Name(s) _____

Worksheet: Kinetics, Ea, and Energy Diagrams

Consider the reaction of the iodide ion and methyl bromide:

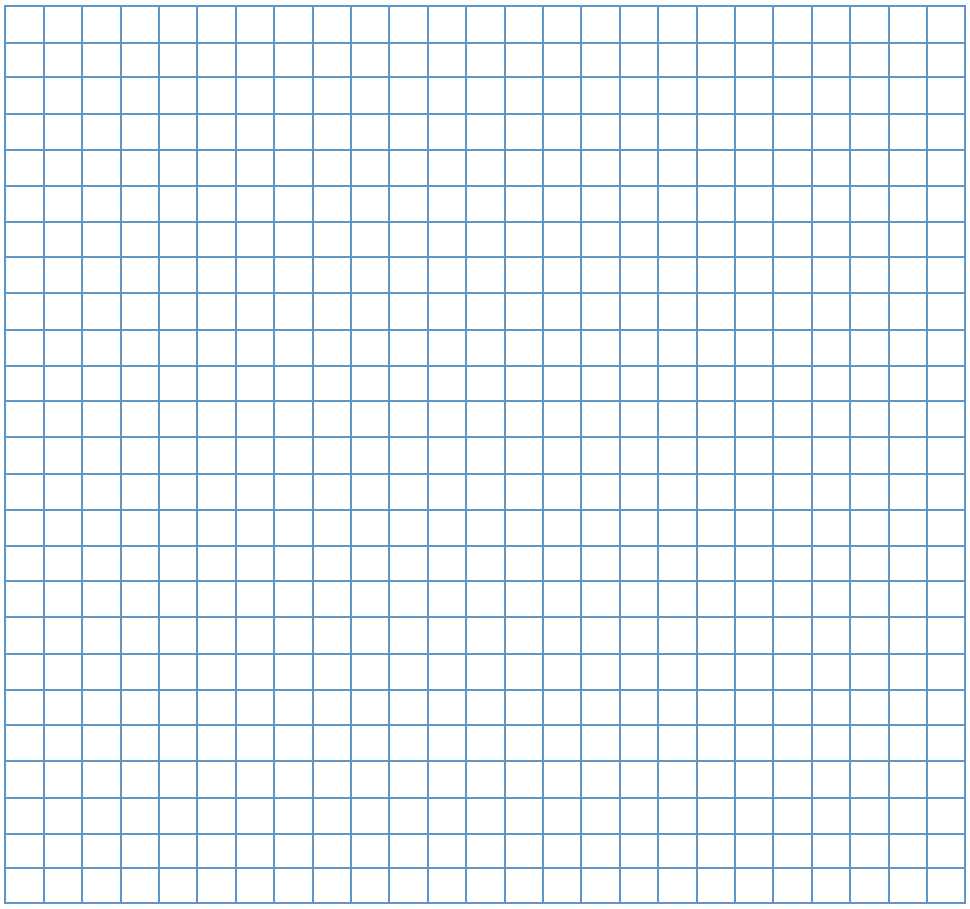
$$I^- + CH_3Br \rightarrow CH_3I + Br^-$$

Chemists believe that the only collisions that can result in a reaction are the ones where the iodide ion approaches the methyl bromide molecule from the opposite side of the location of the bromine atom.

The data below were collected for the reaction of iodide ion and methyl bromide:

T (K)	k (L/mol · s)
273	0.0000418
300	0.000860
340	0.00314
370	0.281

1. Plot the above data: ln k (y-axis) vs. 1/T(K) (x-axis) below. Label your plot.



(a) Determine the activation energy for this reaction. Clearly show your calculation.

(b) The rate law for the reaction is: rate = k $[I^-]$ $[CH_3Br]$

What is the overall order of reaction?

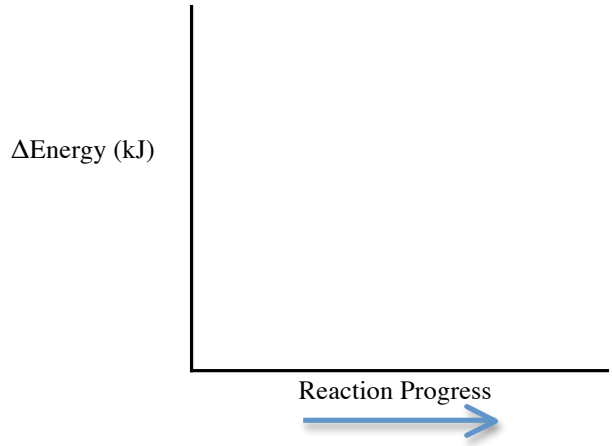
(c) If the concentration of each reactant is initially 0.100 M, how long will it take for the concentration of the reactants to drop to 0.050 M if the reaction takes place at 273 K? Show your calculation on a separate page and attach.

(d) How long will it take for the reaction at 370 K?

(e) What is the percent increase in reaction rate that results from increasing the reaction temperature from 273 K to 370 K?

(f) A rule of thumb used by chemists is that the rate of a reaction roughly doubles with each ten degree temperature increase. Does this reaction follow that rule of thumb?

2. The enthalpy of reaction is ΔH_{rxn} = -25 kJ/mol. Use the E_a value from 1(a) and complete the energy diagram for the reaction below using a solid line to indicate the reaction's path and clearly labeling arrows for ΔH_{rxn} and E_a



(a) A catalyst reduces the energy of activation by 75%. Using the E_a value from 1(a) provide a dashed --- line above to indicate the reaction's new path and clearly label an arrow for the new E_a

(b) If the concentration of each reactant is initially 0.100 M, how long will it take for the concentration of the reactants to drop to 0.050 M if the reaction takes place at 273 K using the catalyst? What is the percent increase in the rate vs. the rate in 1(c). Show your calculations.