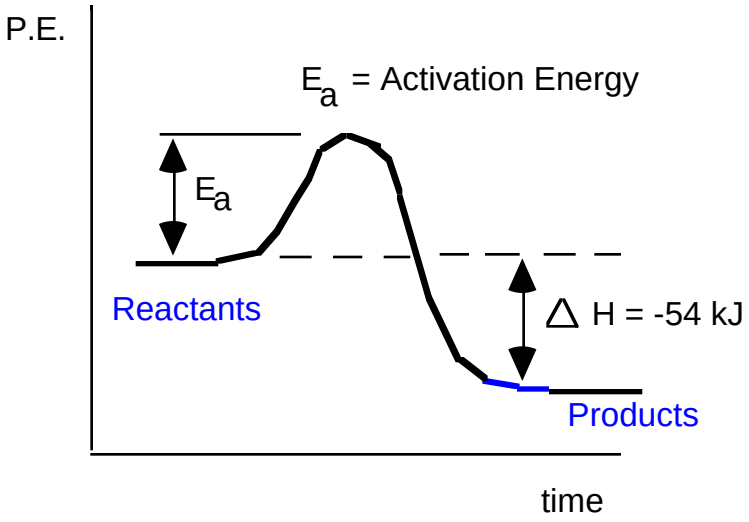
Chem12 Potential Energy Diagrams-10

Both **kinetic** and **potential energy** must be considered in any chemical reaction. KE is converted to PE during the collision as bonds are broken or formed. It requires energy to break a bond and if a bond is formed, energy is released. A certain minimum amount of energy is needed before a reaction will occur. This is called the **activation energy**.

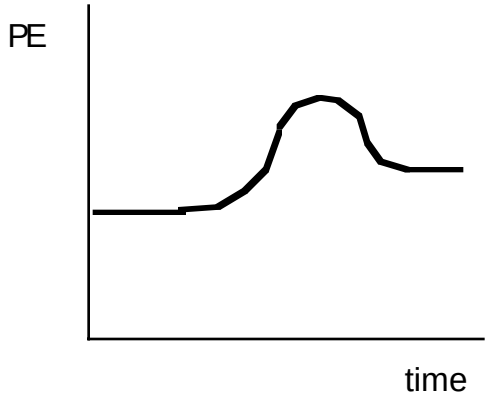
e.g. The exothermic reaction : $H_2(g) + I_2(g) \rightarrow 2HI(g)$ $\Delta H = -54kJ$, may be shown diagrammatically :



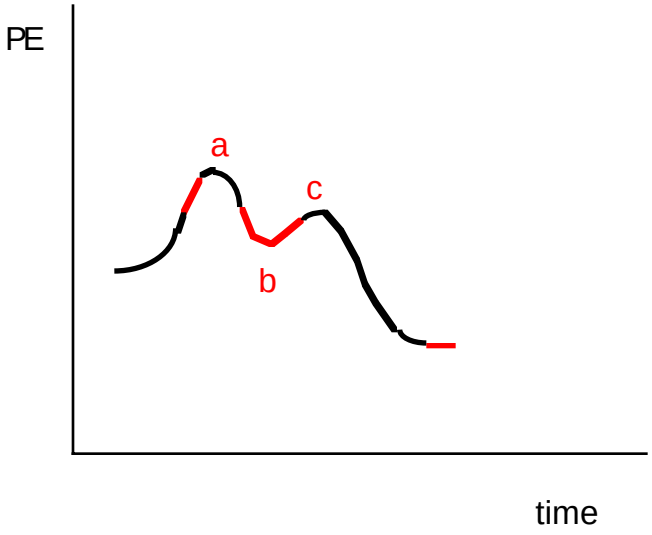
The change in enthalpy, ΔH, is equal to -54kJ. At the peak, an **activated complex** H_2I_2 is formed. The **activation energy** is the difference between the peak PE and the PE of the reactants.

Exercise 1 : What happens to the PE and KE of two reactant particles as they approach ?

The PE diagram for an endothermic reaction looks like this :

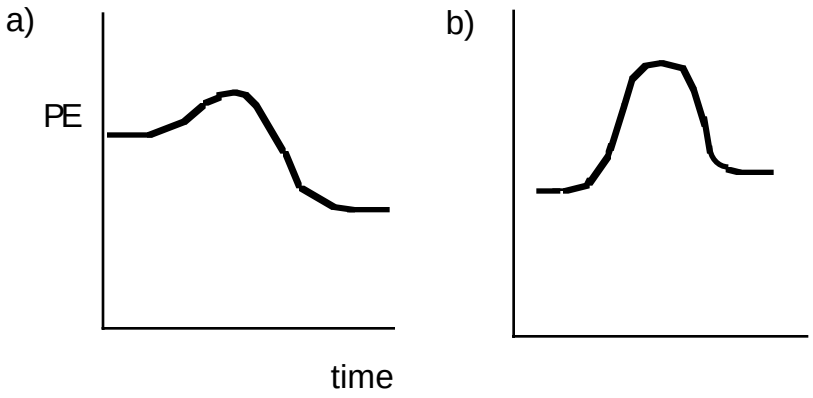


Some reactions may have two or more steps. An example of a two-step exothermic reaction is shown below.

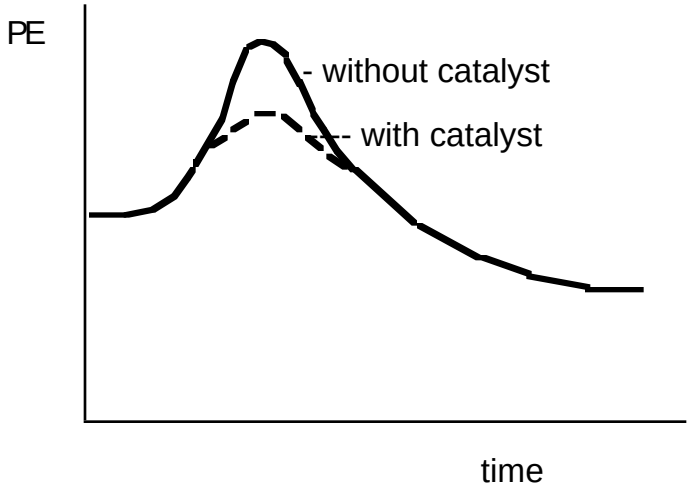


The step at "a" is called the **rate determining step**, since it will be slower, requiring a higher activation energy. At "a, b and c", species (atoms, molecules or ions) are short-lived. At "a and c", **activated complexes** are formed. At "b", a **reaction intermediate** is formed. Reaction intermediates are slightly longer lived than the activated complexes because their PE is lower.

Exercise 2 : State whether the reactions below are fast or slow, and exothermic or endothermic.



If a **<u>catalyst</u>** is used, the reaction proceeds much faster because it reduces the activation energy for the reaction. The catalyst is not used up and has no effect on the amount of energy that is absorbed or released. The catalyst speeds up both the forward and the reverse reactions.



Exercise 3 : Explain in terms of energy, why a catalyst can speed up a reaction.

Answers : 1) PE goes up, KE goes down, 2)a) fast, exo, b) slow, endo, 3) A catalyst lowers the activation energy. More successful collisions will occur.