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Reaction data from mixture D at three temperatures has been provided for you to determine the energy of activation for the reaction using Equation 2.

Data and Calculations

Table 1. Reactant Volumes and Reaction Times

Mixture	Volume (mL) of:				Time of reaction (sec)			Temp
	4.0 M acetone	1.0 M HCl	0.0050 M I_2	H_2O	1st run	2nd run	Ave time	°C
A	1.00	1.00	1.00	2.00				
B	2.00	1.00	1.00	1.00				
C	1.00	2.00	1.00	1.00				
D	1.00	1.00	0.50	2.50				
Your Mixture*								

*Note: Must add up to 5.0 mL; water is not required.

Table 2. Initial Concentration and Rate of Reaction

Mixture	$[\text{acetone}]_{ini}$	$[H^+]_{ini}$	$[I_2]_{ini}$	Rate = $[I_2]_{ini}$ / (ave time)
A				
B				
C				
D				
Your Mixture*				

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Part A: Reactant Order Determination

Calculate the value of m (order with respect to acetone) to TWO decimal places. This means you have to use logarithms. Show calculations. Then round off to the nearest integer to get the true value for m.

m = ________ (2 decimal places) m = ________ (nearest integer)

Calculate the value of n (order with respect to the H^+):

n = ________ (2 decimal places) n = ________ (nearest integer)

Calculate the value of p (order with respect to the I_2):

p = ________ (2 decimal places) p = ________ (nearest integer)

Write the overall rate law: ____

Part B: Determination of the Rate Constant, k

Given the values of m, n, and p, calculate the rate constant k (**with correct units**) for each mixture by simply substituting those orders, the initial concentrations, and the observed rate from the Table 2 above into Equation 3.

Table 3. Rate Constant, k

Mixture	A	B	C	D	average	Units of k
k						

Show calculations for k value of Mixture A:

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Part C: Prediction of Reaction Rate in Your Mixture

Initial concentrations (from Table 2):

$[\text{acetone}]_{ini}$ ___________ M $[H^+]_{ini}$ ___________ M $[I_2]_{ini}$ ___________ M

Calculate the predicted rate based on your determined rate law in Part A as well as your average rate constant (from Part B).

Predicted rate: ________________ M/sec

Calculate the predicted ***time*** (in seconds) for reaction based on $[I_2]_{ini}$ and the value for the predicted rate above using:

$\text{Rate} = [I_2]_{ini}$ **/** (time)

Predicted time: ___________ sec

Observed average time for reaction _________ sec (from Table 1 above)

Calculate the percent difference between the observed and predicted times below:

% difference: _______________

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Part D: Energy of Activation Determination

PROBLEM SET – Use provided data below

Fill Table 4 below.

Table 4. Reaction Rate Data for Mixture **D**.

Temp (^oC)	Temp (Kelvin)	Time (sec)	Rate = $[I_2]_{ini}$ / (time) *(**NOTE:** Use $[I_2]_{ini}$ from Mixture D)*
10.		208	
22		93	
40.		28	

Fill Table 5 below by calculating the rate constant at each temperature using rate from Table 4 above, initial concentrations for Mixture D (Table 2) and your experimentally determined rate law (from Part A).

Table 5. Calculated Values for Arrhenius Plot

Temperature	k	ln k *(y-axis)* (two decimal places)	1 / T *(x-axis)* (Kelvin^{-1})
10 °C			
22 °C			
40 °C			

Construct an Arrhenius plot by graphing ln k vs. 1 / T. Find the slope of the best fitting (straight) line through the points. Show your calculations below: Alternatively, you can use MS Excel to construct your graph; write the trendline equation below.

Slope = ___________ OR Trendline Equation (MS Excel): ______________________

From Equation 2, we see that the slope = $-E_a$ / R where R = 3.814 J / mol K. Use this relationship to calculate the value of E_a:

E_a = __________________ kJ / mol

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Pre-Lab Questions: The Iodination of Acetone

1. In a reaction involving the iodination of acetone, the following volumes were used to make up the reaction mixture.

   1.0 mL 4.0 M acetone + 1.0 mL 1.0 M HCl + 1.0 mL 0.0050 M I_2 + 2.0 mL H_2O

   a. Calculate the initial (diluted) concentration of acetone in the reaction mixture.

   $[\text{acetone}]_{ini}$ = __________

   b. Calculate the initial (diluted) concentration of the hydrogen ion, H^+, in the reaction mixture.

   $[H^+]_{ini}$ = __________

   c. Calculate the initial (diluted) concentration of iodine, I_2, in the reaction mixture.

   $[I_2]_{ini}$ = __________

2. Using the reaction mixture in Problem 1, a student found that it took 300 seconds for the color of the I_2 to disappear.

   a. What was the rate of the reaction?

   rate = ______________

   b. Given the rate from Part a and the initial concentrations of acetone, H^+ ion, and I_2 in the reaction mixture, write Equation 3 as it would apply to the mixture.

   rate =

   c. What are the unknowns that remain in the equation in Part b?

   ____________ ____________ ____________ ____________

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3. A second reaction mixture was made up in the following way:

   2.0 mL 4.0 M acetone + 1.0 mL 1.0 M HCl + 1.0 mL 0.0050 M I_2 + 1.0 mL H_2O

   a. What were the initial concentrations of acetone, H^+ ion, and I_2 in the reaction mixture?

      $[\text{acetone}]_{ini}$ __________ M; $[H^+]_{ini}$ __________ M; $[I_2]_{ini}$ __________ M

   b. It took 140 seconds for the I_2 color to disappear from the reaction mixture when it occurred at the same temperature as the reaction in Problem 2.

      What was the rate of the reaction? __________

      Write Equation 3 as it would apply to the second reaction mixture:

      rate =

   c. Solve for the value of m, the order of the reaction with respect to acetone. (Use the logarithm method and calculate the value of m to two decimal places and then round to the nearest integer.)

      m = _______ (2 decimal places) m = _______ (nearest integer)