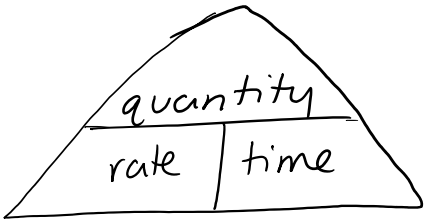
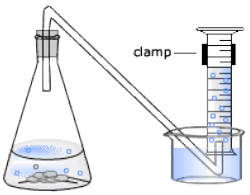
III) Calculating Rate

Monday, September 11, 2017 2:19 PM

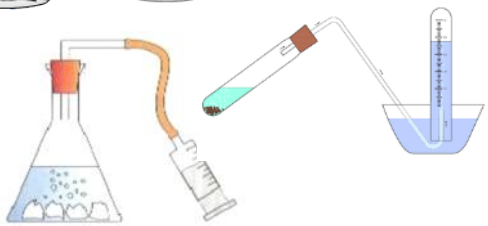
What is the rate equation triangle?





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

$Mg_{(s)} + 2HCl_{(aq)} \Rightarrow MgCl_{2(aq)} + H_{2(g)}$

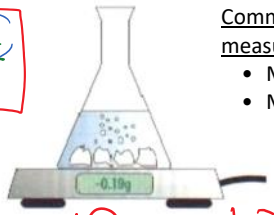


Volume of H_2 gas: 48.7 mL

Time: 17.41 + 16.39 + 17.57 = 17.12 s

Average Rate: $\text{rate} = \frac{\Delta \text{quantity}}{\Delta \text{time}} = \frac{48.7\text{mL}}{17.12\text{s}} = 2.84\ \frac{\text{mL}}{\text{s}}$

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



Common lab set up's for measuring reaction rate:

- Measure gas collected
- Measure mass decrease

*Calculate the ~~rate using~~ mass of the piece of magnesium used:

→ Mg: 0.05 g rate = $\frac{\Delta \text{quant.}}{\Delta \text{time}} = \frac{0.05\text{g}}{17.12\text{s}} = 0.00292\ \frac{\text{g}}{\text{s}}$ (1 s.f.; 4 s.f.; round up.)

$3 \times 10^{-3}\ \frac{\text{g}}{\text{s}}$

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

1) 5.0 g Mg reacting w HCl time: 150 s

average reaction rate = $\frac{\text{quantity}}{\text{time}} = \frac{5.0\text{g Mg}}{150\text{s}} = 0.033\ \frac{\text{g}}{\text{s}} \times \frac{60\text{s}}{1\text{min}}$

$= 2.0\ \frac{\text{g}}{\text{min}}$

2) 45.0 g $CaCO_3$ (s) w dilute HCl

R.R = 2.35 g $CaCO_3$ / min how long? => solve for time.

av. rxn rate = $\frac{\text{quantity}}{\Delta \text{time}}$ ∴ time = $\frac{\Delta \text{quantity}}{\text{rxn rate}}$

time = $\frac{45.0\text{g } CaCO_3}{2.35\ \frac{\text{g}}{\text{min}}}$

time = 19.1 min

19.1 (1 s.f.)

4) a) moles/sec ✓

b) min/m ✗ (↑ time.)

c) $\frac{\text{mols/L}}{\text{sec}} = \frac{\text{M}}{\text{sec}}$ ✓

d) $\frac{\text{g}}{\text{L}} \times$ time

e) $\frac{\text{mL}}{\text{hr}}$ ✓

f) $\frac{\text{g}}{\text{min}}$ ✓

19) $Zn_{(s)} + 2HCl_{(aq)} \longrightarrow H_{2(g)} + ZnCl_{2(aq)}$

a) rate = $\frac{\Delta q}{\Delta t} = \frac{31.0\text{g} - 24.6\text{g}}{60 - 0\text{s}} = \frac{6.4\text{g}}{60} = 0.107\ \frac{\text{g}}{\text{s}}$ (2 s.f.)

b) rate = $\frac{20\text{g} - 17.4\text{g}}{}$ = 0.11 g/s

b) rate = $\frac{20.2 - 17.4\text{g}}{180 - 120}$ = $\frac{0.0467\text{g}}{\text{s}}$ (2 s.f.) (4 s.f.)

$\frac{0.11\text{g}}{\text{s}}$

c) • Rxn rate always decreasing
• less collisions occuring => due to reactants being used up.
∴ at 180s the reaction rate will (of course) be lower than at 60s.
(effective)

Assignment 2: Rate Calculations

Time (s)	Mass of Pb (g)
0	65
15	52
30	41
45	32
60	25

1)

* Assign. 2 HW
Graphing Partner Assign.
=> Due Sept 26th

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?

* Quiz Friday
Section I — III

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_2O 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_2O 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) $C_5H_{12(g)} + 8O_{2(g)} \Rightarrow 5CO_{2(g)} + 6H_2O_{(g)}$
If 17.6g of C_5H_{12} is burned in three seconds, calculate the rate of the reaction in grams of CO_2 per second.