E. Factors that Affect Reaction Rates 2/18

4. 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

2. $C_8H_{18} + 12.5\,O_2 \rightarrow 8\,CO_2 + 9\,H_2O$

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

b Reid Vapor Pressure (RVP) shows gase's volatility

3 Increasing reactant concentration generally increases reactant rate

a $aA + bB \rightarrow xX$

i $k[A]^m[B]^n \rightarrow$ Rate law differential

ii. Reaction orders m and n, often 1 or 2

b. Rate law must be determined experimentally

i. 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?

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

6 Example 2: $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$, so rate = $k[NO]^2[O_2]^1 \rightarrow 3^{rd}$ order

$[NO]$ m	$[O_2]$ 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? $1.0 \cdot 10^{-4} = k[.02m]^2[.01m]$ → divide and calculate!

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

ii. 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. $-\frac{\Delta[CH_3NC]}{\Delta t} = -\frac{d[CH_3NC]}{dt}$

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

a. $\ln[CH_3NC]_t = -kt + \ln[CH_3NC]_0$ ← initial