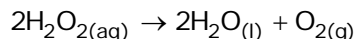


Session #23: Homework Problems

Problem #1

The decomposition of hydrogen peroxide, H_2O_2 , can be represented by the following reaction:



The table below reports data taken at room temperature (300 K).

Table 1. Decomposition of $\text{H}_2\text{O}_{2(\text{aq})}$ at 300 K.

conc H_2O_2 (mol/liter)	time (seconds)
2.32	0
2.01	200
1.72	400
1.49	600
0.98	1200
0.62	1800
0.25	3000

- Show that the reaction is first order.
- Calculate the value of the half-life of this reaction.
- Suppose that the initial concentration of H_2O_2 were 3.5 M. How long would it take at 300 K to reduce the concentration of H_2O_2 to 25% of its initial value?

Problem #2

A chemical reaction which has an activation energy of 167.0 kJ/mole is to proceed at $T = 450$ K with a very constant rate; the rate is allowed to vary at most by $\pm 1\%$. How constant must the temperature be to achieve this required rate stability? (For $T \gg \Delta T$, $T_1 \times T_2 = T^2$)

Problem #3

Determine the diffusivity (D) of lithium (Li) in silicon (Si) at 1200°C , knowing that $D_{1100^\circ\text{C}} = 10^{-5}$ cm^2/s and $D_{695^\circ\text{C}} = 10^{-6}$ cm^2/s .

Problem #4

For a chemical reaction, the concentrations of reactant as a function of time are given below for 25°C and for 50°C .

at 25°C

time (h)	conc. (mole/L)
.00	0.1039
3.15	0.0896
10.00	0.0639
13.50	0.0529
26.00	0.0270
37.30	0.0142

at 50°C

time (min)	conc. (mole/L)
0	0.1056
9	0.0961
18	0.0856
54	0.0536
105	0.0270
180	0.0089

- Indicate schematically (in two different graphic presentations) how you could prove, given concentration data at certain times, that a reaction is of first order.
- Determine, from graphic presentations, the rate constants (k) for the given reaction at 25°C and 50°C.
- Determine the half-life ($t_{1/2}$) for the reaction at 50°C.
- Determine the half-life ($t_{1/2}$) for the reaction at 70°C.
- What is the time required for the reaction at 25°C to be completed to the extent of 42%?

Problem #5

In a chemical reaction the concentration of a rate determining component is measured (in moles) at one minute intervals from zero to 5 minutes. The data are: 1.0×10^{-2} , 0.683×10^{-2} , 0.518×10^{-2} , 0.418×10^{-2} , 0.350×10^{-2} and 0.301×10^{-2} .

- Determine the order (n) of this reaction.
- Determine the rate constant (k).
- Determine the half-life of this reaction.

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