**Energetics – Homework 2**

**1.** (a) Define the terms *standard enthalpy of formation* and *standard enthalpy of combustion*.

*Standard enthalpy of formation*..................................................................................

.....................................................................................................................................

.....................................................................................................................................

*Standard enthalpy of combustion*................................................................................

.....................................................................................................................................

.....................................................................................................................................

(6)

(b) Use the standard enthalpies of formation, *H*, given below

|  |  |
| --- | --- |
| Compound | *H* / kJ mol–1 |
| CO2(g) | –394 |
| C3H7OH(l) | –304 |
| H2O(l) | –286 |

 to calculate the standard enthalpy of combustion of an alcohol C3H7OH, as shown by the equation:

 C3H7OH(l) + 4½O2(g)  3CO2(g) + 4H2O(l)

.....................................................................................................................................

.....................................................................................................................................

.....................................................................................................................................

.....................................................................................................................................

.....................................................................................................................................

.....................................................................................................................................

(3)

(c) A value for the enthalpy of combustion of the alcohol C3H7OH was determined in the laboratory using the apparatus shown below. The following results were obtained.

|  |  |
| --- | --- |
|  | Mass of water in the calorimeter = 200 gInitial temperature of water = 15 ºCFinal temperature = 30 ºCMass of alcohol burned = 0.90 g |

(i) Calculate the heat energy required to raise the temperature of the water from
15 °C to 30 °C. The specific heat capacity of water is 4.2 J g–1 K–1.

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................

(ii) Calculate the number of moles of the alcohol, C3H7OH, burned.

..........................................................................................................................

..........................................................................................................................

(iii) Hence, calculate a value for the enthalpy of combustion of 1.0 mol of the alcohol.

..........................................................................................................................

..........................................................................................................................

(iv) Give **two** reasons why you would expect your answer to part (c)(iii) to differ from that in part (b).

*Reason 1* ...........................................................................................................

...........................................................................................................................

*Reason 2* ...........................................................................................................

...........................................................................................................................

(8)

(Total 17 marks)

**2.** (a) Define the term *standard enthalpy of combustion*.

.....................................................................................................................................

.....................................................................................................................................

.....................................................................................................................................

(3)

(b) Using the data given below, calculate the standard enthalpy change for the following reaction.

 CH4(g)  2O2(g)  CO2(g)  2H2O(l)

 *H*f CO2(g) = –394 kJ mol–1

 *H*f H2O(l) = –286 kJ mol–1

 *H*f CH4(g) = –75 kJ mol–1

(3)

(c) (i) State what is meant by the term *mean bond enthalpy*.

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................

(ii) Using the standard enthalpy of formation of methane given in part (b) and the data given below, calculate the mean bond enthalpy of the **C**-**H** bond in methane.

C(s)  C(g) *H* = +715 kJ mol–1

H2(g)  2H(g) *H* = +436 kJ mol–1

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................

(iii) Using the C–H bond enthalpy calculated in part (c)(ii) and the standard enthalpy change for the reaction given below, calculate the mean bond enthalpy of the C–C bond in propane.

 N.B. If you failed to complete part (c)(ii), you may assume that the mean bond enthalpy of the C–H bond is +390 kJ mol–1. (This is not the correct value.)



..........................................................................................................................

..........................................................................................................................

..........................................................................................................................

(7)

(Total 13 marks)

**3.** The table below contains some mean bond enthalpy data.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Bond | HH | CC | C=C | NN | NH |
| Mean bond enthalpy / kJ mol–1 | 436 | 348 | 612 | 944 | 388 |

(a) Explain the term *mean bond enthalpy.*

...............................................................................................................................

...............................................................................................................................

...............................................................................................................................

...............................................................................................................................

(2)

(b) (i) Write an equation for the formation of one mole of ammonia, NH3, from its elements.

.....................................................................................................................

(ii) Use data from the table above to calculate a value for the enthalpy of formation of ammonia.

.......................................................................................................................

.......................................................................................................................

.......................................................................................................................

.......................................................................................................................

(4)

(c) Use the following equation and data from the table above to calculate a value for the
C–H bond enthalpy in ethane.



...............................................................................................................................

...............................................................................................................................

...............................................................................................................................

...............................................................................................................................

(3)

(Total 9 marks)

**......................Out of 39 (Grade )**