system (g) |
|------------|--------------------|
| 0 | |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |

Procedure: System 2 Combustion of alcohol (methyl alcohol CH_3OH)

1. Place an alcohol burner on a balance and weigh it, record data.
2. Light burner and start timer.
3. While the alcohol burns, record mass every minutes up to 5 minutes.

Observation: **Table #2** **SYSTEM 2 (Alcohol)**

| Time (min) | Mass of system (g) |
|------------|--------------------|
| 0 | |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |

Conclusion on the influence of the reactants

Part B: The influence of surface area

Materials: 2 test tubes Stopwatch
 Test tube rack Calcium carbonate powder
 Hydrochloric acid Calcium carbonate chips
 (3 mol/L)

Procedure:

- 1- Put a piece of Calcium carbonate in the first test-tube.
- 2- To the second test tube add some Calcium carbonate powder
- 3- Put 5 mL of hydrochloric acid the first test tube, and record the time it takes for the Calcium carbonate to disappear.
- 4- Do the same for the Calcium carbonate powder, record the time

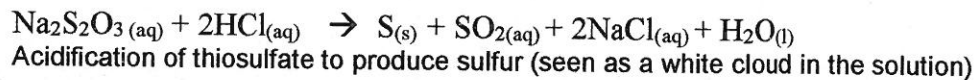
Observation: Table #3

| Reactant | Time (s) |
|--------------------------|-----------------|
| Calcium carbonate chips | |
| Calcium carbonate powder | |

Conclusion on the influence of surface area:

Part C: The influence of concentration

The chemical reaction used to demonstrate the affect of concentration on the rate of reaction is:



Materials: 100 mL beaker 100 mL graduated cylinder Sodium thiosulfate
Stopwatch 10 mL graduated cylinder Hydrochloric acid

Procedure:

- 1- Pour 50 mL of 0.050 mol/L $\text{Na}_2\text{S}_2\text{O}_3$ (sodium thiosulfate) in a 100 mL Beaker.
- 2- Add 5.0 mL of 1.00 mol/L HCl and immediately start the timer.
- 3- Stop the timer as soon as you see the formation of a white cloud.
- 4- In the spaces provided record the reaction times for the formation of the white cloud.
- 5- Repeat steps 2 to 5 above for the other two cases.

Observations: Table #4

| Reactions | Time (s) |
|---|----------|
| 50 mL of 0.050 mol/L $\text{Na}_2\text{S}_2\text{O}_3$ + 5.0 mL of 1.00 mol/L HCl | |
| 50 mL of 0.075 mol/L $\text{Na}_2\text{S}_2\text{O}_3$ + 5.0 mL of 1.00 mol/L HCl | |
| 50 mL of 0.100 mol/L $\text{Na}_2\text{S}_2\text{O}_3$ + 5.0 mL of 1.00 mol/L HCl | |

Conclusion for the influence of concentration of reactants:

Part D: The influence of temperature

The influence of temperature on reaction rates uses the following aqueous reaction:



Materials: Hot plate 2 (100mL) beakers
Beaker tongues 2 Thermometers
100 mL graduated cylinder 10 mL graduated cylinder

Solution A: $\text{H}_2\text{C}_2\text{O}_4$ 0.05 mol/L and H_2SO_4 0.3 mol/L

Solution B: KmnO_4 0.02 mol/L

Procedure:

Part 1: Reaction at room temperature

- 1 Pour 20 mL of solution A containing oxalic acid into a 100 mL beaker.
- 2 Pour 10 mL of solution B containing potassium permanganate into a 100 mL beaker.
- 3 Record the room temperature.
- 4 Mix solution A with solution B and immediately start the timer.
Be sure to stop the timer as soon as the mixture becomes colorless.
Record the reaction time below.
NOTE: The solution will first turn brown before becoming colorless.
A white paper placed under the beaker make it easier to observe the reaction.

Part 2: Reaction at higher temperature

- 1 Pour 20 mL of solution A into a 100 mL beaker.
- 2 Pour 10 mL of solution B into the other 100 mL beaker.
- 3 Place both beakers on a hot plate and bring the solution to a boil.
- 4 Mix solution A with solution B and immediately start the timer.
Again record the reaction time.

Observation: Table #5

| Reaction | Time (s) |
|--------------------------|----------|
| Part 1: Room temperature | |
| Part 2: High temperature | |

Conclusion for the influence of temperature on the rate of a reaction: