

Lecture 4.3. Determination of the Reaction Rate Equation

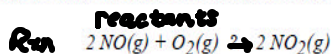
Note Title

1/4/2012

Using exp info to determine the rxn. rate equation.

Problem Solving. Change only variable a time.

28. (5 points) Given the following information:



	$[NO]_i (M)$	$[O_2]_i (M)$	Initial Rate ($M s^{-1}$)
exp 1	0.030	0.0055	8.55×10^{-3}
exp 2	0.030	0.0110	1.71×10^{-2}
exp 3	0.060	0.0055	3.42×10^{-2}
exp 4	0.035	0.015	X

Determine the (i) rate law equation, (ii) value of k and (iii) reaction rate X.

(Explanations and/or work are required for any credit. You decide how much is enough)

i) $rate = k [NO]^x [O_2]^y$

x. $[NO]$ changes $\cdot \times 2$
 $[O_2]$ const $\cdot NC$

$$\frac{3.42 \times 10^{-2}}{8.55 \times 10^{-3}} = 4$$

rxn rate incr $\times 4$

$$2^x = 4$$

$$x = 2$$

\therefore rxn second order $[NO]$

$$rate = k [NO]^2 [O_2]^y$$

y: $[NO]$ const $\cdot NC$
 $[O_2]$ changes $2x$
 reaction rate $2x$

$$2^y = 2$$

$y = 1$
 1st order in $[O_2]$

i) $rate = k [NO]^2 [O_2]^1 = k [NO]^2 [O_2]$

ii) calc value for k (include the units)

Exp. #3

$$rate = k [NO]^2 [O_2]$$

$$k = \frac{rate}{[NO]^2 [O_2]}$$

$$Exp \#3 \quad k = \frac{3.42 \times 10^{-2} \frac{M}{s}}{(0.060 M)^2 (0.0055 M)} = 1727.27 \frac{\frac{M}{s}}{M^3 \cdot M}$$

$$= 1700 \frac{M}{s} \cdot \frac{1}{M^3} \left(\frac{1}{5M} \right)$$

$$k = 1700 \frac{1}{s \cdot M^2}$$

iii) reaction rate X (exp #4)

$$[NO]_i = 0.035 M \quad [O_2]_i = 0.015 M$$

$$rate = k [NO]^2 [O_2]$$

$$rate = (1727.27) (0.035 M)^2 (0.015 M)$$

$$rate = 0.03173 \frac{M}{s} = 0.032 \frac{M}{s}$$