AP Wkst 5b (Rate Law Practice)

(1) The bromination of acetone is acid-catalyzed:

$$CH_3COCH_3 + Br_2 \xrightarrow{H+} CH_3COCH_2Br + H^{+1} + Br^{-1}$$

The rate of disappearance of bromine was measured for several different concentration of acetone, bromine, and H^+ ions:

$[CH_3COCH_3]$	$[Br_2]$	$[H^{+1}]$	Rate
0.30	0.050	0.050	5.7×10^{-5}
0.30	0.10	0.050	5.7×10^{-5}
0.30	0.050	0.10	1.2×10^{-4}
0.40	0.050	0.20	3.1×10^{-4}
0.40	0.050	0.050	7.6×10^{-5}

x1.3 | x2 | 1st order | x1 | ϕ order Br_2 | x4 | 1st order H^+

(a) What is the rate law for the reaction? (Find the order for each of the three reactants.)

(b) Determine k, and show the correct units.

$5.7 \cdot 10^{-5}\ M/s = k(.3M)(.050M)$

$k = .0038\ \frac{1}{M \cdot s}$

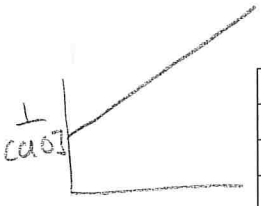
Rate = $k[CH_3COCH_3][Br_2]^0[H^+]$

Rate = $k[CH_3COCH_3][H^+]$

(2) Chlorine oxide (ClO) decays rapidly according to the reaction:

$$2ClO(g) \rightarrow Cl_2(g) + O_2(g)$$

From the following data, determine the reaction order and calculate the rate constant. Show the correct units and justify your answer.



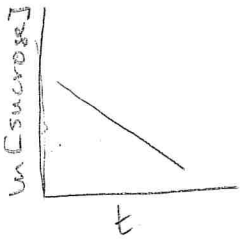
Time (s)	[ClO]
0.12×10^{-3}	8.49×10^{-6}
0.96×10^{-3}	7.10×10^{-6}
2.24×10^{-3}	5.79×10^{-6}
3.20×10^{-3}	5.20×10^{-6}
4.00×10^{-3}	4.77×10^{-6}

Rxn is 2nd order

k = slope = $2.4 \cdot 10^{7}\ \frac{1}{M \cdot s}$

(3) Sucrose ($C_{12}H_{22}O_{11}$) undergoes hydrolysis to product fructose ($C_6H_{12}O_6$) and glucose ($C_6H_{12}O_6$):

$$C_{12}H_{22}O_{11} + H_2O \rightarrow C_6H_{12}O_6 \text{ (glucose)} + C_6H_{12}O_6 \text{ (fructose)}$$



Time (min)	$[C_{12}H_{22}O_{11}]$
0	0.500
60.0	0.400
96.4	0.350
157.5	0.280

Rxn is 1st order

(a) Determine the order of the reaction and the rate constant. Show units. k = -slope = $.0037\ \frac{1}{s}$

(b) How long does it take to hydrolyze 95% of the sucrose?

(c) Explain why $[H_2O]$ is not in the rate law even though water is a reactant.

b)

$[A]_t = .05[A]_0$

$\ln[A]_t - \ln[A_0] = kt$

$\ln(.05[A]_0) - \ln[A_0] = kt$

$\ln(.05) + \ln[A]_0 - \ln[A]_0 = kt$

$\ln(.05) = kt \qquad t = \frac{\ln(.05)}{k} = 810\ min$

c) H_2O is in such high concentration that the $[H_2O]$ does not change appreciably