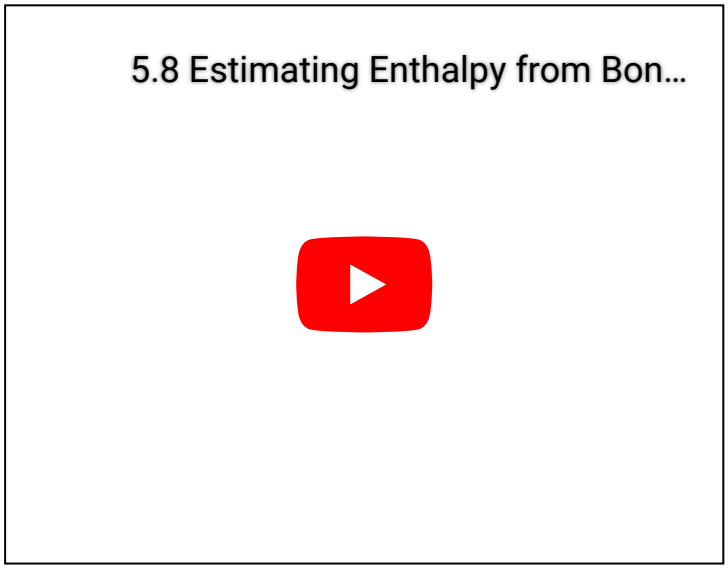
Background information

Perhaps one of the easiest parts of Nature of Science to assess is the validity of a hypothesis. The use of hypotheses is covered in the Nature of Science part of the chemistry guide which deals with the *Understanding of Science*. Hypotheses are explanatory statements about the world. They may be true or false but should be based on solid reasoning rather than pure guesswork. A hypothesis may suggest a causal relationship or a correlation between factors. Support of or opposition to a hypothesis can be tested by experimental observations of the natural world.

The validity or otherwise of a hypothesis has been assessed several times in the past. Question 2 on TZ1 2009 SL Paper 2 (it is Question 3 on the HL Paper) is a good example. Even though I wrote this question I cannot repeat it here as it is copyright IB but your teacher should easily be able to get hold of it. What I have done for Example 1 is to write another question which is essentially about Topics 5. Energetics but contains a considerable amount of Nature of Science and also contains some of the new command terms that first appeared on the current programme (e.g. 'show' and 'examine'). This is very much a genuine example as many chemistry teachers make the same mistake in their teaching as the student makes in the question. You can see examples of this mistake being made on page 249 in one of the new text books recently published on the new programme and in the following video.



SL HL NoS Question 1 on Energetics

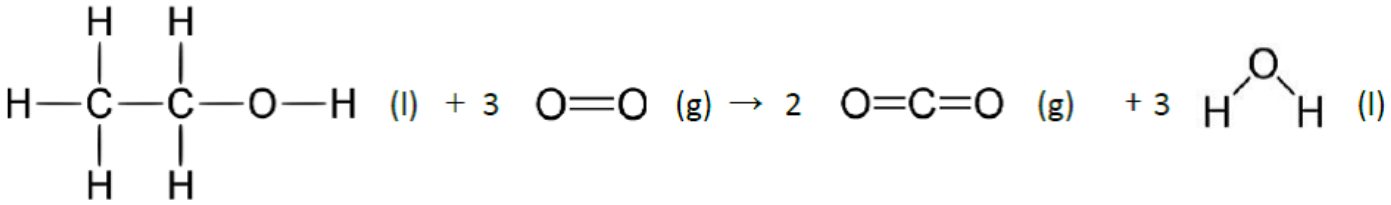
1. The enthalpy of formation of ethanol is expressed by the following equation:

$$2C(s) + 3H_2(g) + \tfrac{1}{2}O_2(g) \xrightarrow{\Delta H_f^{\ominus}} C_2H_5OH(l)$$

Hess's law states that the overall enthalpy change for a reaction is independent of the reaction pathway. Based on this statement a student hypothesised that if she calculated the enthalpy of formation of ethanol using the values given for the enthalpies of combustion of graphite, hydrogen and ethanol in Section 13 of the data booklet she should get the same answer as the value given in Section 12 of the data booklet.

(a) Demonstrate that the student's hypothesis is correct. *[3]*

(b) The student then reasoned that if she calculated the standard enthalpy of combustion of ethanol using the bond enthalpies given in Section 11 of the data booklet she should get an answer close to – 1367 kJ (the value given in Section 13 of the data booklet) for every mole of ethanol combusted.
She did not expect her hypothesis to be exactly correct as she realised that some of the bond enthalpies she would be using would be average bond enthalpies rather than the exact values for the bonds in ethanol.
She set out her equation showing the bonds broken and formed as follows:



Show that the result obtained using this equation is – 1263 kJ and calculate the percentage error. *[3]*

(c) Examine the method used by the student in **(b)** and suggest how it could have been improved to obtain a more accurate result with a much smaller percentage error. *[3]*

To see the answers click on the 'eye'
