CHM152 Quiz 2 Falll 2018 25 Pts 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/(molK)

$$\ln\frac{k_1}{k_2} = \frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

$1/[A]_t = kt + 1/[A]_0$ $t_{1/2} = [A]_0/2k$ $t_{1/2} = 0.693/k$ $t_{1/2} = 1/k[A]_0$

1) (5 Pts) A nuclear stress test utilizes a gamma-emitting radioisotope such as thallium-201 to follow the flow of blood through the heart – first at rest, and then under stress. The first-order rate constant for the decay of thallium-201 is 9.5 x 10^{-3} hr^{-1}. Calculate how long it takes for the amount of thallium-201 to fall to 5.0% of its original value.

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

$$\ln\frac{5}{100} = -9.5\times10^{-3}\,t$$

$t = 3\underline{1}5$ hr or $3\underline{2}0$ hrs

2) (3 Pts) The following mechanism has been suggested for the reaction:

$H_2O_2 + 2H^+ + 2I^- \rightarrow I_2 + 2H_2O$

$H_2O_2 + I^- \rightarrow HOI + OH^-$ *Slow*

$OH^- + H^+ \rightarrow H_2O$ *Fast*

$HOI + H^+ + I^- \rightarrow I_2 + H_2O$ *Fast*

rate = $k[H_2O_2][I^-]$

Identify a rate law that is consistent with this mechanism.

3) (3 Pts) Nitrous oxide (N_2O) decomposes at 600°C according to the balanced equation

$2N_2O(g) \rightarrow 2N_2(g) + O_2(g)$

A reaction mechanism involving three steps is shown below. Identify all of the catalysts in the following mechanism.

$Cl_2(g) \rightarrow 2Cl(g)$

$N_2O(g) + Cl(g) \rightarrow N_2(g) + ClO(g)$ (occurs twice)

$ClO(g) + ClO(g) \rightarrow Cl_2(g) + O_2(g)$

$\boxed{Cl_2}$

4) (6 Pts) The isomerization of cyclopropane follows first order kinetics. The rate constant at 700 K is 6.20×10^{-4} min^{-1}, and the half-life at 760 K is 29.0 min. Calculate the activation energy for this reaction.

Find k at 760: $k = \frac{\ln 2}{t_{1/2}} = 2.39\times10^{-2}\ min^{-1}$

$$\ln\frac{6.20\times10^{-4}}{2.39\times10^{-2}} = \frac{E_a}{8.314}\left(\frac{1}{760} - \frac{1}{700}\right)$$

$E_a = 265000$ J/mol or $2\underline{6}5$ kJ/mol

Key B-2

5) (5 Pts) Given that E_a for a certain biological reaction is 48 kJ/mol and that the rate constant is 2.5 $\times 10^{-2}$ s^{-1} at 15°C, what is the rate constant at 37°C?

15°C = 288 K   37°C = 310 K

$$\ln \frac{k_2}{2.5 \times 10^{-2}} = \frac{48 \times 10^3 \text{ J/mol}}{8.314 \text{ J/mol·K}} \left(\frac{1}{288} - \frac{1}{310} \right)$$

$$\ln \frac{k_2}{2.5 \times 10^{-2}} = 1.4226 \ldots$$

$$k_2 = 1.0 \times 10^{-1} \text{ s}^{-1}$$

6) (3 Pts) The following mechanism has been suggested for the reaction:

$H_2O_2 + 2H^+ + 2I^- \rightarrow I_2 + 2H_2O$

$H_2O_2 + I^- \rightarrow HOI + OH^-$	*Slow*
$OH^- + H^+ \rightarrow H_2O$	*Fast*
$HOI + H^+ + I^- \rightarrow I_2 + H_2O$	*Fast*

Identify all intermediates included in this mechanism.

HOI and OH^-