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Name:________________

Kinetics Practice – Supplemental Worksheet

Determining reaction mechanism based on initial rate data

1. A reaction has the experimental rate law, rate = $k[A]^2$.
   a. How will the rate change if the concentration of a is tripled?

   b. How will the rate change if the concentration of A is halved?

2. A reaction has the experimental rate law, rate = k[A].
   a. How will the rate change if the concentration of a is tripled?

   b. How will the rate change if the concentration of A is halved?
3. Three mechanisms for the reaction $NO_2(g) + CO(g) \rightarrow CO_2(g) + NO(g)$ have been proposed:

   a. Mechanism A
      Step 1: $NO_2(g) + CO(g) \rightarrow CO_2(g) + NO(g)$
   b. Mechanism B
      Step 1: $NO_2(g) + NO_2(g) \rightarrow NO(g) + NO_3(g)$ (slow)
      Step 2: $NO_3(g) + CO(g) \rightarrow CO_2(g) + NO_2(g)$ (fast)
   c. Mechanism C
      Step 1: $NO_2(g) + NO_2(g) \rightarrow NO(g) + NO_3(g)$ (fast, equilibrium)
      Step 2: $NO_3(g) + CO(g) \rightarrow CO_2(g) + NO_2(g)$ (slow)

   Which mechanism agrees with the following initial rate data:

Experiment number	Initial $[NO_2]$ (mol/L)	Initial [CO] (mol/L)	Initial Rate (M/s)
1	0.133	0.074	0.144
2	0.399	0.074	1.296
3	0.133	0.370	0.144

4. Three mechanisms for the reaction $O_2(g) + 2\ NO(g) \rightarrow 2\ NO_2(g)$ have been proposed:

   a. Mechanism A
      Step 1: $O_2(g) + NO(g) \rightarrow NO_3(g)$ (fast, equilibrium)
      Step 2: $NO_3(g) + NO(g) \rightarrow NO_2(g) + NO_2(g)$ (slow)
   b. Mechanism B

Step 1: $NO(g) + NO(g) \rightarrow N_2O_2(g)$ (slow)
Step 2: $O_2(g) + N_2O_2(g) \rightarrow N_2O_4(g)$ (fast)
Step 3: $N_2O_4(g) \rightarrow NO_2(g) + NO_2(g)$ (fast)

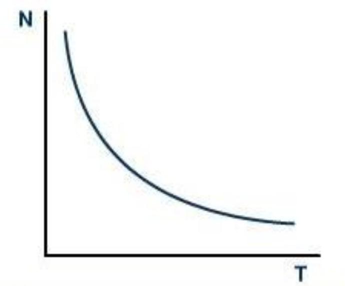
Which mechanism agrees with the following initial rate data:

Experiment number	Initial $[O_2]$ (mol/L)	Initial [NO] (mol/L)	Initial Rate (M/s)
1	0.210	0.122	0.136
2	0.420	0.122	0.272
3	0.210	0.244	0.544

Going from rate laws to the integrated rate equations

5. The rate law for the reaction $C_4H_9Cl + H_2O \rightarrow C_4H_9OH + HCl$ is rate = $k[C_4H_9Cl]$.
   a. What would the integrated rate equation look like for this reaction?

   b. How would a plot of this equation look?



   c. How could you find k from the plot?

6. The rate law for the reaction $2\ NO_2 \rightarrow 2\ NO + O_2$ is rate = $k[NO_2]^2$.
   a. What would the integrated rate equation look like for this reaction?
   b. How would a plot of this equation look?
   c. How could you find k from the plot?

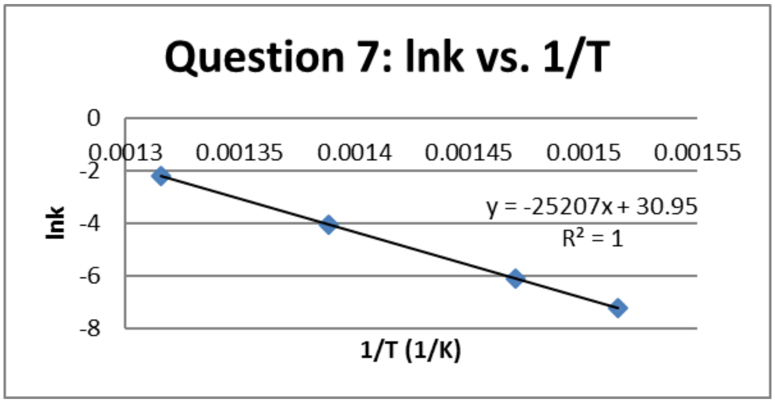
Activation Energy

7. Given the data below for the reaction of the decomposition of iodoethane into ethane and hydrogen iodide,

T (K)	k (s^{-1})
660	$7.2 * 10^{-4}$
680	$2.2 * 10^{-3}$

720	$1.7 * 10^{-2}$
760	0.11

a. Calculate the activation energy for the reaction.



b. What is the value of the rate constant at 400 °C?

8. Given the data below for the reaction of the conversion of cyclopropane into propene,

T (K)	**k (s^{-1})**
750	$1.8 * 10^{-4}$
800	$2.7 * 10^{-3}$
850	$3.0 * 10^{-2}$
900	0.26

a. Calculate the activation energy for the reaction.

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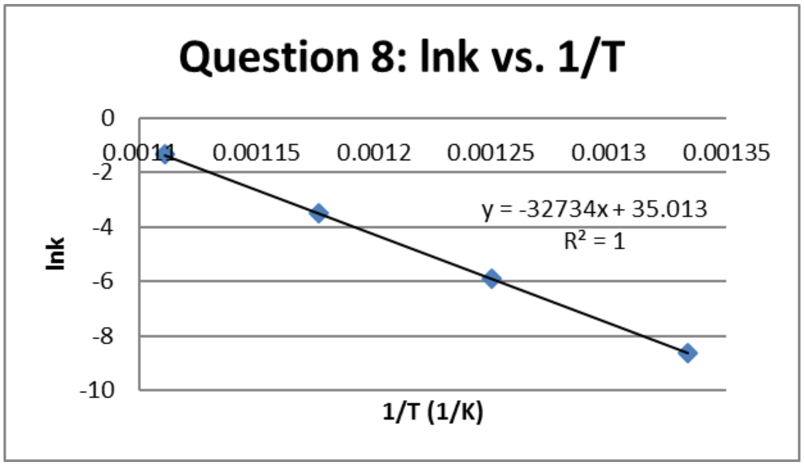

b. What is the value of the rate constant at 600 °C?