Exercise walk-through

Endothermic and Exothermic Processes ▪ 6.1

eXercise

You must be able to

- classify a process as **exothermic** 放热 ($\Delta H < 0$) or **endothermic** 吸热 ($\Delta H > 0$)
- link the sign of ΔH to heat released or absorbed
- relate bond breaking/forming to energy

Method — Exo vs endo

- **Exothermic** — releases heat to the surroundings; $\Delta H < 0$; surroundings warm up.
- **Endothermic** — absorbs heat from the surroundings; $\Delta H > 0$; surroundings cool down.

Method — Bonds and energy

Breaking bonds **absorbs** energy; **forming** bonds **releases** energy. If more energy is released (forming) than absorbed (breaking), the reaction is exothermic.

Method — A worked judgement

Combustion feels hot $\rightarrow$ releases heat $\rightarrow$ **exothermic**, $\Delta H < 0$. A cold pack that gets cold when mixed $\rightarrow$ absorbs heat $\rightarrow$ **endothermic**, $\Delta H > 0$.

Method — Sign convention

ΔH is written from the system's view: negative when the system **loses** energy (exothermic), positive when it **gains** energy (endothermic).

Practice 2.1 ▪ 1 mark

State the sign of ΔH for an exothermic reaction.

Solution 2.1

Method: Sign convention

Worked steps

Negative ($\Delta H < 0$) B1.

Practice 2.2 ▪ 1 mark

A reaction makes the beaker feel cold. Classify it.

Solution 2.2

Worked steps

Endothermic B1.

Practice 2.3 ▪ 1 mark

Does breaking a bond absorb or release energy?

Solution 2.3

Method: Bonds and energy

Worked steps

Absorbs energy B1.

Exam-style 3.1 ▪ 1 mark

An endothermic reaction has

A $\Delta H < 0$ and releases heat

B $\Delta H > 0$ and absorbs heat

C $\Delta H = 0$

D no energy change

Solution 3.1

A $\Delta H < 0$ and releases heat

B $\Delta H > 0$ and absorbs heat ✓

C $\Delta H = 0$

D no energy change

Worked steps

B — $\Delta H > 0$ and absorbs heat.

Exam-style 3.2 ▪ 2 marks

When ammonium nitrate dissolves in water, the solution gets colder.
(a) Classify the process and give the sign of ΔH.
(b) State the direction of heat flow (system surroundings).

Solution 3.2

Worked steps

(a) Endothermic; $\Delta H > 0$ M1 A1. (b) Heat flows from the surroundings into the system B1.

Exam-style 3.3 ▪ 2 marks

Explain, in terms of bond breaking and forming, why combustion is exothermic.

Solution 3.3

Method: Bonds and energy

Worked steps

Combustion forms strong bonds in CO_2 and H_2O, releasing more energy than is absorbed breaking the fuel and O_2 bonds, so the net ΔH is negative M1 A1.