1. Experimental data for the one-step reaction A → B + C have been plotted in three different ways:

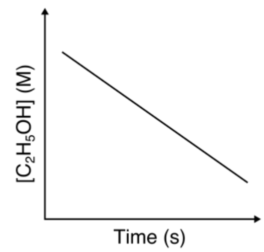
    i. $\frac{1}{[A]}$ vs. time, which gives a straight line with a positive slope
    ii. [A] vs. time, which gives a curved line
    iii. ln[A] vs. time, which gives a curved line

    Based on these plots, write the rate law for this reaction and determine the units of *k*.

2. The decomposition of ethanol (C_2H_5OH) on an alumina (Al_2O_3) surface was studied at 400 K.

    $$C_2H_5OH\ (g) \rightarrow C_2H_4\ (g) + H_2O\ (g)$$

    You plot the data and obtain a straight-line relationship (shown to the right) with a slope of -4.00×10^{-5} M/s.



    A) What is the half-life if the initial concentration of C_2H_5OH is 1.25×10^{-2} M?

    B) Determine the time required for 1.25×10^{-2} M C_2H_5OH to completely decompose?

3. The activation energy (E_a) for the following reaction is 32 kJ/mol and ΔE is –17 kJ/mol.

    $$NO_2\ (g) + CO\ (g) \rightarrow NO\ (g) + CO_2\ (g)$$

    Assuming, this is a single-step reaction, draw and label an energy diagram for this reaction and calculate the activation energy for the reverse reaction (E_a').

4. Recall this reaction from last week's discussion:

$$2\ NO\ (g) + O_2\ (g) \rightarrow 2\ NO_2\ (g)$$

A) Re-determine the rate law for the reaction using the new initial rates data.

Experiment	$[NO]_0$ (M)	$[O_2]_0$ (M)	Initial Rate (M/s)
1	0.10	0.20	4.1×10^2
2	0.20	0.10	8.2×10^2
3	0.10	0.30	6.15×10^2

B) Which of the following are valid mechanisms for the reaction above?

Mechanism 1:
- *step 1)* $NO\ (g) + O_2\ (g) \rightarrow NO_2\ (g) + O\ (g)$ (slow)
- *step 2)* $NO\ (g) + O\ (g) \rightarrow NO_2\ (g)$ (fast)

Mechanism 2:
- *step 1)* $2\ NO\ (g) \rightarrow N_2O_2\ (g)$ (fast)
- *step 2)* $N_2O_2\ (g) + O_2\ (g) \rightarrow 2\ NO_2\ (g)$ (slow)

Mechanism 3:
- *step 1)* $2\ NO\ (g) \rightarrow N_2\ (g) + O_2\ (g)$ (fast)
- *step 2)* $N_2\ (g) + 2\ O_2\ (g) \rightarrow 2\ NO_2\ (g)$ (slow)

Mechanism 4:
- *step 1)* $NO\ (g) + O_2\ (g) \rightarrow NO_3\ (g)$ (fast)
- *step 2)* $NO_3\ (g) + NO\ (g) \rightarrow 2\ NO_2\ (g)$ (slow)

Mechanism 5:
- *step 1)* $NO\ (g) + O_2\ (g) \rightleftharpoons NO_3\ (g)$ (fast)
- *step 2)* $NO_3\ (g) + NO\ (g) \rightarrow 2\ NO_2\ (g)$ (slow)

Mechanism 6:
- *step 1)* $2\ NO\ (g) \rightarrow N_2O_2\ (g)$ (fast)
- *step 2)* $N_2O_2\ (g) \rightarrow NO_2\ (g) + N\ (g)$ (slow)
- *step 3)* $N\ (g) + O_2\ (g) \rightarrow NO_2\ (g)$ (fast)

5. The following reaction is studied at 37.0 °C

$$H_2NCONH_2 + 3\ H_2O \rightarrow 2\ NH_4^+ + OH^- + HCO_3^-$$

A) You find the activation energy for the uncatalyzed reaction to be 138 kJ/mol. Calculate the rate constant, k_{uncat}, for the uncatalyzed reaction at 37.0 °C assuming the frequency factor is equal to A = $8.66 \times 10^{12}\ s^{-1}$.

B) Adding the catalyst, urease, you find the activation energy for the catalyzed reaction to be 38.0 kJ/mol. Calculate the rate constant, k_{cat}, for the catalyzed reaction at 37.0 °C assuming the frequency factor is equal to A = $8.66 \times 10^{12}\ s^{-1}$.

C) Calculate the temperature, theoretically, you would need to heat the uncatalyzed reaction in order for the rate of the uncatalyzed reaction to be equal to the rate of the catalyzed reaction at 37.0 °C.

Assume the overall rate order, concentrations, and frequency factor (A) are constant between the catalyzed and uncatalyzed reactions.