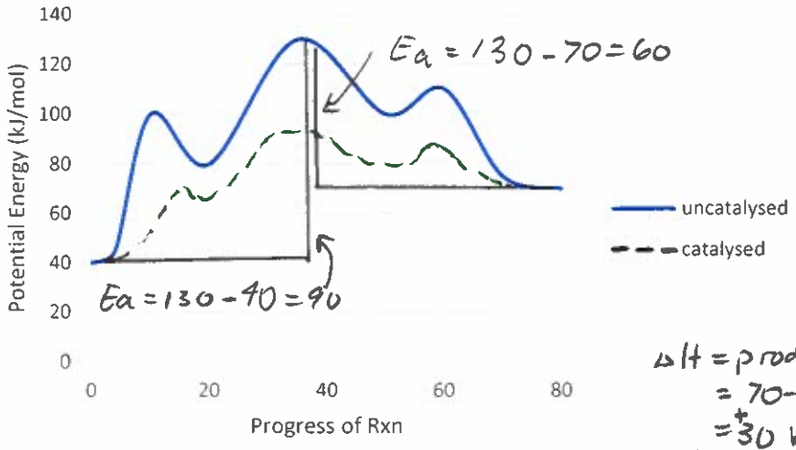
CHEMICAL KINETICS – IV **Name:** _____

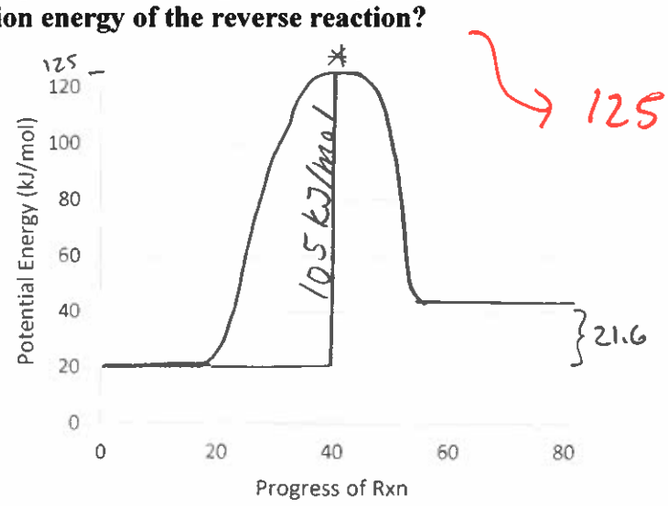
1. The progress of the reaction curve shown below is for a hypothetical reaction. Use it to answer the questions in #1.



ΔH = products − reactants
= 70 − 40
= +30 kJ/mol

a. What is the <u>overall</u> activation energy for this reaction? 90 kJ/mol
b. What is the <u>overall</u> activation energy for the reverse reaction? 60 kJ/mol
c. Is the forward reaction exothermic or endothermic? Explain how you know. endo
d. What is the ΔH for the forward reaction? +30 kJ/mol
e. What is the ΔH for the reverse reaction? -30 kJ/mol
f. Trace the curve (using the above grid) that might result if a catalyst were added to this system.

In the reaction involving the production of nitric oxide: $N_{2\,(g)} + O_{2\,(g)} \rightarrow 2\,NO_{(g)}$ The ΔH = + 21.6 kcal/mole of NO. The activation energy is 105 kcal/mole of NO. Trace the potential energy diagram for this reaction using the graph below. ~~Put a scale on the y-axis~~ and indicate where the activated complex forms. **What is the activation energy of the reverse reaction?**



3. $NH_4^+{}_{(aq)} + NO_2^-{}_{(aq)} \rightarrow N_{2\,(aq)} + 2\,H_2O_{(l)}$

Ex. #	$[NH_4^+{}_{(aq)}]$	$[NO_2^-{}_{(aq)}]$	Rate (mol/Ls)
1	0.100 M	0.0050 M	1.35×10^{-7}
2	0.100 M	0.010 M	2.70×10^{-7}
3	0.200 M	0.010 M	5.40×10^{-7}

① rate = $k[NH_4^+][NO_2^-]$

Step 1: write the rate equation:
Step 2: Compare experiment #1 & #2, then compare #2 & #3 to find the exponents.
Step 3. Use any experiment to find "k".
Step 4: Check your k value with another experiment.

② rate 1 / rate 2

$$\frac{1.35\times10^{-7}}{2.70\times10^{-7}} = \frac{k(0.100)^x(0.0050)^y}{k(0.100)^x(0.010)^y}$$

$$0.5 = \left(\frac{0.005}{0.01}\right)^y$$

$$0.5 = 0.5^y$$

$$y = 1$$

rate 2 / rate 3

$$\frac{2.70\times10^{-7}}{5.40\times10^{-7}} = \frac{k(0.100)^x(0.010)^y}{k(0.200)^x(0.010)^y}$$

$$0.5 = \left(\frac{0.100}{0.200}\right)^x$$

$$0.5 = 0.5^x$$

$$x = 1$$

③ rate = $k[NH_4^+][NO_2^-]$

$$1.35\times10^{-7}\ \frac{M}{s} = k(0.100\,M)(0.0050\,M)$$

$$1.35\times10^{-7}\ \frac{M}{s} = k(0.00050\,M^2)$$

$$k = 2.7\times10^{-4}\ \frac{1}{M\,s} \text{ or } \frac{L}{mol\,s}$$

④ rate 3 = $2.7\times10^{-4}(0.200)(0.010)$
= 5.4×10^{-7} ✓