CHM152/54 Quiz #2a 25 Pts Fall 10 Name: Key

Show work where possible rate = k rate = k[A]^2 $[A]_t = -kt + [A]_0$ $\ln[A]_t = -kt + \ln[A]_0$ $1/[A]_t = kt + 1/[A]_0$

$t_{1/2} = 0.693/k$ $t_{1/2} = 1/(k[A]_0)$ $\ln\frac{k_2}{k_1} = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$ R = 8.314 J/mol·K

1. The reaction $H_2(g) + I_2(g) \rightarrow 2HI(g)$ was found to have the following rate constant values: @556 K, k = 1.2 x 10^{-4} $M^{-1}s^{-1}$ and @ 666 K, k = 3.8 x 10^{-2} $M^{-1}s^{-1}$.

a. (6 Pts) Determine the activation energy.

$$\ln\frac{1.2\times10^{-4}}{3.8\times10^{-2}} = \frac{E_a}{8.314\,\text{J/mol·K}}\left(\frac{1}{666} - \frac{1}{556}\right)$$

$E_a = 160000$ J/mol or 1.6×10^5 J/mol

161 kJ/mole

b. (6 Pts) At what temperature will the rate constant have a value of 1.0 x 10^{-3} $M^{-1}s^{-1}$?

$$\ln\frac{1.0\times10^{-3}}{1.2\times10^{-4}} = \frac{1.6\times10^{5}}{8.314}\left(\frac{1}{556} - \frac{1}{T_2}\right)$$

$T_2 = 592$ K

2a. (3 Pts) Determine the rate constant for a first order reaction with a half-life of 15.5 days.

$t_{1/2} = \frac{\ln 2}{k}$ $k = \frac{\ln 2}{t_{1/2}} = \frac{0.693}{15.5\text{ days}} = 0.0447\text{ days}^{-1}$

b. (4 Pts) How long will it take for the concentration the reactant in problem 2a to reach 90% of its starting concentration?

$\ln[A]_t = -kt + \ln[A]_0$

$\ln[0.90] = -0.0447\text{ days}^{-1}\, t + \ln[1]$

$t = 2.36$ days

3. (6 Pts) A reaction that is second order in one reactant has a rate constant of 1.0 × 10^{-2} L mol^{-1} s^{-1} at 25 °C. If the initial concentration of the reactant is 0.100 M, how long will it take for the concentration to become 0.0500 M?

$\frac{1}{[A]_t} = kt - \frac{1}{[A]_0}$

$\frac{1}{0.0500} = 1.0\times10^{-2}\,M^{-1}s^{-1}(t) - \frac{1}{0.100}$

$t = 1000$ seconds