What is the rate equation triangle?

Calculate the rate of the demonstration reaction using the eudiometer tube setup.

\[
\text{Mg}(s) + 2\text{HCl}(aq) \rightarrow \text{MgCl}_2(aq) + \text{H}_2(g)
\]

Volume of H₂ gas: 48.7 mL

Time: 17.41 + 16.39 + 17.57 = 51.37 s

Average Rate: \( \frac{\Delta \text{ quantity}}{\Delta \text{ time}} = \frac{48.7 \text{ mL}}{51.37 \text{ s}} = 0.95 \text{ mL/s} \)

Why is the rate we calculated an 'average' rate?

Calculate the mass of the piece of magnesium used:

\[
\text{rate using}\quad \text{rate} = \frac{\Delta \text{ quantity}}{\Delta \text{ time}} = \frac{0.05 \text{ g}}{17.12 \text{ s}} = 0.00 \text{ g/s}
\]

We will work through questions #1, 2, and 4 on p.2 of Hebden and then #19 on p.11.

1. 5.0g Mg reacting with HCl time: 150s

average reaction rate = \( \frac{\text{quantity}}{\text{time}} \) = \( \frac{5.0g \text{ Mg}}{150s} \) = 0.00333 g/s

2. 45.0g CaCO₃(s) with dilute HCl

\( \text{rate} = \frac{0.535 \text{ g CaCO}_3}{\text{min}} \)

\( \text{time} = \frac{\Delta \text{ quantity}}{\text{rxn rate}} \) = \( \frac{45.0g \text{ CaCO}_3}{2.55g/\text{min}} \) = 17.78 min

4. a) moles/sec ≥

b) min/m ×

c) moles/L/sec = \( \frac{M}{\text{sec}} \)

d) g × e) mL (check)

19. Zn (s) + 2HCl (aq) \rightarrow \text{H}_2(g) + \text{ZnCl}_2 (aq)

a) \( \text{ rate} = \frac{\Delta g}{\Delta t} = \frac{3.10g - 2.46g}{60s} = 0.41g/60s = 0.00068g/s \)

b) \( \text{ rate} = \frac{20g - 17.45g}{60s} = 0.000417g/s \)
Assignment 2: Rate Calculations

<table>
<thead>
<tr>
<th>Time (s)</th>
<th>Mass of Pb (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>65</td>
</tr>
<tr>
<td>15</td>
<td>52</td>
</tr>
<tr>
<td>30</td>
<td>41</td>
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<tr>
<td>45</td>
<td>32</td>
</tr>
<tr>
<td>60</td>
<td>25</td>
</tr>
</tbody>
</table>

1) The above is data for a reaction in which Pb is a reactant.
   a) Calculate the overall rate of the reaction.
   b) Calculate the rate from 0-30s and from 30-60s.
   c) Explain why the 30-60s rate is lower than the 0-30s rate.

2) When CaCO$_3$ reacts with HCl, CO$_2$(g) is produced. If 243mL of CO$_2$ is produced in 22s, what is the rate of the reaction?

3) A 5.0g sample of Mg reacts completely with HCl in 120s. What is the average rate of this reaction in g Mg per minute?

4) How long will it take (in seconds) for 45.0g of Mg to react with HCl, if the average rate of the reaction is 2.30g Mg/min?

5) Electrolysis of H$_2$O produces O$_2$ and H$_2$. If O$_2$ gas is produced at an average rate of 28.5mL/min, calculate the consumption of H$_2$O in grams per second.

6) Given the reaction: H$_2$(g) + Cl$_2$(g) $\rightarrow$ 2HCl(g)
   a) If 2.32g of HCl are produced in 4.0 min, what is the rate of reaction in mol HCl/second?
   b) If H$_2$ is used up at a rate of 30.0 mol/s, at what rate is HCl produced in g/min? (hint: use stoich table!)

7) C$_3$H$_2$(g) + 8O$_2$(g) $\rightarrow$ 5CO$_2$(g) + 6H$_2$O(g)
   If 17.6g of C$_3$H$_2$ is burned in three seconds, calculate the rate of the reaction in grams of CO$_2$ per second.