Quiz 2 Name: _____

Chem 1B, Spring 2020

Fossum

R = 8.314 J/mol•K

$$\ln\frac{[A]_t}{[A]_0} = -kt \qquad \frac{1}{[A]_t} = kt + \frac{1}{[A]_0} \qquad t_{1/2} = \frac{0.693}{k}$$

$$k = Ae^{-E_a/RT} \qquad \ln k = \frac{-E_a}{RT} + \ln A \qquad \ln\frac{k_1}{k_2} = \frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

Always show your work and reasoning, include units, and check significant figures.

1. (2) The attached graph shows the concentration of reactant A vs. time for a first order reaction. From the graph, estimate the value and units of the half-life of this reaction as precisely as possible.

2. (5) a. For a first order reaction, if it requires 35.8 minutes for the reactant concentration to drop from 0.200 M to 0.175 M, calculate the half-life of the reaction.

   b. Explain why your answer makes sense.

3. (4) Determine the rate law that is consistent with the following proposed mechanism. Show your work/reasoning. Remember that intermediates must not appear in the overall rate law. (All reactants and products are gases.)

   1. $O_3 \leftrightarrows O_2 + O$ (fast, equilibrium)
   2. $O + O_3 \rightarrow 2\,O_2$ (slow)

4. (4) a. Draw a sketch of the Boltzmann distribution for a sample at a low temperature and at a high temperature. Label the sketch.

b. Use this sketch to help explain the underlying reason(s) behind the effect of temperature on the rate of reaction.

5. (5) A reaction has a rate constant of 2.59×10^{-3} min^{-1} at 22°C. At 53°C, the rate constant is 4.17×10^{-2} min^{-1}. Calculate the activation energy of this reaction in kJ/mole.