1

Chap. 16 - Jan. 17 **Slide #21**

Consider the reaction, 2 NO(g) + Cl2(g) → 2 NOCl(g)

The rate law is: R = k[NO]^m[Cl2]^n

Use the initial rate data below to determine m, n and k

Expt.	$[NO]_o$	$[Cl_2]_o$	R_o
#1	0.01 M	0.02 M	4.10×10^{-5} M s^{-1}
#2	0.04	0.02	6.56×10^{-4}
#3	0.01	0.06	1.23×10^{-4}

Compare (1) & (2)

$$\frac{R_2}{R_1} = \frac{k[NO]_2^m[Cl_2]_2^n}{k[NO]_1^m[Cl_2]_1^n}$$

$$= \left(\frac{[NO]_2}{[NO]_1}\right)^m \left(\frac{[Cl_2]_2}{[Cl_2]_1}\right)^n$$

$$\frac{6.56\times10^{-4}}{4.10\times10^{-5}} = \left(\frac{[0.04]}{[0.01]}\right)^m \left(\frac{0.02}{0.02}\right)^n$$

$$16.0 = (4.0)^m$$

m = 2

Compare (1 & 3)   S 21

(2)

$$\frac{1.23\times10^{-4}}{4.1\times10^{-5}} = \left(\frac{[0.06]}{[0.02]}\right)^n$$

$$3.0 = 3.0^n \qquad n=1, \; m=2$$

Exp 1 $\quad Ro_1 = k [NO]_1^2 [Cl_2]^1$

$$k = \frac{Ro_1}{[NO]_1^2 [Cl_2]^1} = \frac{4.10\times10^{-5}\ M\ s^{-1}}{(0.01\ M)^2 (0.02\ M)^1}$$

$$= 20.5\ \frac{M}{M^3}\ s^{-1} = 20.5\ M^{-2} s^{-1}$$

Chap. 16 - Jan. 29 Slide 35

Consider a Second Order reaction, A → Products.

The initial concentration of [A] is 0.50 M, and the concentration decreases to 0.30 M after 150 s. Calculate the following quantities:

(A) The rate constant, k

$$\frac{1}{[A]_t} = kt + \frac{1}{[A]_0}$$

$[A]_0 = 0.50\ M$

$[A]_t = 0.30\ M$

$t = 150\ s$

$$\frac{1}{0.30\ M} = k(150\ s) + \frac{1}{0.50\ M}$$

$$k = \frac{3.33\ M^{-1} - 2.0\ M^{-1}}{150\ s} = 8.89 \times 10^{-3}\ M^{-1}s^{-1}$$

Consider a Second Order reaction, A → Products.

The initial concentration of [A] is 0.50 M, and the concentration decreases to 0.30 M after 150 s. Calculate the following quantities:

(B) The concentration, $[A]_t$. after 250 s

$[A_0] = 0.5\,M$

$t = 250\,s.$

$[A]_t = ?$

$k = 8.89 \times 10^{-3}\,M^{-1}\,s^{-1}$

$$\frac{1}{[A]_t} = +kt + \frac{1}{[A]_0}$$

$$= (+8.89 \times 10^{-3}\,M^{-1}\,s^{-1})(250\,s) + \frac{1}{0.5\,M}$$

$$\frac{1}{[A]_t} = 4.22\,M^{-1}$$

$$[A]_t = \frac{1}{4.22\,M^{-1}} = 0.24\,M$$

Chap. 16 - Jan. 29 Slide 35

Consider a Second Order reaction, $A \rightarrow$ Products.

The initial concentration of [A] is 0.50 M, and the concentration decreases to 0.30 M after 150 s. Calculate the following quantities:

(C) The time it takes to for the concentration to decrease from $[A]_0$ to 0.10 M

$$\frac{1}{[A]_t} = kt + \frac{1}{[A]_0}$$

$[A]_0 = 0.50\,M$

$k = 8.89 \times 10^{-3}\,M^{-1}s^{-1}$

$[A]_t = 0.10\,M$

$t = ?$

$$\frac{1}{0.10\,M} = (8.89 \times 10^{-3}\,M^{-1}s^{-1})\,t + \frac{1}{0.50\,M}$$

$$t = \frac{10\,M^{-1} - 2.0\,M^{-1}}{8.89 \times 10^{-3}\,M^{-1}s^{-1}}$$

$= 900\,s$