Reaction Rate Graphing Assignment

Groups of 2
Answer questions on a separate page
Show all working out
Correct significant figures
Use and show units
DUE in 1 week!
Organize with your partner to meet at focus...no excuses for late assignments if partner is away.

Objective: To calculate the average reaction rate, reaction rate at a particular time for a particular reaction.

Reaction: Solid calcium carbonate reacting with hydrochloric acid to produce carbon dioxide gas, water, and a precipitate of calcium chloride.

Date: Use the following data set to complete the assignment

Table 1: CO₂ released over time

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Time (s)</th>
<th>Mass CO₂ released (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.76</td>
</tr>
<tr>
<td>1</td>
<td>60</td>
<td>0.92</td>
</tr>
<tr>
<td>2</td>
<td>120</td>
<td>0.99</td>
</tr>
<tr>
<td>3</td>
<td>180</td>
<td>1.04</td>
</tr>
<tr>
<td>4</td>
<td>240</td>
<td>1.15</td>
</tr>
<tr>
<td>5</td>
<td>300</td>
<td>1.17</td>
</tr>
<tr>
<td>6</td>
<td>360</td>
<td>1.18</td>
</tr>
<tr>
<td>7</td>
<td>420</td>
<td>1.18</td>
</tr>
<tr>
<td>8</td>
<td>480</td>
<td>1.18</td>
</tr>
<tr>
<td>9</td>
<td>540</td>
<td>1.18</td>
</tr>
</tbody>
</table>

Discussion Questions:

1. Graph the mass of CO₂ released against time. (3 marks)

2. The slope of the graph at any point on the curve gives the rate of the reaction at that point. Find the reaction rate halfway through the timed period by drawing a tangent and finding its slope. Use large signs transfer for better accuracy. Include units. (2 marks)

3. Label your graph and plot a tangent to your average rate of reaction, expressed in g CO₂/min. (2 marks)

4. In general, what quantities are involved in expressing reaction rate? Give some typical units for reaction rate. (3 marks)

5. Write the balanced equation for the reaction. Include states. (3 marks)

6. Using the average reaction rate between 1 and 2 minutes from step above, express the reaction rate in terms of:
   a. Molarity of HCl
   b. Moles of HCl
   c. Molarity of HCl/min (3 marks)

7. What happens to the reaction rate during the overall time period? Explain two reasons why this happens. (3 marks)

8. List factors which would cause a greater initial reaction rate, and explain how each would lead to an increased reaction rate. (6 marks)

9. How would your graph look different if you increased the initial reaction rate? (1 mark)

10. How would your graph appear if the reaction rate:
    a. Was constant? (1 mark)
    b. Increased during the timed period? (1 mark)
    c. Decreased during the timed period? (1 mark)

11. What would the rate of the reaction have been if the following had not been measured?
A. Why would this kind of measurement be less informative? (2 marks)

Graph MUST INCLUDE:

- Meaningful, detailed title
- Labelled axes (with units)
- Appropriate scale which uses the entire page
- Tidy, show calculations (e.g. tangent triangle for scale...best fit line, etc)
- YES 'connect the dots' to show a best fit curve

Rates from gradients

The rate of reaction can be calculated from the gradient of a graph of amount of product against time of reaction:

1. Draw a tangent to the curve (a straight line that represents the gradient at that point).
2. Draw a vertical line and horizontal line to form a right-angled triangle with this line from step 1.
3. Read off the change in amount of product (vertical line in your triangle).
4. Read off the change in time (the horizontal line in your triangle).
5. Calculate the gradient. This will be the answer from step 3 divided by answer from step 4.

In the example above:
rate of reaction = 15.4 / 2 = 7.72 g/min
Make sure that the unit for rate matches the units used in the graph.