

Exercise 4.21 – The standard enthalpy of combustion

Q421-01 A simple calorimeter was used to determine the enthalpy of combustion of ethanol. The experimental value obtained was -920 kJ mol^{-1} . The data booklet value is $-1371 \text{ kJ mol}^{-1}$. Which of the following is the best explanation for the difference between the two values?

- A. Incomplete combustion of the fuel
- B. Heat loss to the surroundings
- C. Poor ventilation in the laboratory
- D. Inaccurate temperature measurements

Q421-02 The standard enthalpy of combustion H_c^\ominus and the relative molecular masses M_r of a series of alkanols are given below:

Alkanol	CH ₃ OH methanol	CH ₃ CH ₂ OH ethanol	CH ₃ CH ₂ CH ₂ OH propan-1-ol	CH ₃ CH ₂ CH ₂ CH ₂ OH butan-1-ol
$H_c^\ominus / \text{kJ mol}^{-1}$	-715	-1371	-2010	-2673
M_r	32.0	46.0	60.0	74.0

Use the data to calculate the relative molecular mass of pentan-1-ol and estimate H_c^\ominus for pentanol [2]

Q421-03 What is the equation for the complete combustion of ethene?

Q421-04 Expressing the number of carbon atoms as 'n', what is the general equation for complete combustion of an alkane.

Q421-05 If the standard enthalpy of combustion of methanol is -715 kJ , calculate the energy released by 1 kg of methanol when burned.

Q421-06 The standard enthalpy of combustion of butane is -2877 kJ . Calculate the mass of butane needed to produce $100,000 \text{ kJ}$ of energy.

Q421-07 Calculate the mass of hydrogen needed to heat 1 kg of water by 10°C . The standard enthalpy of combustion of hydrogen = -285.8 kJ , specific heat capacity of water = $4.18 \text{ kJ kg}^{-1} \text{ }^\circ\text{C}^{-1}$.

Q421-08 Petrol is mainly 2,2,4-trimethyl pentane, C_8H_{18} , standard enthalpy of combustion = -5461 kJ . Calculate the energy released by complete combustion of 1 dm^3 of petrol (density = 0.737 g cm^{-3}).

Q421-09 The density of liquid hydrogen is 67.76 g dm^{-3} . Calculate the energy that is released on combustion of 1 dm^3 of liquid hydrogen. [standard enthalpy of combustion of hydrogen = -285.8 kJ , ignore enthalpy of vaporisation.]

Q421-10 The standard enthalpy change for the combustion of phenol is $-3050 \text{ kJ mol}^{-1}$ at 298K . Write an equation for the complete combustion of phenol, $\text{C}_6\text{H}_5\text{OH}(\text{s})$.