CHM152 Quiz #2a 25 Pts Fall 2006 Name: Key

show work where possible

1. (3 Pts) If the rate of a reaction doubles for every 10°C, how much faster does a reaction proceed at 85°C than at 25°C? 64 times as fast

From 85° to 25° there are "6" 10° changes, doubling each time would be $2^6 = 64$.

2. The rate constant for the rate of decomposition fo N_2O_5 to NO and O_2 in the gas phase is 1.66 $M^{-1}s^{-1}$ at 650 K and 7.39 $M^{-1}s^{-1}$ at 700 K.

a. (4 Pts) What is the activation energy for this decomposition reaction? $\ln\left[\frac{k_2}{k_1}\right] = \left[\frac{E_a}{R}\right]\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$

$$\ln\left(\frac{7.39}{1.66}\right) = \frac{E_a}{8.314}\left(\frac{1}{650} - \frac{1}{700}\right)$$

$E_a = 113000$ J/mol or 113 kJ/mol

b. (6 Pts) Determine the value of the rate constant at 25°C.

$3.11 \times 10^{-11}\ M^{-1}s^{-1} = k$ @ 25°C

$$\ln\left(\frac{k_2}{1.66}\right) = \frac{113000}{8.314}\left(\frac{1}{650} - \frac{1}{298}\right)$$

$$\ln\frac{k_2}{1.66} = -24.6947$$

$$\frac{k_1}{1.66} = e^{-24.6947}$$

$k_1 = 3.12 \times 10^{-11}\ M^{-1}s^{-1}$

3. In a first-order decomposition reaction, 50.0% of a compound decomposes in 10.5 minutes.

a. (5 Pts) What is the value of the rate constant (be sure to include proper units)?

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

$$\ln 0.5 = -k(10.5\ \text{min})$$

$k = 0.0660\ \text{min}^{-1}$

b. (5 Pts) How long does it take for 75.0% of the compound to decompose?

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

$$\ln 0.25 = -0.0660\,(t)$$

$t = 21.0$ min

c. (2 Pts) What is the half-life of the reaction?

10.5 min