Chem 12 Hw set 9 - graded part

1. Ch 15, 16. k for $H\ddot{O}\cdot$ + benzene $= 1.24 \times 10^{-12} \frac{cm^3}{molecule \cdot sec}$

$$1.24 \times 10^{-12} \frac{\cancel{cm^3}}{\cancel{molec.} \cdot sec} \times \frac{1\ L}{1000\ \cancel{cm^3}} \times \frac{6.022 \times 10^{23}\ \cancel{molec}}{1\ mol}$$

$$= 7.47 \times 10^{8}\ L\ mol^{-1} sec^{-1} = \underline{\underline{7.47 \times 10^{8}\ M^{-1} sec^{-1}}}$$

18. $2I^- + S_2O_8^{2-} \longrightarrow I_2 + 2SO_4^{2-}$

a. conc. vs initial rate data $\Rightarrow$ $2 \times [I^-] \Rightarrow 2\times$ rate
$2 \times [S_2O_8^{2-}] \Rightarrow 2\times$ rate

so

$$\text{rate} = -\frac{d[S_2O_8^{2-}]}{dt} = -\frac{1}{2}\frac{d[I^-]}{dt} \underline{\underline{=}} k[I^-][S_2O_8^{2-}]$$

b. $3.91 \times 10^{-3} M^{-1} sec^{-1}$ for first 4, $3.89 \times 10^{-3} M^{-1} sec^{-1}$ for 5th
the average is $3.91 \times 10^{-3} M^{-1} sec$,
but conc. data has only 2 sig figs, so $3.9 \times 10^{-3} M^{-1} sec^{-1}$
(kind of a silly exercise - sorry.)

20. a. 1st-order in each; b. rate $= k[Hb][CO]$

c. $k = \frac{\text{rate}}{[Hb][CO]}$

0.280 $\mu M^{-1} sec^{-1}$ 1st set of data
0.281 " " 2nd " " " "
0.280 " " 3rd " " " "

ave $= 0.280\ \mu M^{-1} sec^{-1}$

$$\times \frac{10^6\ \mu M}{1\ M} = 0.280 \times 10^6\ M^{-1} sec^{-1}$$
$$= 2.80 \times 10^5\ M^{-1} sec^{-1}$$

d. plug 'n' chug ...
init. rate $= 2.26\ \mu M\ sec^{-1}$
$(= 2.26 \times 10^{-6} M\ sec^{-1})$

29. linear plot of $\ln[A]$ vs t ⇒ 1st-order rxn, rate $= k[A]$

a. Integrated rate law: $\ln[A] = -kt + \ln[A]_0$

$$\text{slope} = -k = -2.97 \times 10^{-2}\ \text{min}^{-1}$$

$$\text{so } k = 2.97 \times 10^{-2}\ \text{min}^{-1} \times \frac{1\ \text{min}}{60\ \text{sec}}$$

$$= 4.95 \times 10^{-4}\ \text{sec}^{-1}$$

b. $t_{1/2} = \frac{\ln 2}{k} = 1400\ \text{sec} = 23.3\ \text{min}$

c. $\ln\left(\frac{[A]_0}{[A]}\right) = kt$ plug in k, $[A]_0 = 2.00 \times 10^{-2}\ M$
& $[A] = 2.50 \times 10^{-3}\ M$

⇒ $t = 4200\ \text{sec} = 70\ \text{min}$

also note that $0.25 \times 10^{-2}\ M$ is $\frac{1}{8}$ init conc. — so exactly 3 half-lives gets the rxn to this point.

40. $^{32}P \xrightarrow[\text{decay"}]{\text{"beta-}} e^- + {}^{32}S$

$t_{1/2} = 14.3$ days ⇒ $k = \frac{\ln 2}{t_{1/2}} = 0.0485\ \text{day}^{-1}$ (I'll leave this in units of per day since the result we want will probably be in days.)

$$\ln\left(\frac{[A]_0}{[A]}\right) = kt$$

for 95% decay, "[A]" = 5%
so this ratio is 20

$$t = 61.8\ \text{days} \left(\times \frac{1\ \text{month}}{30.437\ \text{days}} = 2.03\ \text{months}\right)$$

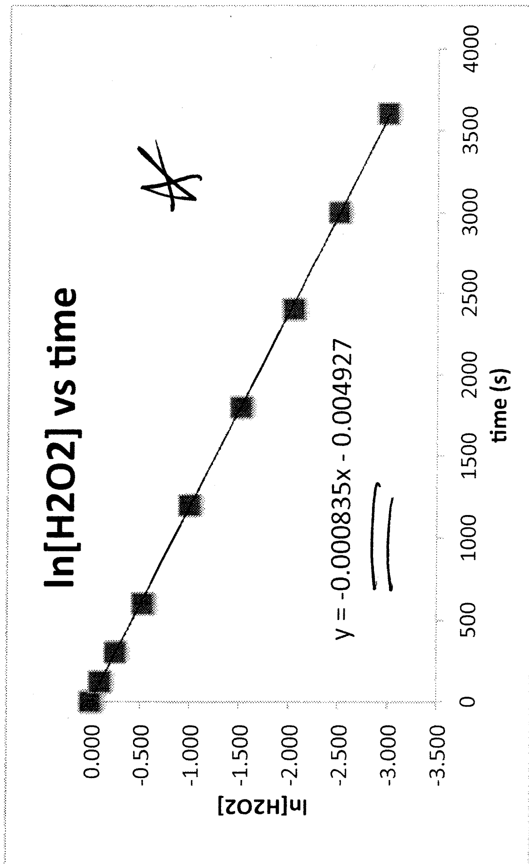
Hw set 9 - sr.

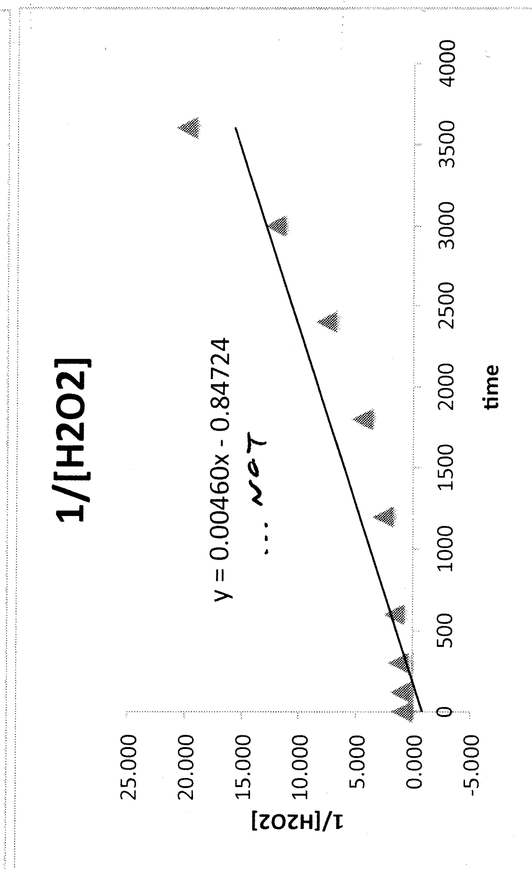
2. Ch 15 31. If 1st-order, a plot of $\ln[H_2O_2]$ vs t will be linear

$$\left(\ln[H_2O_2] = -kt + \ln[H_2O_2]_0\right)$$

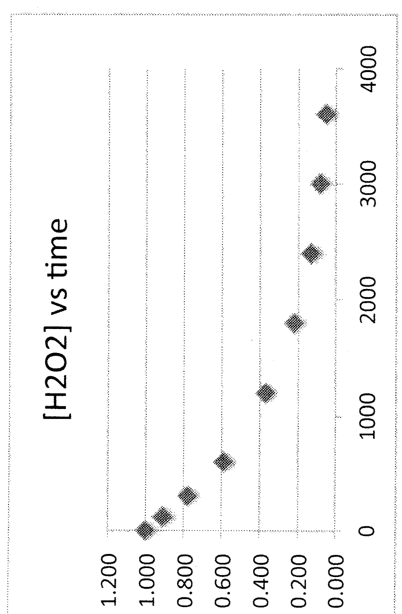
If 2nd-order, a plot of $1/[H_2O_2]$ vs t will be linear

$$\left(\frac{1}{[H_2O_2]} = kt + \frac{1}{[H_2O_2]_0}\right)$$





time (s)	[H2O2] (M)	ln[H2O2]	1/[H2O2]
0	1.000	0.000	1.000
120	0.910	-0.094	1.099
300	0.780	-0.248	1.282
600	0.590	-0.528	1.695
1200	0.370	-0.994	2.703
1800	0.220	-1.514	4.545
2400	0.130	-2.040	7.692
3000	0.082	-2.501	12.195
3600	0.050	-2.996	20.000



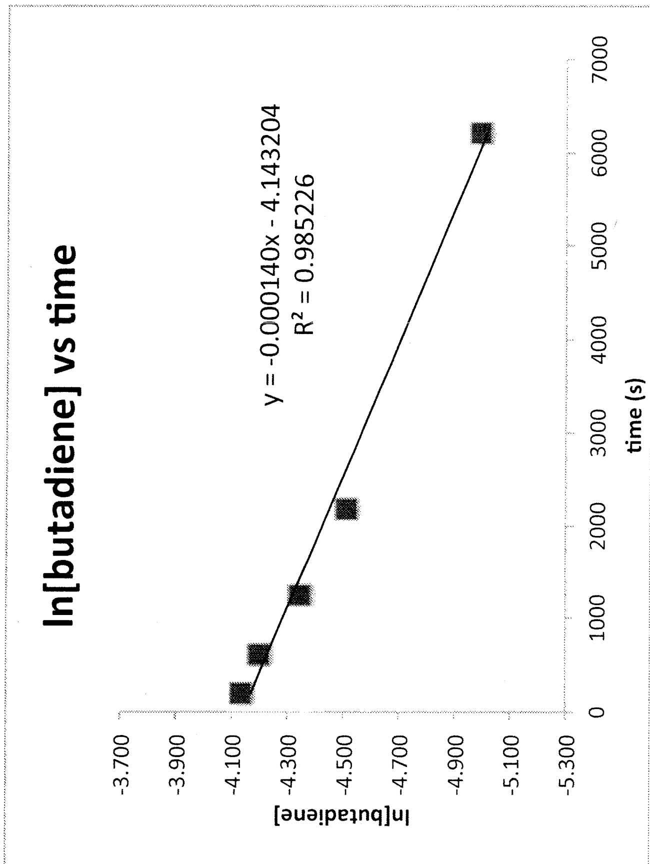
$k = 8.35 \times 10^{-4}\ \text{sec}^{-1}$

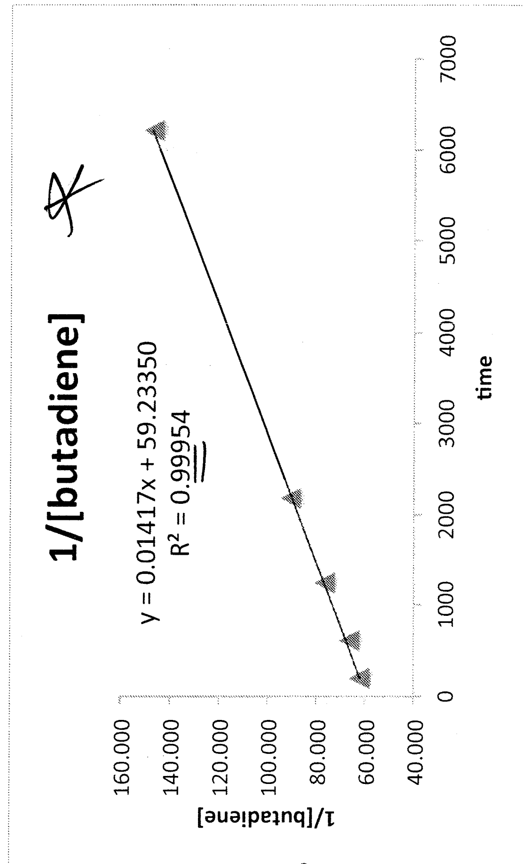
at $t = 4000$ sec,

$\ln[H_2O_2] = -3.34$

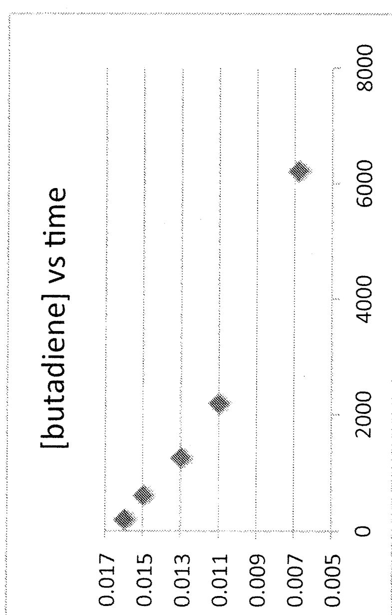
so $[H_2O_2] = 0.035$ M

32. This is tough because that ln[butadiene] vs t plot is close to linear. The $\frac{1}{[\text{but.}]}$ vs t plot has a better correlation coefficient (R^2 value), but this data set could really benefit from a few more points!





time (s)	[C4H6] (M)	ln[C4H6]	1/[C4H6]
195	0.016	-4.135	62.500
604	0.015	-4.200	66.667
1246	0.013	-4.343	76.923
2180	0.011	-4.510	90.909
6210	0.007	-4.991	147.059



2nd-order -

$$\text{rate} = -\frac{1}{2}\frac{d[\text{but.}]}{dt} = k[\text{but.}]^2$$

integrated rate law is:

$$\frac{1}{[\text{but}]} = 2kt + \frac{1}{[\text{but}]_0}$$

slope = 0.01417 = 2k

$k = 7.1 \times 10^{-3}\ M^{-1}\text{sec}^{-1}$