Show all work

CHM 152/54 Quiz #2 25 Pts Spring 04 Name: Key

$rate = k$ $rate = k[A]$ $rate = k[A]^2$ $[A]_t = -kt + [A]_0$ $\ln[A]_t = -kt + \ln[A]_0$

$1/[A]_t = kt + 1/[A]_0$ $t_{1/2} = [A]_0/2k$ $t_{1/2} = 0.693/k$ $t_{1/2} = 1/k[A]_0$

$\ln(k_2/k_1) = (E_a/R)(1/T_1 - 1/T_2)$ $R = 8.314\ J/(mol \cdot K)$ $e = mc^2$

1. Determine the rate law and the rate constant that corresponds to the data shown for the following reaction?

$$2A + B \rightarrow C$$

Exp.	Initial [A]	Initial [B]	Initial rate
1	0.015	0.022	0.125
2	0.030	0.044	0.500
3	0.060	0.044	0.500
4	0.060	0.066	1.125

General form: $rate = k[A]^x[B]^y$

for A use Exp 2 + 3

$$\frac{rate\ 2}{rate\ 3} = \frac{k(A)_2^x (B)^y}{k(A)_3^x (B)^y}$$

$$\frac{0.5}{0.5} = \left(\frac{0.030}{0.060}\right)^x$$

$$1 = \left(\frac{1}{2}\right)^x$$

$x = 0$

for B use $\frac{Exp\ 4}{Exp\ 3}$

$$\frac{1.125}{0.500} = \left(\frac{0.066}{0.044}\right)^y$$

$$2.25 = (1.5)^y$$

$$\ln 2.25 = y \ln 1.5$$

$y = 2$ (rate = k [B]²)

$$k = \frac{0.125}{[0.022]^2}$$

$k = 258\ M^{-1}t^{-1}$

2. Nitric oxide reacts with hydrogen to form nitrous oxide, and water. Use the following data to determine the rate law for the reaction.

$$2NO + H_2 \rightarrow N_2O + H_2O$$

Expt. #	$[NO]_0$	$[H_2]_0$	Initial rate
1	0.021	0.065	1.46 M/min
2	0.021	0.260	1.46 M/min
3	0.042	0.065	5.84 M/min

A. rate = k[NO]

B. rate = k[NO]²

C. rate = k[NO][H₂]

D. rate = k[NO]²[H₂]

E. rate = k[NO]²[H₂]²

$rate = k[NO]^x[H_2]^y$

for [NO]: $\frac{Exp\ 3}{Exp\ 1}$ $\frac{rate\ 3}{rate\ 1} = \frac{k[NO]_3^x [H_2]^y}{k[NO]_1^x [H_2]^y}$

$$\frac{5.84}{1.46} = \left(\frac{0.042}{0.021}\right)^x$$

$4 = 2^x$ $x = 2$

for H_2: $\frac{Exp\ 1}{Exp\ 2}$ shows 0 order

so $rate = k[NO]^2$

(more on back)

3. At 25°C, the rate constant for the first-order decomposition of a pesticide solution is 6.40×10^{-3} ~~min^{-1}~~. If the starting concentration of pesticide is 0.0314 M, what concentration will remain after 62.0 min at 25°C?

$\ln[A]_t = -kt + \ln[A]_0$

$\ln[A]_t = -6.40 \times 10^{-3}(62) + \ln[0.0314]$

$\ln[A]_t = -3.8577$

$e^{-3.8577} = 0.0211\ M$

4. For the overall chemical reaction shown below, which one of the following statements can you rightly assume?

$$2H_2S(g) + O_2(g) \rightarrow 2S(s) + 2H_2O(l)$$

A. The reaction is third-order overall. B. The reaction is second-order overall.
C. The rate law is, rate = $k[H_2S]^2\,[O_2]$. D. The rate law is, rate = $k[H_2S]\,[O_2]$.
E. The rate law cannot be determined from the information given.

5. The units for a first-order rate constant are

A. M/s B. 1/M•s C. 1/s D. M^{2}•s E. None of these

$\text{rate} = k[A]$

$\frac{M}{s} = \left(\frac{1}{s}\right) M$

$\uparrow$

$\frac{1}{s}$

6. The reaction A + 2B → products was found to follow the rate law: rate = $k[A]^2[B]$. Predict by what factor the rate of reaction will increase when the concentration of A is doubled and the concentration of B is tripled, and the temperature remains constant.

A. 5 B. 6 C. 12 D. 18 E. None of the above.

$\text{rate} = k[2]^2[3]$

$4 \times 3 = 12$