**CHEM 130** **Name** ____________________________________

**Quiz 8 – November 16, 2011** **Due at the beginning of class November 18, 2011.**

Complete the following individually. You may use your textbook and notes, but may not receive assistance from your classmates or anyone other than Dr. Lamp. *This signed tatement must accompany the completed assignment*. By signing below, you certify that you completed the problems in accordance with these rules. No credit will be given to unsigned papers. Staple any additional sheets prior to turning the assignment in.

Signature________________________________________________ Date_________________

Complete the following problems. **You must show your work to receive full credit**. Show your answers to the correct number of significant figures with the correct units.

1. The decomposition of hydrogen peroxide was studied at a particular temperature, and the data below were obtained. Determine the order of reaction in $H_2O_2$ and the rate constant. If you use a spreadsheet, attach any plots or spreadsheet output. (9 pts)

| Time (s) | $[H_2O_2]$ (M) |
|---|---|
| 0 | 1 |
| 121 | 0.91 |
| 299 | 0.78 |
| 601 | 0.59 |
| 1201 | 0.37 |
| 1799 | 0.22 |
| 2399 | 0.13 |
| 3001 | 0.082 |
| 3601 | 0.05 |

2. Experimental values for the temperature dependence of the rate constant for the gas phase reaction $NO + O_3 \rightarrow NO_2 + O_2$ are shown below. Determine the activation energy and the frequency factor for this reaction. If you use a spreadsheet, attach any plots or spreadsheet output. (8 pts)

| T ($^oC$) | k ($L\ mol^{-1}\ s^{-1}$) |
|---|---|
| -78.1 | $1.08 \times 10^9$ |
| -43.2 | $2.95 \times 10^9$ |
| -12.9 | $5.42 \times 10^9$ |
| 25.0 | $12.0 \times 10^9$ |
| 96.1 | $35.5 \times 10^9$ |

3. The reaction $2CO(g) + O_2(g) \rightarrow 2CO_2(g)$ exhibits the rate law: Rate = $k[CO]^2[O_2]$. Two proposed mechanisms for this reaction are listed below. Determine if one, both, or neither mechanisms are consistent with this rate law. Justify your answer. (8 pts)

| Mechanism 1: | Mechanism 2 |
|---|---|
| Step 1: $CO + O_2 \rightarrow CO_2 + O$ (slow) | Step 1: $CO + O_2 = CO_3$ (fast equilibrium) |
| Step 2: $O + CO \rightarrow CO_2$ (fast) | Step 2: $CO_3 + CO \rightarrow 2CO_2$ (slow) |

**Possibly Useful Information**

| | | |
|---|---|---|
| $k = Ae^{-E_a/RT}$ | $\ln k = -\left(\frac{E_a}{R}\right)\left(\frac{1}{T}\right) + \ln A$ | R = 0.08206 L atm $mol^{-1}$ $K^{-}$<br>R = 8.3144 J $mol^{-1}$ $K^{-}$ |
| rate = $k[A]^1$ | $[A]_t = -kt + [A]_0$ | $t_{1/2} = [A]_0/2k$ |
| rate = $k[A]^2$ | $\ln[A]_t = -kt + \ln[A]_0$ | $t_{1/2} = 1/(k[A]_0)$ |
| rate = $k[A]^0$ | $\frac{1}{[A]_t} = kt + \frac{1}{[A]_0}$ | $t_{1/2} = 0.693/k$ |