Alka-Seltzer® reaction

When an Alka-Seltzer tablet is dissolved in water, the bicarbonate ($\text{HCO}_3^-$) reacts with hydrogen ions ($\text{H}^+$) of the citric acid, which results in carbon dioxide gas and water. The reaction equation can be summarized as:

$$3 \text{ HCO}_3^- (l) + 3 \text{ H}^+ (l) \rightarrow 3 \text{ H}_2\text{O} (l) + 3 \text{ CO}_2 (g)$$

Alka-Seltzer ingredients:
- aspirin
- citric acid
- sodium bicarbonate

From sodium bicarbonate ($\text{NaHCO}_3$) and citric acid ($\text{C}_6\text{H}_8\text{O}_7$), bubbles are created.
Materials you need

Teacher
- Masking tape
- Measuring cup
- Scale

Students
- Alka-Seltzer tablets
- 250 mL beaker (or 8 oz. cup)
- Water
- Metal spoon or hammer
- Sheet of paper
- Stopwatch
Preparing the experiment

- Fill the beaker/cup with water up to the top of the masking tape.
- Make sure the water is always the same temperature!
Experiment 1: whole tablet

- Take one whole Alka-Seltzer tablet and drop it into the water
- Start the stopwatch immediately
- Watch the tablet disintegrate
- Stop timing as soon as reaction is done
Experiment 2: tablet 16 pieces (1)

Break one whole tablet into 16 pieces of approximately the same size.
Experiment 2: tablet 16 pieces (2)

- Drop all pieces into the water at the same time
- Start the stopwatch immediately
- Stop the stopwatch as soon as the reaction is done
Experiment 3: tablet powder (1)

- Wrap a whole tablet into a sheet of paper
- Fold over the open sides
- Carefully crush it with a metal spoon
Experiment 3: tablet powder (2)

- Slide the powder from the paper into the water
- Start the stopwatch immediately
- Stop the stopwatch as soon as the reaction is done
Data analysis

<table>
<thead>
<tr>
<th>Tablet size</th>
<th>Reaction Time [s]</th>
<th>Reaction Rate [g/s]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group 1</td>
<td>Group 2</td>
</tr>
<tr>
<td>Whole</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 pieces</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Powder</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From all your results, calculate the average

- reaction times
- reaction rates
Calculate the reaction rate

\[
\text{Reaction rate} = - \frac{\text{Change in tablet mass [g]}}{\text{Change in time [s]}}
\]

**Change in tablet mass [g]** = Final tablet mass [g] - Initial tablet mass [g]

- Final tablet mass [g] = 0 grams
- Initial tablet mass [g] = ask your teacher for this value

**Change in time [s]** = Final time [s] - Initial time [s]

- Final time [s] = Time at end of reaction [s]
- Initial time [s] = 0 seconds