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, $C_7H_{16}(l)$, is completely combusted to produce $CO_2(g)$ and $H_2O(l)$, as represented by the following equation.

$$C_7H_{16}(l) + 11\ O_2(g) \rightarrow 7\ CO_2(g) + 8\ H_2O(l)$$

The heat of combustion, ΔH°_{comb}, for one mole of $C_7H_{16}(l)$ is -4.85×10^3 kJ.

(c) Using the information in the table below, calculate the value of ΔH°_f for $C_7H_{16}(l)$ in kJ mol^{-1}.

Compound	ΔH°_f (kJ mol^{-1})
$CO_2(g)$	–393.5
$H_2O(l)$	–285.8

(d) A 0.0108 mol sample of $C_7H_{16}(l)$ 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.