SL & HL Questions on Collision theory

1. Describe how the collision theory leads to an understanding of the factors governing the rate of a chemical reaction.

2. Potassium manganate(VII) can oxidize oxalic acid according to the following equation.

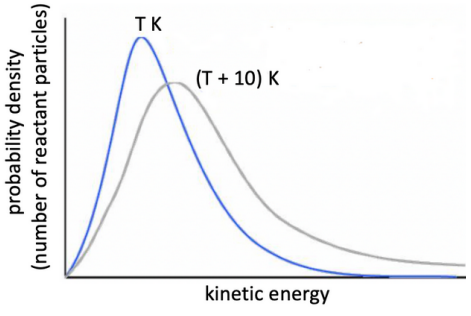
$$2MnO_4^-(aq) + 5C_2H_2O_4(aq) + 6H^+(aq) \rightarrow 2Mn^{2+}(aq) + 10CO_2(g) + 8H_2O(l)$$

This reaction is an example of an autocatalytic reaction where the $Mn^{2+}(aq)$ product acts a catalyst for the reaction.
The chemical reaction is quite slow at room temperature so it is usual to heat the reaction mixture initially but once some products are formed it is no longer necessary to continue heating.

i. Explain in terms of collision theory why it is necessary to heat the mixture initially.

ii. Explain in terms of collision theory why it is not necessary to continue heating the mixture once some products have been formed.

3.



The Maxwell-Boltzmann curves (left) show the distribution of kinetic energy amongst the particles of a fixed amount of reactant gas at a particular absolute temperature, T K and when the temperature has increased by 10 K.

i. Explain why the areas under the two curve are equal.

ii. Use the curves above to explain why increasing the temperature increases the rate of reaction.

iii. Use the curves above to explain why adding a catalyst increases the rate of reaction.

4. In coal mines there is always the danger that trapped methane gas may cause an explosion. This can cause serious problems on its own but there is the greater risk that it may trigger a coal explosion which can completely obliterate the mine. Suggest a reason why limestone powder is often scattered around a coal mine.