AP CHEMISTRY • EXERCISE SHEET

5.6 Reading an Energy Profile

Name: _____ Class: _____ Date: _____ **Total: 11 marks**

KEY WORDS energy profile 能量图 • exothermic 放热 • endothermic 吸热 • transition state 过渡态 • activation energy 活化能

Objective

Build the skills to answer exam questions on **reading an energy profile** (reaction coordinate diagram).

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

1 Worked examples

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 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.

Activation energy from the diagram

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

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**.

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).

2 Practice

Now apply the methods above.

2.1 On an energy profile, where is the activation energy measured from and to? [1]

2.2 Reactants at 60 kJ, products at 40 kJ. Find ΔH and classify it. [2]

2.3 What does the peak of an energy profile represent? [1]

3 Exam-style questions

3.1 An exothermic reaction has products that are [1]

- **A** higher in energy than reactants
- **B** lower in energy than reactants
- **C** equal to reactants
- **D** at the peak

3.2 An energy profile shows reactants at 80 kJ, the peak at 150 kJ, products at 110 kJ.

(a) Find the activation energy. [2]

(b) Find ΔH and state whether the reaction is exo- or endothermic. [2]

3.3 Sketch-describe how the energy profile changes when a catalyst is added, and state

which quantity is unaffected. [2]

Solutions

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

2.2 $\Delta H = 40 - 60 = -20$ kJ; exothermic.

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

3.1 B — products lower in energy than reactants.

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

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