**Exothermic and Endothermic Reactions**

**Part 1: Reaction of Citric Acid and Sodium Bicarbonate (bicarb soda)**

**Equipment:** 100 mL beaker, thermometer, timer, 4 g citric acid, 4 g sodium bicarbonate, watch glass, water, electronic balance

**Method:**

1. Weigh 4 g of citric acid in the beaker.
2. Add 20 mL of water and swirl until dissolved.
3. Weigh 4 g of sodium bicarbonate on the watch glass.
4. Measure and record the temperature of the citric acid solution.
5. Add the sodium bicarbonate to the citric acid solution and start the timer.
6. Record the temperature of the mixture every 30 seconds, for 4 minutes.
7. Draw a graph of your results.

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**Results:**

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| --- | --- |
| Time (minutes) | Temperature (°C) |
| 0 |  |
| 0.5 |  |
| 1 |  |
| 1.5 |  |
| 2 |  |
| 2.5 |  |
| 3 |  |
| 3.5 |  |
| 4 |  |

**Questions:**

1. Is this reaction exothermic or endothermic? Explain your choice.

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1. This reaction produces sodium citrate, water and carbon dioxide. Write a word equation to describe this reaction, including the change in energy.
2. The products have **more / less** energy than the reactants because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Part 2: Reaction of Magnesium and Hydrochloric Acid**

**Equipment:** test tube, test tube rack, thermometer, timer, 3 small pieces of magnesium, 0.5 M hydrochloric acid

**Method:**

1. Carefully pour hydrochloric acid into the test tube until it is ¼ full.
2. Measure and record the temperature of the hydrochloric acid.
3. Add the magnesium pieces to the hydrochloric acid and start the timer.
4. Record the temperature of the mixture every 30 seconds, for 5 minutes.
5. Draw a graph of your results.

**Results:**

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| --- | --- |
| Time (minutes) | Temperature (°C) |
| 0 |  |
| 0.5 |  |
| 1 |  |
| 1.5 |  |
| 2 |  |
| 2.5 |  |
| 3 |  |
| 3.5 |  |
| 4 |  |
| 4.5 |  |
| 5 |  |

**Questions:**

1. Is this reaction exothermic or endothermic? Explain your choice.

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1. This reaction produces magnesium chloride and hydrogen. Write a word equation to describe this reaction, including the change in energy.
2. The products have **more / less** energy than the reactants because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_