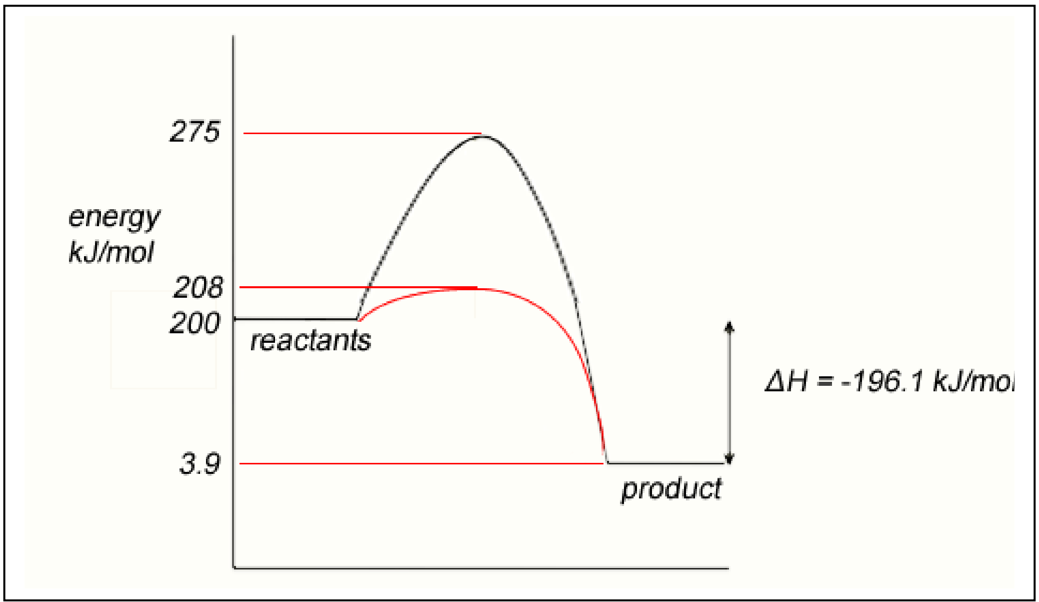
Friday Worksheet **Name: ………………**

Heat of reaction worksheet 5

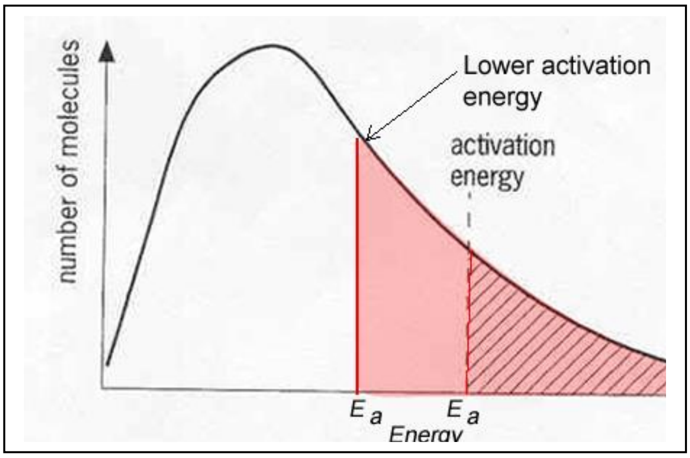
1) The decomposition of ammonia is represented by the following equation.
$2H_2O_2(aq) \Rightarrow 2H_2O(l) + O_2(g)$ $\Delta H = -196.1$ kJ mol^{-1}

a. The activation energy for the reaction is 75 kJ/mol in the absence of a catalyst. Catalase, which is an enzyme found in the liver, lowers the activation energy to 8 kJ/mol, which significantly increases the rate at which hydrogen peroxide is broken down at body temperature. On the grid provided below, draw a labelled energy profile diagram for the uncatalysed and catalysed reactions



b. When a platinum metal catalyst is used the activation energy drops to about 49 kJ/mol. Explain, using your knowledge of the relationship between kinetic energy and temperature, whether the reaction rate using the platinum catalyst will be greater than the enzyme catalysed reaction

The enzyme has an activation of 8kJ/mol, whereas the platinum catalyst has an activation energy of 49 kJ/mol, the lower the activation energy the greater the rate of reaction. This is because more reactant particles have the lower activation energy and so can react.



c. The following two statements, represent changes to a gaseous system associated with an increase in temperature.

i. At a higher temperature, particles move faster and the reactant particles collide more frequently.

ii. At a higher temperature, more particles have energy greater than the activation energy.

Which alternative below best explains why the observed reaction rate is greater at higher temperatures?

1) i only
2) i and ii equally.
3) ii only
4) i and to a lesser extent ii.

An increase in temperature will increases the average kinetic energy of the gaseous system and hence increase the number of collisions between reactant particles. However, it is the number of fruitful collisions that determines the rate of the reaction and molecules that have the minimum energy required to react, known as the activation energy, will undergo a fruitfull collisions resulting in the formation of product.

2) Consider the following two reactions

i. $N_2(g) + 2O_2(g) \Rightarrow 2NO_2(g)$ $\Delta H = +68$ kJ mol^{-1}

ii. $N_2(g) + 2O_2(g) \Rightarrow N_2O_4(g)$ $\Delta H = +10$ kJ mol^{-1}

If the activation energy for the following reaction ½ $N_2O_4(g) \Rightarrow NO_2(g)$ is 53.7 kJ/mol
What is the activation energy for the reverse reaction?

Using equations i. and ii. obtain the equation
½ $N_2O_4(g) \Rightarrow NO_2(g)$
Step 1 reverse ii.
$\Rightarrow$iii. $N_2O_4(g) \Rightarrow N_2(g) + 2O_2(g)$ $\Delta H = -10$ kJ mol^{-1}

Step 2 add iii. to i.
$\Rightarrow N_2O_4(g) \Rightarrow NO_2(g)$ $\Delta H = +58$ kJ mol^{-1}

Step 3 Find the ΔH of the reaction below
½ $N_2O_4(g) \Rightarrow NO_2(g)$
$\Rightarrow \Delta H = +29$ kJ mol^{-1}.

Step 4 Calculate the activation energy for the reverse reaction. It is easier to draw an energy profile diagram to visualise the reverse reaction.