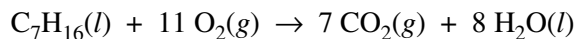


2003 AP[®] CHEMISTRY FREE-RESPONSE QUESTIONS (Form B)

3. In an experiment, a sample of an unknown, pure gaseous hydrocarbon was analyzed. Results showed that the sample contained 6.000 g of carbon and 1.344 g of hydrogen.

- (a) Determine the empirical formula of the hydrocarbon.
- (b) The density of the hydrocarbon at 25°C and 1.09 atm is 1.96 g L⁻¹.
- (i) Calculate the molar mass of the hydrocarbon.
- (ii) Determine the molecular formula of the hydrocarbon.

In another experiment, liquid heptane, C₇H₁₆(l), is completely combusted to produce CO₂(g) and H₂O(l), as represented by the following equation.



The heat of combustion, $\Delta H_{\text{comb}}^\circ$, for one mole of C₇H₁₆(l) is -4.85×10^3 kJ.

- (c) Using the information in the table below, calculate the value of ΔH_f° for C₇H₁₆(l) in kJ mol⁻¹.

Compound	ΔH_f° (kJ mol ⁻¹)
CO ₂ (g)	-393.5
H ₂ O(l)	-285.8

- (d) A 0.0108 mol sample of C₇H₁₆(l) is combusted in a bomb calorimeter.
- (i) Calculate the amount of heat released to the calorimeter.
- (ii) Given that the total heat capacity of the calorimeter is 9.273 kJ °C⁻¹, calculate the temperature change of the calorimeter.