Mock Exam 3 Part II

1. For a reaction A ⇆ B.

a. If you start with 4.00 M solution of A (and no B), draw a plot of concentration v time for [A].

b. On the same graph, show how [B] changes over the same time.

   Explain the difference (if any)

c. Now imagine that the reaction comes to equilibrium at t = 30 mins. **The equilibrium constant K = 3.** Redraw the plot, from 0 – 60 mins to show how the concentrations change.

d. Now imagine that at t = 40 mins you add some more of the reactant A – draw a new graph showing how the [A] and [B] would change (don't worry about exact quantities here).

2. The reaction of CH_3Br with ^-OH has a rate equation: rate = $k[CH_3Br][^-OH]$

a. What does this tell you about the mechanism of the reaction? (i.e. the sequence of events at the molecular level that leads from reactants to products)

b. Draw a **fully labeled** reaction profile for this reaction – assuming it is exothermic.

3. Draw a reaction profile for an endothermic three step reaction where the first step has a low activation energy and the second step is the rate determining step.

4. Explain why reaction rates depend on each of the following.

a. concentration of reactants

b. the temperature

c. the type of reaction

d. the presence of a catalyst

5. For the reaction
N_2 (g) + $3H_2$ (g) ⇄ $2NH_3$ (g) ΔH = + 65 kJ

What effect would the following have on the position of equilibrium (shift → or ←, or NC). Explain why each action would result in the change you report.

a. adding ammonia

b. increasing the pressure

c. increasing the temperature

d. adding a catalyst

e. adding helium

6. Carbonic acid (H_2CO_3) is a weak acid with a pKa of 6.5 (for ionization of the first proton).

a. Draw out the reaction of carbonic acid to show ionization of one proton.

b. What will the predominant species in H_2CO_3 at pH of 7.5?

c. What would be the pH of a buffer that is 1.5 M in H_2CO_3 and 1.0 M in $NaHCO_3$?

d. What would be the pH if 0.05 mol NaOH was added to 1.0 L of this buffer?