Tuesday, February 3, 2015

Learning objective: 4.2 The student is able to analyze concentration vs. time data to determine the rate law for a zeroth-, first-, or second-order reaction

As you enter...
Riddle me this:

A ladder hangs over the side of a ship anchored in a port. The bottom rung touches the water. The distance between rungs is 20 cm and the length of the ladder is 180 cm. The tide is rising at the rate of 15 cm each hour.

When will the water reach the seventh rung from the top?

Reminders: Textbook homework tonight

Big Idea 5: The laws of thermodynamics describe the essential role of energy and explain and predict the direction of changes in matter.

1st period:
- Review Midterm Exam (45 min)

2nd period:
New Unit: Kinetics
- Lab 10: Reaction Rates (45 min)

Tix out the door

Write your name on the paper.

How does concentration (molarity) of a substance affect the rate of a reaction?

$Pb(NO_3)_2 + NiCl_2 \rightarrow PbCl_2 + Ni(NO_3)_2$

$Pb^{+2} + 2NO_3^- + Ni^{+2} + 2Cl^- \rightarrow PbCl_2 + Ni^{+2} + 2NO_3^-$

$Pb^{+2}_{(aq)} + 2Cl^-_{(aq)} \rightarrow PbCl_2$

$Pb(NO_3)_2$: $M = \frac{mol}{L}$, $0.056 = \frac{x}{.0128\ L}$, $x = 7.17 \times 10^{-4}$ mol

$NiCl_2$: $M = \frac{mol}{L}$, $.076 = \frac{x}{.0151\ L}$, $x = 1.15 \times 10^{-3}$ mol

1 : 1

$Pb(NO_3)_2$: $NiCl_2$

Lim. reagent : excess

$\frac{1\ mol\ Pb(NO_3)_2}{1\ mol\ PbCl_2} = \frac{7.17 \times 10^{-4}\ mol}{x}$

$x = 7.17 \times 10^{-4}$ mol $PbCl_2$

mass = moles × g/m

$= (7.17 \times 10^{-4}\ mol)(278\ g/mol)$

$= 0.199\ g\ PbCl_2$

(7) Dipole moment zero

C_6H_6 NH_3 $H-\ddot{N}-H$ (H)

CS_2 $O=S=O$ H_2S $H-\ddot{S}:$ (H)

H_2O_2 14 e⁻

$H-\ddot{O}-\ddot{O}-H$

(10) halogen ion = full shell

7 valence e⁻ → 8 valence (B)

(11) transition element (E)

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$

$6 + 6 = 23\ e^-$

(18) $q = mc\Delta T$

ΔT: −10 → 35

$150000\ J = m(2.09)(35 - -10)$

(F)

(20) ΔH_f $CH_4 = ?$

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O + 889$ kJ heat released in rxn

x ∅ −393.3 −285.8

Total = Σ products − Σ reactants

$-889.1\ kJ = [-393.3 + 2(-285.8)] - x$

(27)

Be $1s^2 2s^2$

B $1s^2 2s^2 2p^1$

C $1s^2 2s^2 2p^2$

N $1s^2 2s^2 2p^3$

(28)

(29) EN diff.

Fluorine 4.0

H — X

New Unit: CHEMICAL KINETICS

1 What is the rate of a reaction?

2 What is integrated reaction rate?

3 How do reaction mechanisms work?

4 How does a catalyst affect a reaction?

5 How do we model chemical kinetics?

Wednesday, February 4, 2015

Learning objective: 4.2 The student is able to analyze concentration vs. time data to determine the rate law for a zeroth-, first-, or second-order reaction

As you enter...

How would you setup the rate law equation for the decomposition of $2N_2O_2 \rightarrow 2N_2O + O_2$?

$Rate = k[N_2O_2]^{n}$

Reminders: Textbook homework tonight

Big Idea 5: The laws of thermodynamics describe the essential role of energy and explain and predict the direction of changes in matter.

1st period:

- Review HW (10 min)
- Finish Lab 10 (25 min)
- Exit Tix (5 min)

Tix out the door

Write your name on the paper.

How does concentration (molarity) of a solvent affect the rate of a reaction?
Defend your answer in terms of collisions of particles.

Thursday, February 5, 2015

Learning objective: 4.2 The student is able to analyze concentration vs. time data to determine the rate law for a zeroth-, first-, or second-order reaction

As you enter...

Determine the **rate law** for the decomposition of $2N_2O_5 \rightarrow 4NO_2 + O_2$, given the following information.

	$[N_2O_5]$	Rate (mol/L · s)
1	0.90 M	5.4×10^{-4}
2	0.45 M	2.7×10^{-4}

$\frac{Rate\ 2}{Rate\ 1} = \frac{[\ ]^n}{[\ ]^n}$

$\frac{2.7 \times 10^{-4}}{5.4 \times 10^{-4}} = \frac{k(.45)^n}{k(.90)^n}$

$.5 = .5^n$

$n = 1$

$Rate = k[N_2O_5]^n$

$Rate = k[N_2O_5]$

Note: Final grades are posted above the collection bin.

Big Idea 5: The laws of thermodynamics describe the essential role of energy and explain and predict the direction of changes in matter.

1st period:

- Lab Debrief (15 min)
- Review HW (30 min)

2nd period

- Inegrated Rate Law (25 min)
- Exit Tix (5 min)

Tix out the door

Write your name on the paper.

How does concentration (molarity) of a solvent affect the rate of a reaction?
Defend your answer in terms of collisions of particles.

Rate Law = $k[NO]^n[Cl_2]^m$

$$\frac{\text{Rate 2}}{\text{Rate 1}} = \frac{5.72\times10^{-6}}{1.43\times10^{-6}} = \frac{k(.500)^n(.250)^m}{k(.250)^n(.250)^m}$$

$$4 = 2^n$$

$$n = 2$$

$$\frac{\text{Rate 3}}{\text{Rate 1}} = \frac{2.86\times10^{-6}}{1.43\times10^{-6}} = \frac{k(.250)^n(.500)^m}{k(.250)^n(.250)^m}$$

$$2 = 2^m$$

$$m = 1$$

Rate = $k[NO]^{2}[Cl_2]^{1}$

mol/L·s $\quad k: \frac{L^2}{mol^2\cdot s}$ $\quad \frac{mol^2}{L^2}$ $\quad$ mol/L

1	9.15×10^{-5}	
2	4.58×10^{-5}	9.15×10^{-5}
3	4.58×10^{-3}	9.15×10^{-5}
4		

$$\frac{mol}{L\cdot s} = k\frac{mol^3}{L^3}$$

$$\left(\frac{L^2}{mol^2\cdot s}\right)\left(\frac{mol^3}{L^3}\right)$$

$$\frac{mol}{L\cdot s}$$

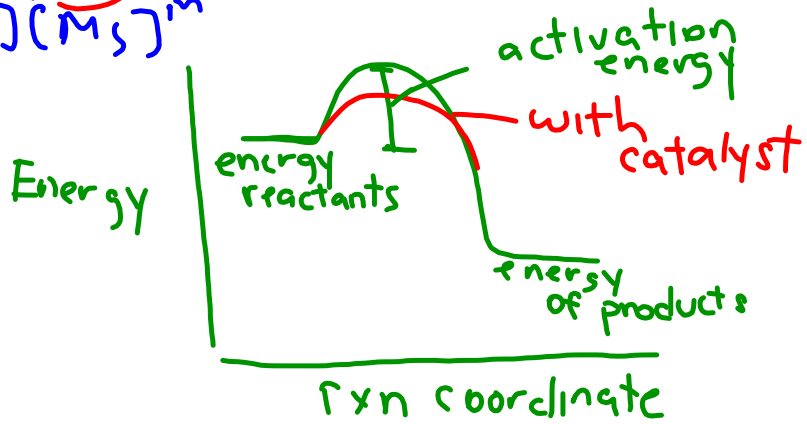
Order = 2 + 1 = 3

E. Rate of Reaction in g/s

1	2	3	4	5	6
.003	.0025	.0021	.000254	.0001688	.0000713
6.3×10^{-3}	3.5×10^{-3}	2.9×10^{-3}	1.0×10^{-3}	$.17 \times 10^{-3}$	$.092 \times 10^{-3}$
6.06×10^{-3}	3.3×10^{-3}	1.94×10^{-3}	9.13×10^{-4}	2.05×10^{-4}	7.13×10^{-5}

HCl + Mg

Rate = $k[HCl]^n[Mg]^m$



Friday, February 6, 2015

Learning objective: 4.2 The student is able to analyze concentration vs. time data to determine the rate law for a zeroth-, first-, or second-order reaction

As you enter...

Write the general rate law formula for a reaction that is...

1. **zero order** Rate = $k[X]^0$
2. **first order** Rate = $k[X]^1$
3. **second order** Rate = $k[X]^2$ or $k[X][Y]$

Homework: LAB 11 Pre-Lab due Monday

Big Idea 5: The laws of thermodynamics describe the essential role of energy and explain and predict the direction of changes in matter.

1st period:

- Review HW (30 min)
- Exit Tix (15 min)

Tix out the door

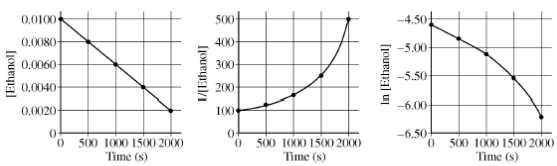
Write your name on the paper.

AP Exam Question 2011

In a second experiment, which is performed at a much higher temperature, a sample of ethanol gas and a copper catalyst are placed in a rigid, empty 1.0 L flask. The temperature of the flask is held constant, and the initial concentration of the ethanol gas is 0.0100 *M*. The ethanol begins to decompose according to the chemical reaction represented below.

$$CH_3CH_2OH(g) \xrightarrow{Cu} CH_3CHO(g) + H_2(g)$$

The concentration of ethanol gas over time is used to create the three graphs below.



(c) Given that the reaction order is zero, one, or two, use the information in the graphs to respond to the following.

(i) Determine the order of the reaction with respect to ethanol. Justify your answer.

(ii) Write the rate law for the reaction.

(iii) Determine the rate constant for the reaction, including units.

(23) a) H_2O_2 : 2.31×10^{-5} mol/L·s
O_2 : 1.16×10^{-5} mol/L·s

b) H_2O_2 : 1.16×10^{-5} mol/L·s
O_2 : 5.80×10^{-6} mol/L·s

$$Rate = -\frac{\Delta[A]}{\Delta t}$$

(28) a) $Rate = k[I^-][S_2O_8^{2-}]$

b) $k = 3.91\times10^{-3}$

$2\ I^- + S_2O_8^{2-} \rightarrow$

(29) a) $Rate = k[NOCl]^2$

b) $k = 6.65\times10^{-29}$

c) 4.00×10^{-8}

$2\ NOCl \rightleftharpoons 2\ NO + Cl_2$

$$Rate = -\frac{\Delta[NOCl]}{\Delta t}$$

(a) $Rate = k[NOCl]^n$

$n = ?$

$$\frac{Rate\ 2}{Rate\ 1} = \frac{2.66\times10^{-4}}{5.98\times10^{-4}} = \frac{k(2.0\times10^{16})^n}{k(3.0\times10^{16})^n}$$

$$.445 = .667^n$$

$n = 2$

$$\boxed{Rate = k[NOCl]^2}$$

(b) $2.66\times10^{-4} = k(2.0\times10^{16})^2$

$2.66\times10^{-4} = k(4\times10^{32})$

$k = 6.65\times10^{-29}\ \frac{cm^3}{molecules\cdot s}$

(c) $\frac{6.65\times10^{-29}\ cm^3}{molecules\cdot s} \times \frac{6.02\times10^{23}\ molecules}{mol} \times \frac{mol/L}{}$

$= \frac{4.00\times10^{-5}\ cm^3}{mol\cdot s} \times \frac{1\ L}{1000\ cm^3}$

$1\ cm^3 = 1\ mL$

$= 4.00\times10^{-8}\ \frac{L}{mol\cdot s}$

(31) $I^- + OCl^- \rightarrow IO^- + Cl^-$

$Rate = k[I^-]^n[OCl^-]^m$

$$\frac{Rate\ 1}{Rate} = \frac{7.91\times10^{-2}}{3.95\times10^{-2}} = \frac{k(.12)^n(.18)^m}{k(.06)^n(.18)^m}$$

$2 = 2^n$

$n = 1$

$$\frac{Rate\ 3}{Rate\ 2} = \frac{9.88\times10^{-3}}{3.95\times10^{-2}} = \frac{k(.030)^n(.090)^m}{k(.060)^n(.18)^m}$$

$0.250 = 0.5\left(\frac{.090}{.18}\right)^m$

$.5 = .5^m$

$m = 1$

$$\boxed{Rate = k[I^-][OCl^-]}$$

$7.91\times10^{-2} = k(.12)(.18)$

$\boxed{k = 3.66}$

Initial $[I^-]$ & $[OCl^-] = .15$

$Rate = ?$

$= .0824$ mol/L·s