Drawing a Potential Energy Diagram

Sample Problem

Carbon monoxide, $CO(g)$, reacts with nitrogen dioxide, $NO_2(g)$. Carbon dioxide, $CO_2(g)$, and nitrogen monoxide, $NO(g)$, are formed. Draw a potential energy diagram to illustrate the progress of the reaction. (You do not need to draw your diagram to scale). Label the axes, the transition state, and the activated complex. Indicate the activation energy of the forward reaction, $E_{a(fwd)} = 134$ kJ, as well as $\Delta_rH = -226$ kJ. Calculate the activation energy of the reverse reaction, $E_{a(rev)}$, and show it on the graph. Because the reaction is going in the reverse direction, Δ_rH would be positive.

Solution

The activation energy of the reverse reaction may be determined using the formula described on page 407, or it can be determined from the potential energy diagram. The reaction is exothermic; therefore, the reverse reaction is endothermic.

$E_{a(rev)} = E_{a(fwd)} + \Delta_rH$
$= 134$ kJ $+ 226$ kJ
$= 360$ kJ

The activation energy of the reverse reaction is 360 kJ.

Potential Energy Diagram for CO + NO₂(g)
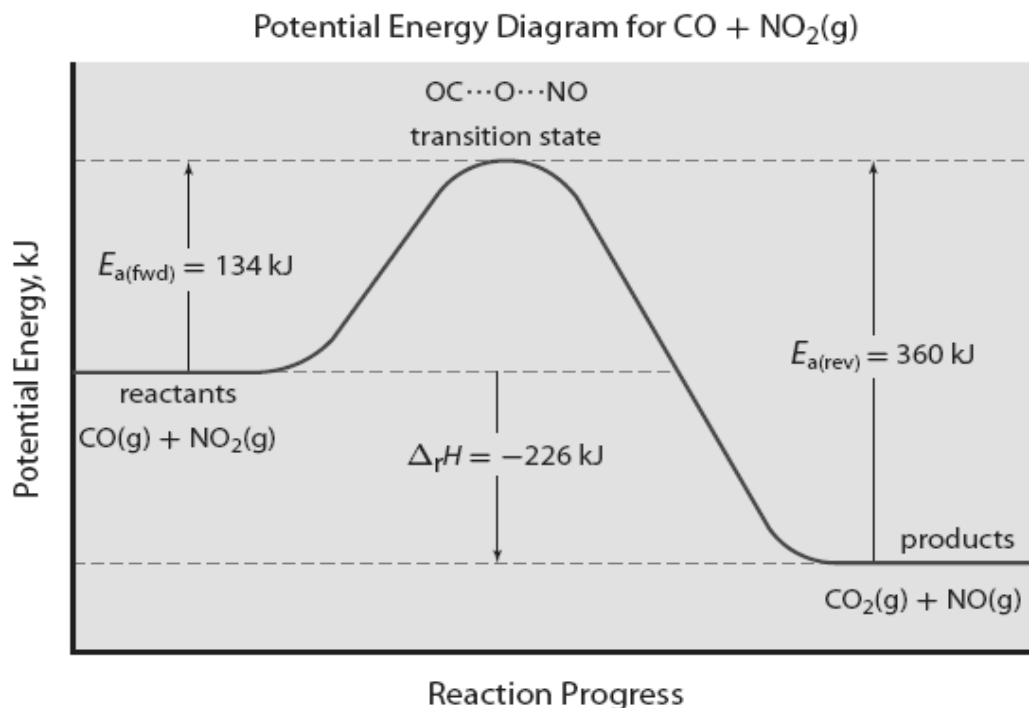
Using the potential energy diagram, you can confirm that the activation energy of the reverse reaction is 360 kJ.

Check Your Solution

Look carefully at the potential energy diagram. Check that you have labelled it completely. Since the forward reaction is exothermic, the reactants should be shown at a higher energy level than the products, and they are. The value of $E_{a(rev)}$ is reasonable.