Answer the following short questions as completely and succinctly as you can. Questions that cover a whole page are valued at 10 points and the rest at 5 points each. This exam should be completed within the class period, 3:15 - 4:30 PM. It is also set to coincide with this time limit.

(a) In general catalytic mechanisms, describe the scenario that can deliver an Arrhenius intermediate and a van’t Hoff intermediate. Derive and isolate the special case that can deliver specific acid catalysis.
(a) In a flow system, reactants continuously enter and both reactants and products continuously exit the reaction zone. Give a brief derivation of how one can convert a temporal variable into a spatial variable and vice-versa.
(b) Briefly describe the stopped-flow technique and how it differs from quenched flow.

(c) What inherent advantage does a relaxation technique have over the stopped-flow technique and what is its biggest drawback?
(d) By a short derivation, prove that for a simple reaction $A \rightleftharpoons B$; the relaxation technique delivers kinetics data which are intractable with respect to an evaluation of the forward and reverse rate constants. How can these values be finally deduced?
The following reaction was studied by NMR line broadening $\text{Co(II)(ttt) + Co(III)(ttt)Cl} \rightleftharpoons \text{Co(III)(ttt)Cl + Co(II)(ttt)}$ by observing the p-Me line shapes. Roughly give the expected changes in line widths in going through slow, intermediate and fast exchange regions. Briefly explain the bifurcation sequence.
(f) How can we utilize competition methods to completely circumvent having to perform kinetics experiments and yet still produce accurate rate constants? Use, as an example competition for Cr(II) by two Co(III) complexes A and B with bimolecular rates constants $k_A$ and $k_B$ resp.?
(g) What are the fundamental differences between a transition state and an intermediate?

(h) The oxidation of HCrO$_4^-$ by H$_2$O$_2$ to give CrO$_3$ is seemingly third order overall and first order in HCrO$_4^-$, H$^+$ and H$_2$O$_2$. Devise a possible mechanism that may support such kinetics.
(i) The oxidation of iodide by acidified chlorite in excess iodide: \( \text{ClO}_2^- + 4\Gamma^- + 4H^+ \rightarrow \text{Cl}^- + 2\Gamma_2 + 2H_2O \) has a rate which is first order in all three reagents. What possible wrong conclusion might one arrive at if both acid and iodide are adjusted in the reaction system by addition of HI?

(j) There is very little to chose from between enthalpy of activation and activation energy. Using the transition state theory, prove that the enthalpy of activation is always higher, and that at room temperatures, this is approximately 10 kJ mol\(^{-1}\).
(k) Composite rate constants that are products or quotients will still deliver linear temperature profiles; is this correct?

(l) The following equation is derivable from volume of activation data: \( \ln(k) = \ln(k_0) - P(\Delta V^0/RT) \).
Assuming a \( \Delta V^0 \) of 7.0 dm\(^3\) mol\(^{-1}\); compute the pressure one might need, from initial pressure of 1 bar, to double the rate constant? (\( k_0 \) is rate constant at 1 bar).
(m) The observation of a bridged complex does not necessarily suggest inner sphere kinetics. By a suitable scenario, prove if this assertion is correct.

(n) In acid-base catalysis, the following equation holds: \( \log k = \log k_0 + k_{H^+} [H^+] + k_{OH^-} [OH^-] \). Attempt to explain why the transition between slope -1 and 0 in the plot of \( \log k \) vs. pH is not sharp.