Solutions

Each answer shows the steps, then the **result**.

2.1

- ΔH is negative; the products have less energy than the reactants

2.2

- the enthalpy change when one mole of a substance is burned completely in oxygen under standard conditions

3.1 B

- Endothermic = ΔH positive, heat taken in

3.2 B

- Breaking a bond requires energy (endothermic)

3.3

- broken $= 945 + 3(436) = 2253$; made $= 6 \times 391 = 2346$; $\Delta H = 2253 - 2346 = -93$ kJ mol^{-1}

3.4

(a)

- $q = 200 \times 4.18 \times 9.0 = 7524$ J

(b)

- $n = 0.32/32 = 0.010$ mol; $\Delta H_c = -q/n = -7524/0.010 = -752$ kJ mol^{-1} (≈ -750)

3.5

(a)

- $q = mc\Delta T = 150 \times 4.18 \times 27.5 = 17\,240$ J $= 17.2$ kJ; $n = \dfrac{0.780}{60.0} = 0.0130$ mol; $\Delta H_c = -\dfrac{17.2}{0.0130} = -1.33 \times 10^3$ kJ mol^{-1}

(b)

- Heat is lost to the surroundings and to the apparatus instead of warming the water; combustion is incomplete, or some alcohol evaporates without burning; in an open calorimeter the **heat loss** is normally much the larger effect

(c)

- Negative means energy is released to the surroundings, i.e. the reaction is exothermic; more energy is released when the bonds in CO_2 and H_2O form than is absorbed breaking the bonds in the alcohol and oxygen; so the products lie at a lower enthalpy than the reactants

(d)

- The conditions are not standard — the temperature changes throughout and the pressure is not controlled at 100 kPa; and the alcohol is not necessarily burned completely to CO_2 and H_2O