

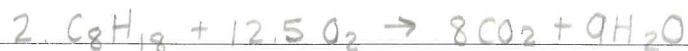
## E. Factors that Affect Reaction Rates

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↳ molecules must collide in order to react

1. Homogenous reactions are often faster than heterogenous reactions

a. Homogeneous reactions with solids are faster if surface area is increased



a. In order for liquid fuel to burn, it must be gaseous

b. Reid Vapor Pressure (RVP) shows gas's volatility

3. Increasing reactant concentration generally increases reactant rate



↳  $k[\text{A}]^m[\text{B}]^n \rightarrow$  Rate law differential

↳ Reaction orders  $m$  and  $n$ , often 1 or 2

b. Rate law must be determined experimentally

↳ Keep all concentrations but one the same, do many trials

4. First Order Reaction: If exponent is 1

a. Second Order Reaction: If exponent is 2

5 rate =  $k[A]^2$ , what is  $k$ ?

$$4.0 \cdot 10^{-5} = k[.100]^2; \quad \underline{4.0 \cdot 10^{-5} \text{ m/s}} = .004 \text{ m}^{-1} \text{ s}^{-1} \\ (.1 \text{ m})^2$$

6 Example 2:  $2\text{NO(g)} + \text{O}_2\text{(g)} \rightarrow 2\text{NO}_2\text{(g)}$ , so rate =  $k[\text{NO}]^2[\text{O}_2]^1 \rightarrow 3^{\text{rd}}$  order

| $[\text{NO}] \text{ m}$ | $[\text{O}_2] \text{ m}$ | Rate (m/s)          |
|-------------------------|--------------------------|---------------------|
| .02                     | .01                      | $1.0 \cdot 10^{-4}$ |
| .04                     | .01                      | $4.0 \cdot 10^{-4}$ |
| .02                     | .04                      | $4.0 \cdot 10^{-4}$ |

a What's  $k$ ?  $1.0 \cdot 10^{-4} = k[.02 \text{ m}]^2[.01 \text{ m}] \rightarrow$  divide and calculate!

b. With actual experiments, you average the  $k$  value or use the integrated rate law

6. The differential rate law allows calculation of the rate from the reactant concentrations

1 The integrated rate law changes depending on reaction order

2 **Differential rate law**: how rate depends on concentration

$$a. \frac{-\Delta[\text{CH}_3\text{NC}]}{\Delta t} = -\frac{d[\text{CH}_3\text{NC}]}{dt}$$

3 **Integrated rate law**: how rate depends on time

$$a. \ln[\text{CH}_3\text{NC}]_t = -kt + \ln[\text{CH}_3\text{NC}]_0 \quad \text{initial}$$