Solutions

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

2.1

- an exothermic reaction gives out energy
- ΔH is **negative**

2.2

- bond breaking **takes in** energy (endothermic)

2.3

- **endothermic**: the temperature falls
- temperature change $= 14 - 21 = \mathbf{-7}$ °C, a fall of 7 °C

2.4

- bond making **gives out** energy

3.1 B

- an endothermic reaction takes in energy, so the surroundings **cool down**
- A is exothermic; C and D are wrong

3.2

(a)

- bonds broken $= 436 + 158 = 594$ kJ mol^{-1}
- bonds made $= 2 \times 568 = 1136$ kJ mol^{-1}

$$\Delta H = \text{bonds broken} - \text{bonds made} = 594\ \text{kJ mol}^{-1} - 1136\ \text{kJ mol}^{-1} = \mathbf{-542}\ \text{kJ mol}^{\mathbf{-1}}$$

(b)

- ΔH is negative, so the reaction is **exothermic**

3.3

- the height of the hill above the reactants is the **activation energy**

3.4

(a)

- break 4× C–H and 2× O=O: $4(412) + 2(496) = 1648 + 992 = \mathbf{2640}$ kJ

(b)

- make 2× C=O and 4× O–H: $2(743) + 4(463) = 1486 + 1852 = \mathbf{3338}$ kJ

(c)

- ΔH = energy to break bonds − energy released making bonds

$$\Delta H = 2640\ \text{kJ/mol} - 3338\ \text{kJ/mol} = \mathbf{-698}\ \text{kJ/mol}$$