

# 6.2 Energy Diagrams

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Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Total: 9 marks

## Objective

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Build the skills to answer exam questions on **energy diagrams** for reactions.

**You must be able to:**

- draw/read an energy diagram showing reactants, products, and  $E_a$
- show  $\Delta H$  as products minus reactants
- compare exothermic and endothermic diagrams

## 1 Worked examples

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Study these first. Each one shows the method for a question type used later —follow the steps and you can do the Practice and Exam-style questions yourself.

### ■ The exothermic diagram

Reactants start **high**, climb over the activation-energy barrier, and end **lower** as products. Energy is released, so  $\Delta H < 0$  (the arrow points down from reactants to products).

### ■ The endothermic diagram

Reactants start **low**, climb the barrier, and end **higher** as products. Energy is absorbed, so  $\Delta H > 0$  (the arrow points up).

### ■ Reading $E_a$ and $\Delta H$

$E_a$  = height of the peak above the **reactants**.  $\Delta H$  = (product level) – (reactant level).

### ■ A worked comparison

Same  $E_a$  but different  $\Delta H$ : an exothermic reaction's products sit below the reactants; an endothermic reaction's products sit above. The barrier position is the same idea in both.

## 2 Practice

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Now apply the methods above.

2.1 On an energy diagram, how is  $\Delta H$  found? [1]

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2.2 For an exothermic reaction, are the products higher or lower than the reactants? [1]

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2.3 Where is  $E_a$  measured to on the diagram? [1]

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### 3 Exam-style questions

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3.1 On an **endothermic** energy diagram, the products are [1]

- **A** lower than the reactants
  - **B** higher than the reactants
  - **C** at the same level
  - **D** at the peak
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3.2 An energy diagram shows reactants at 30 kJ, peak at 110 kJ, products at 70 kJ.

(a) Find  $E_a$ . [1]

(b) Find  $\Delta H$  and classify the reaction. [2]

3.3 Two reactions have the same  $\Delta H$  but different  $E_a$ . Explain which reacts faster and why. [2]

### 4 Go further

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You are now ready for the real exam questions on this subtopic:

- work through the **6.2 Energy Diagrams** lesson on the **Learn** page;
- read the **Energy Diagrams** section of the AP Chemistry handout on the **Know** page.

## Solutions

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**2.1** Products' energy minus reactants' energy.

**2.2** Lower.

**2.3** From the reactants up to the peak.

**3.1 B** —higher than the reactants.

**3.2** (a)  $E_a = 110 - 30 = 80$  kJ. (b)  $\Delta H = 70 - 30 = +40$  kJ, endothermic.

**3.3** The one with the **lower**  $E_a$  reacts faster, because a larger fraction of collisions exceed the smaller barrier.