CHM152 Quiz2 25 Pts Fall 2017 **Name:** Key

Show all Work to Receive Credit

rate = k   rate = k[A]   rate = k[A]^2 $[A]_t = -kt + [A]_0$ $\ln[A]_t = -kt + \ln[A]_0$ R= 8.314 J/(mol•K)

$1/[A]_t = kt + 1/[A]_0$ $t_{1/2} = [A]_0/2k$ $t_{1/2} = 0.693/k$ $t_{1/2} = 1/k[A]_0$ $\ln\frac{k_1}{k_2} = \frac{E_a}{R}(\frac{1}{T_2} - \frac{1}{T_1})$ e=mc^2

1.(2 Pts) What is the overall order of the reaction is 2nd

$CO(g) + NO_2(g) \rightarrow CO_2(g) + NO(g)$ if it proceeds via the following rate expression?

$$\frac{\Delta[CO_2]}{\Delta t} = k[CO][NO_2]$$

2.(6 Pts) Calculate the activation energy, E_a for $N_2O_5(g) \rightarrow 2\ NO_2(g) + 1/2\ O_2(g)$

given k (at 25°C) = 3.46×10^{-5} s^{-1} and k (at 35°C) = 1.48×10^{-4} s^{-1}.

$$\ln\frac{3.46 \times 10^{-5}}{1.48 \times 10^{-4}} = \frac{E_a}{8.314}\left(\frac{1}{308} - \frac{1}{298}\right)$$

$$E_a = 111\ \frac{kJ}{mol}$$

3.(6 Pts) For a given reaction, the activation energy is 19.0 kJ/mol. If the reaction rate constant is 8.30×10^{-3} M^{-1}s^{-1} at 298 K, what is the reaction rate constant at 348 K?

$$\ln\frac{k_2}{8.30 \times 10^{-3}} = \frac{19.0 \times 10^3\ J/mol}{8.314\ J/mol}\left(\frac{1}{298} - \frac{1}{348}\right)$$

$$\ln\frac{k_2}{8.30 \times 10^{-3}} = 1.1018\ldots$$

$$\frac{k_2}{8.30 \times 10^{-3}} = e^{1.1018\ldots}$$

$$k_2 = 2.50 \times 10^{-2}\ M^{-1}, s^{-1}$$

More on Back

Key

4.(5 Pts) In basic solution, $(CH_3)_3CCl$ reacts according to the equation below.

$$(CH_3)_3CCl + OH^- \rightarrow (CH_3)_3COH + Cl^-$$

The accepted mechanism for the reaction is

$(CH_3)_3CCl \rightarrow (CH_3)_3C^+ + Cl^-$ (slow)
$(CH_3)_3C^+ + OH^- \rightarrow (CH_3)_3COH$ (fast)

What is the rate law for the reaction?

$$\text{rate} = k\left[(CH_3)_3CCl\right]$$

5.(6 Pts)Nitrogen monoxide reacts with chlorine to produce NOCl.

$$2\,NO(g) + Cl_2(g) \rightarrow 2\,NOCl(g)$$

A proposed mechanism for this reaction is

$NO(g) + NO(g) \rightleftharpoons N_2O_2^{\ddagger}(g)$ (fast, equilibrium)
$N_2O_2^{\ddagger}(g) + Cl_2(g) \rightarrow 2\,NOCl(g)$ (slow)

What is a rate law that is consistent with this mechanism?

from slow: $\text{rate} = k_2[N_2O_2^{\ddagger}][Cl_2]$

from fast: $k_1[NO]^2 = k_{-1}[N_2O_2^{\ddagger}]$

so: $\dfrac{k_1}{k_{-1}}[NO]^2 = [N_2O_2^{\ddagger}]$

Substitution for the intermediate in slow rate law gives

$$\text{rate} = \frac{k_2 k_1}{k_{-1}}[NO_2]^2[Cl_2]$$