Introduction to energy profiles – Part 2.

1. Methanol is produced by the following reaction
   $CO(g) + 2H_2(g) \rightarrow CH_3OH(l)$
   During the reaction 100 kj of energy is devoted to breaking bonds whilst 228 kj is released during bond formation.
   a. Complete the energy profile of the reaction shown in diagram 1. Label the following
      i. the value of the activation energy in kJ.

      ii. the ΔH of the reaction.

      iii. the energy content of the products in kJ.

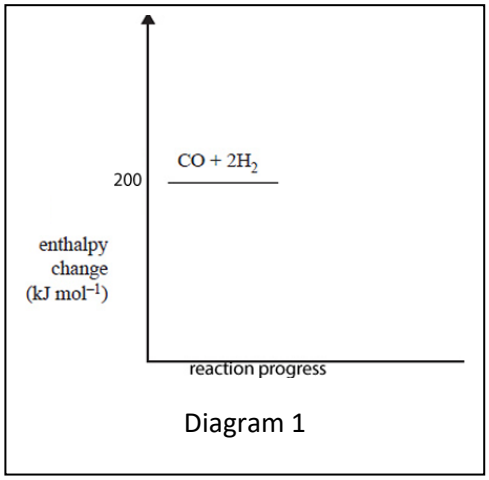

Diagram 1

   b. Is the reaction endothermic or exothermic? Justify your answer.

2. The energy profile shown on the right in diagram 2, is of the complete combustion of glucose ($C_6H_{12}O_6$) during cellular respiration.
   a. Write the balanced chemical equation for this reaction, states included.

   b. Give the value, in kJ, of the following:

      i. The energy needed to break chemical bonds.
      ii. The energy released during bond formation.
      iii. The ΔH of the reaction.

   c. Write the balanced thermochemical equation for the reaction.

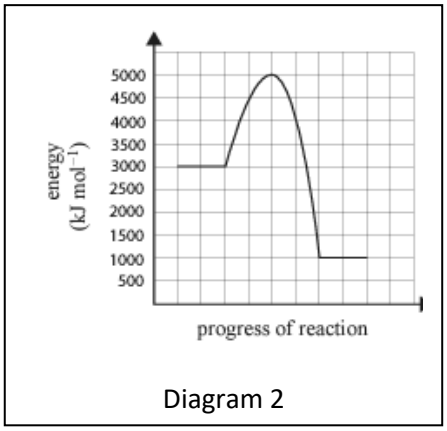

Diagram 2

   d. On the set of axes shown on the right draw the energy profile for the process of photosynthesis.

   e. Give the balanced thermochemical equation for the process of photosynthesis using the information provided in diagram 2.

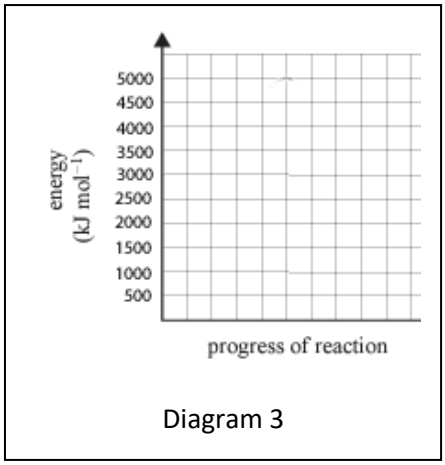

Diagram 3

   f. Without reference to any particular gas, justify why the reaction given by the equation in a. above represents complete combustion.

3. The energy profile for the reaction below is shown in diagram 4.
   A(g) + B(g) → BA(g)
   a. Give the ΔH for the reaction
      BA(g) → A(g) + B(g)

   b. A reaction with a low activation energy occurs very quickly compared to a reaction with high activation energy. Fuels must react quickly with oxygen and release as much energy as possible.

      The energy profiles of the reaction between two fuels and oxygen gas is shown in diagram 5. The two reactions occur at SLC.

      Using the information above and the energy profiles shown in diagram 5, which one of the two fuels A or B is best to use? Justify your answer.

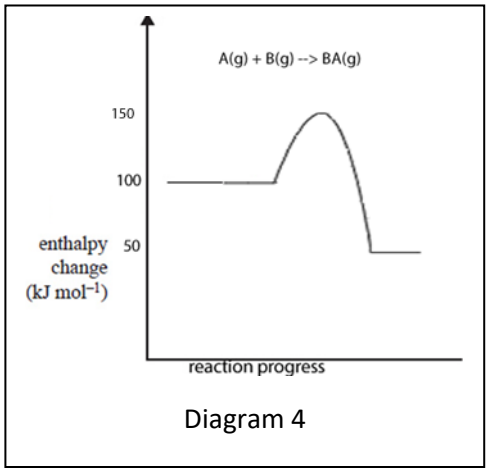

Diagram 4

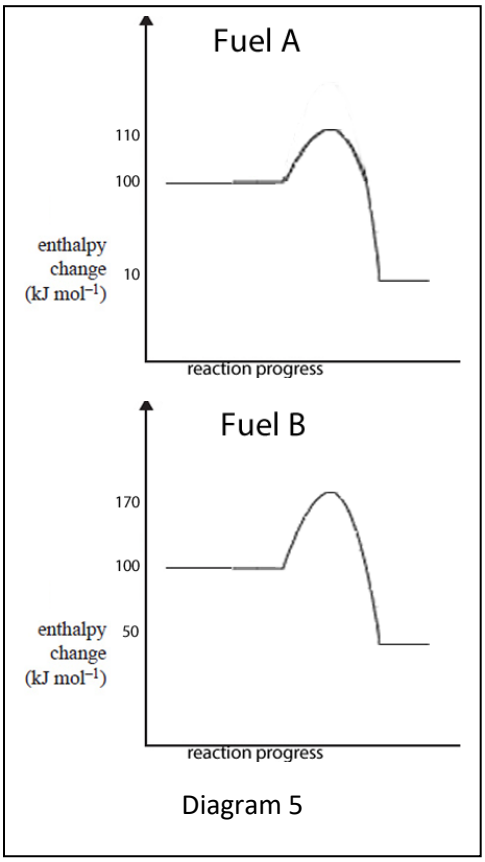

Diagram 5

4. Consider the 6 graphs shown in diagram 6. All graphs are drawn to the same scale.

   a. Which graph represents the energy profile for the reaction shown below. Justify your answer.
   $A_2(g) + H_2(g) \rightarrow 2HA(g)$ $\Delta H = +200kJ$

   b. Which graph represents the energy profile of a fuel that undergoes combustion with the lowest activation energy and the greatest energy release. Justify your answer.

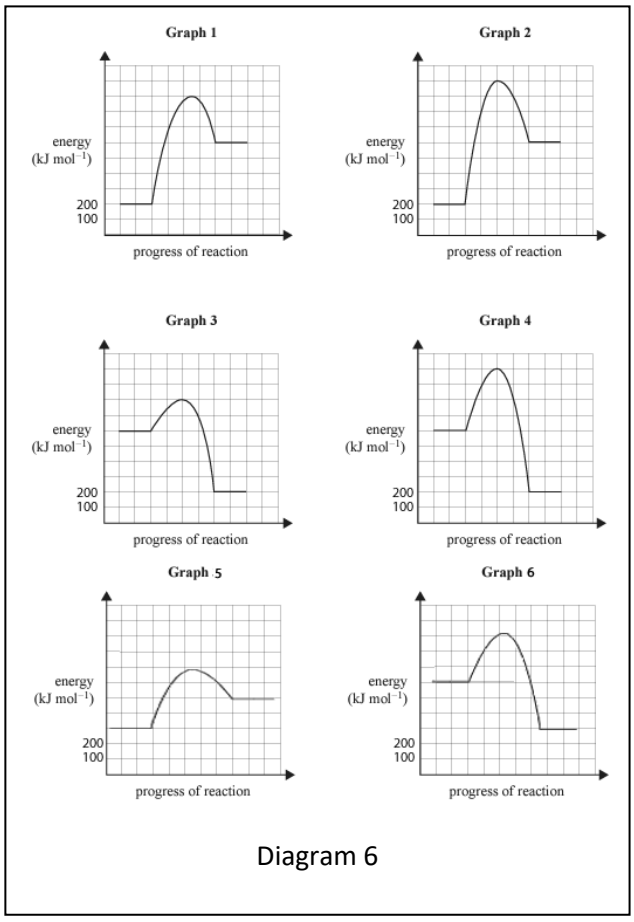

Diagram 6

   c. Graph 1 represents the energy profile of the reaction shown below.
   $A(g) + B(g) \rightarrow C(g)$
      i. Give the ΔH of the reaction
      ii. Which graph represents the energy profile diagram of the reaction $C(g) \rightarrow A(g) + B(g)$.
      Justify your answer.

      iii. Give the ΔH for the reaction $C(g) \rightarrow A(g) + B(g)$ $\Delta H =$ _____

   d. Catalysts are used during chemical reactions to increase the rate of reaction. Catalysts increase the rate of reaction by lowering the activation energy required for the reaction without impacting the ΔH of the reaction Which of the of the following pair of graphs represent the energy profile of a reaction with and without a catalyst. Justify your answer.
      i. Graphs 2 and 6
      ii. Graphs 3 and 4
      iii. Graphs 5 and 6

e. Label the following comments as TRUE or FALSE.
Justify each response.

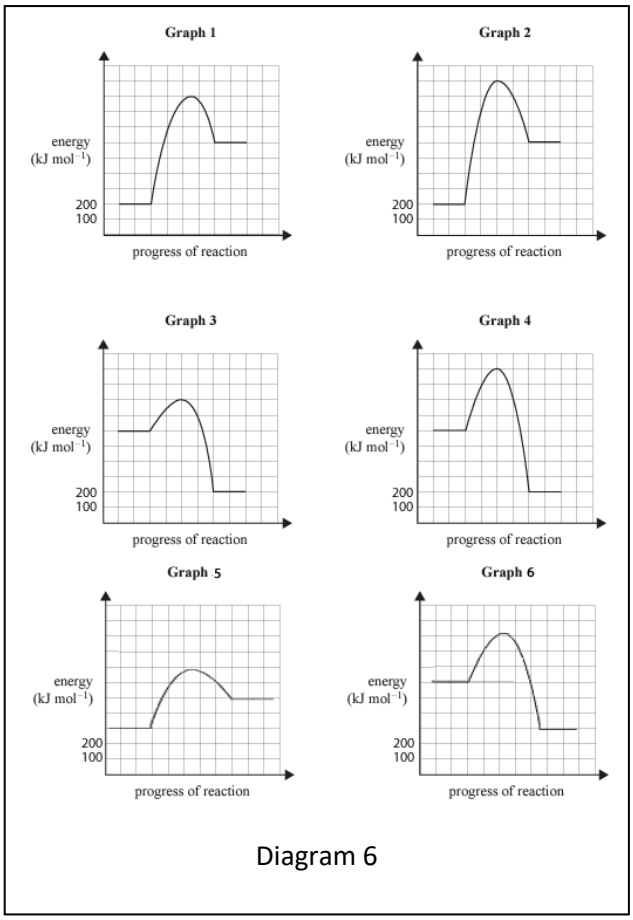

Diagram 6

i. Graph 2 represents the energy profile of an endothermic reaction.
True / False

ii. Graph 2 represents the energy profile of an endothermic reaction whilst graph 6 represents the energy profile of the reverse reaction with the use of a catalyst.
True / False

iii. Graph 5 represents the energy profile of an endothermic reaction without the use of a catalyst whilst graph 6 represents the energy profile of its reverse reaction.
True / False

iv. Graph 1 represents the energy profile of a catalysed reaction whilst graph 2 represents the energy profile of the same reaction but without a catalyst.
True / False