Exercise walk-through

Reaction Energy Profile ▪ 5.6

eXercise

You must be able to

- read reactant and product energies and the **activation energy** E_a
- find ΔH from the diagram
- classify the reaction as **exothermic** 放热 or **endothermic** 吸热

Method — The energy profile

The graph plots energy (y) against reaction progress (x): reactants on the left, a peak (the **transition state**), then products on the right.

Method — Activation energy from the diagram

E_a is the height from the **reactants** up to the **peak**. A higher barrier means a slower reaction.

Method — Enthalpy change

ΔH is the energy of **products minus reactants**:

- products **lower** than reactants $\rightarrow \Delta H < 0$, **exothermic** (releases energy);
- products **higher** $\rightarrow \Delta H > 0$, **endothermic**.

Method — A worked reading

If reactants sit at 50 kJ, the peak at 120 kJ, and products at 30 kJ: $E_a = 120 - 50 = 70$ kJ; $\Delta H = 30 - 50 = -20$ kJ (exothermic).

Practice 2.1 ▪ 1 mark

On an energy profile, where is the activation energy measured from and to?

Solution 2.1

Worked steps

From the reactants up to the peak (transition state) B1.

Practice 2.2 ▪ 2 marks

Reactants at 60 kJ, products at 40 kJ. Find ΔH and classify it.

Solution 2.2

Method: A worked reading

Worked steps

$\Delta H = 40 - 60 = -20$ kJ; exothermic M1 A1.

Practice 2.3 ▪ 1 mark

What does the peak of an energy profile represent?

Solution 2.3

Method: The energy profile

Worked steps

The transition state (the highest-energy point) B1.

Exam-style 3.1 ▪ 1 mark

An exothermic reaction has products that are

A higher in energy than reactants

B lower in energy than reactants

C equal to reactants

D at the peak

Solution 3.1

A higher in energy than reactants

B lower in energy than reactants ✓

C equal to reactants

D at the peak

Worked steps

B — products lower in energy than reactants.

Exam-style 3.2 ▪ 2 marks

An energy profile shows reactants at 80 kJ, the peak at 150 kJ, products at 110 kJ.
(a) Find the activation energy.
(b) Find ΔH and state whether the reaction is exo- or endothermic.

Solution 3.2

Method: The energy profile

Worked steps

(a) $E_a = 150 - 80 = 70$ kJ M1 A1. (b) $\Delta H = 110 - 80 = +30$ kJ, endothermic M1 A1.

Exam-style 3.3 ▪ 2 marks

Sketch-describe how the energy profile changes when a catalyst is added, and state which quantity is unaffected.

Solution 3.3

Method: The energy profile

Worked steps

A catalyst lowers the peak (a smaller E_a, an alternative pathway) M1; ΔH (the reactant-to-product energy difference) is unchanged A1.