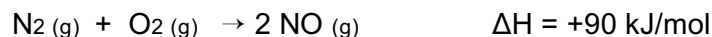Potential Energy diagrams

1. Nitrogen and oxygen gas react to produce poisonous nitrogen monoxide. Assume the activation energy for the forward reaction is 270 kJ.

$$N_2 \text{ (g)} + O_2 \text{ (g)} \rightarrow 2 \text{ NO (g)} \qquad \Delta H = +90 \text{ kJ/mol}$$

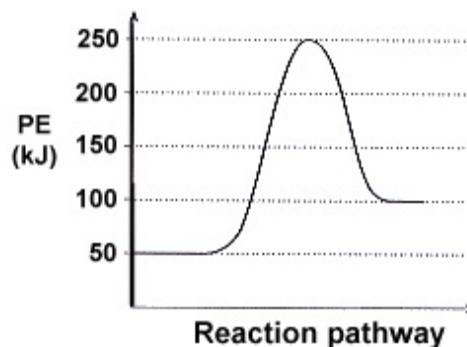(a) Sketch a potential energy diagram for the reaction.

Be sure to label the:
*   reactants and the products
*   heat of reaction
*   activated complex
*   activation energy of the forward
    and reverse reactions.

(b) Is the forward reaction endothermic or exothermic. _____

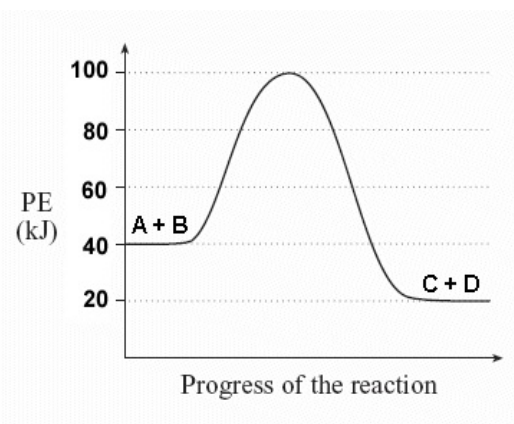(c) Consider the activation energy of the forward reaction. Is the forward reaction fast or slow? Why?

2. Answer the following questions based on the potential energy diagram shown here:
a) Does the graph represent an endothermic or exothermic reaction?

b) Label the postion of the reactants, products, and activated complex.

c) Determine ΔH for the reaction. _____

d) Determine the activation energy, E_a, for the:

       forward reaction _____
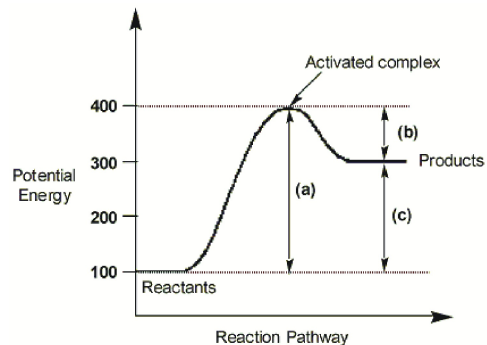
       reverse reaction _____

Reaction pathway

3. Complete the following based on the potential energy diagram below.
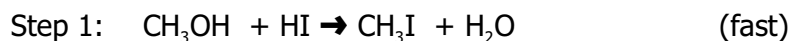
a) type of reaction: **endothermic** or **exothermic** ?

b) E_a for the: forward reaction _____

                   reverse reaction _____

c) ΔH for the reaction is _____

Progress of the reaction

4.   Fully describe the reaction shown by the diagram below:

Activated complex

400 ···

(b)

300 ─   Products

Potential   (a)
Energy
200 ─   (c)

100 ─

Reactants

Reaction Pathway

5.   Consider this proposed reaction mechanism and overall equation:

Step 1: $CH_3OH + HI \rightarrow CH_3I + H_2O$ (fast)

Step 2: $CH_3I + CO \rightarrow CH_3COI$ (slow)

Step 3 : $CH_3COI + H_2O \rightarrow CH_3COOH + HI$ (fast)

_____

Overall:

(a) Write the overall equation.

(b) The Rate-Determining Step is Step _____.

(c) Identify three reaction intermediates _____.

(d) Identify the catalyst _____

(e) Which step has the highest activation energy? _____

(f) Sketch a potential energy diagram for this
reaction mechanism. Assume that the heat of
reaction is -80 kJ.
     `(Hint: three bumps – watch relative size.)

(g) What happens to the overall rate if we increase the concentration of:

    i) CO _____

    ii) HI _____