Revision - enthalpy

1. Methanol undergoes complete combustion in the presence of atmospheric oxygen at SLC.
   a. Write a balanced thermochemical reaction for the complete combustion of methanol at SLC.

      Step 4 write the balanced thermochemical equation

   b. What volume of oxygen gas is used when 2.45 MJ of energy is released?

   c. On an industrial scale, methanol is predominantly produced from natural gas by reforming the gas with steam and then processing the resulting synthesized gas mixture to create pure methanol. Describe the conditions, under which methanol is formed, that would enable it to be labelled as a renewable fuel.

2. Consider the three molecules shown on the right.

   Identify the following statements as True or False. Explain your choice.

$C_4H_{10}O_2$	Methyl butanoate
C_7H_{16}	Heptane
$CH_3(CH_2)_{12}CH_3$	Tetradecane

   i. Methyl butanoate and heptane have molar masses that are very similar. Methyl butanoate, however, would be expected to have a higher cloud and flash point than heptane.

   ii. Tetradecane should be more viscous than heptane and methyl butanoate.

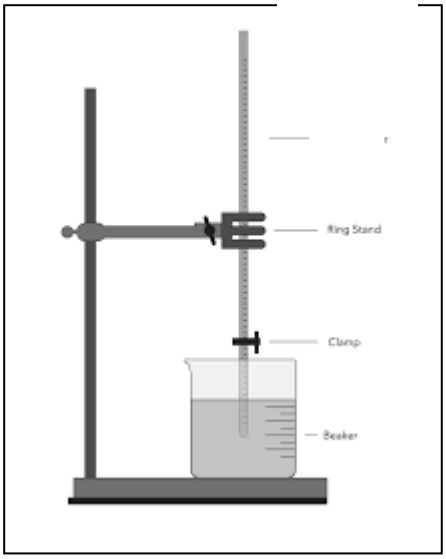
   iii. Methyl butanoate and tetradecane are produced via a condensation reaction.

   iv. Methyl butanoate is a net zero carbon emitter as the molecules it is made from are both produced via photosynthesis and fermentation reactions.

3. The calculate enthalpy change for the dissolving of anhydrous copper sulfate as shown below.

$CuSO_4(s) \rightarrow Cu^{2+}(aq) + SO_4^{2-}(aq)$ $\Delta H = ?$

A given amount of anhydrous copper sulfate is dissolved in a beaker of water. The temperature of the water is monitored using a hand-held thermometer, as shown on the right.



The procedure for the investigation is summed up below.
A 100mL beaker is placed on a electronic balance and weighed. Water is added to fill the beaker to the 100ml mark and once again the mass of the beaker and water recorded. Finally, a sample of $CUSO_4$ is added to the beaker of water and the final mass of water, beaker and $CuSO_4$ is recorded. The initial temperature of the eater in the beaker is recorded. The temperature of the water is allowed to reach its maximum where it is finally recored.
Below is a table of data collected from the investigation.

Measurement	Value
Mass of empty 100ml beaker	50.55 grams
Mass of 100ml beaker and water	145.56 grams
Mass 100ml beaker with water and sample of $CuSO_4$	150.56 grams
Initial temperature of water	23.00 ^oC
Final temperature of water	33.00 ^oC

a. Calculate the mol of $cuSO_4$ (molar mass 159.6 g/mol) dissolved in the water

b. Calculate the amount of energy, in kJ, released when one mole of anhydrous $CuSO_4$ dissolves in water.

c. Below is a table of data that another group recorded of the temperature of the water every minute for 7 minutes. This group used an identical mass of $CuSO_4$.

i. Graph the results on the graph paper below and use the graph to obtain a more accurate value for the energy (kJ) released per mole of $CuSO_4$ dissolved.

Time(min)	Temperature ^oC
0	23.00
1	26.00
2	29.00
3	33.00
4	32.00
5	29.00
6	26.00
7	23.00

ii. Discuss why this is a more accurate representation of the energy per mol.