

Exercise walk-through

Cellular Energy ■ 3.3

eXercise

You must be able to

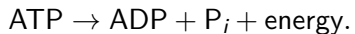
- describe **ATP** 三磷酸腺苷 as the cell's energy currency
- explain that energy is released when $\text{ATP} \rightarrow \text{ADP} + \text{P}_i$
- link ATP hydrolysis to powering cell work

Method — ATP is the energy currency

ATP (adenosine triphosphate) stores energy in the bonds between its **three phosphate** groups. Cells use ATP to power nearly all their energy-requiring work.

Method — Releasing energy

Breaking off the last phosphate by **hydrolysis** releases energy:



Method — Recharging

The energy from respiration is used to **rebuild** ATP from $\text{ADP} + \text{P}_i$. ATP and ADP cycle continuously — used and remade.

Method — A worked link

Active transport, muscle contraction, and building molecules all **couple** to ATP hydrolysis — the released energy drives the otherwise-unfavorable work.

Practice 2.1 ■ 1 mark

What does ATP stand for and store?

Solution 2.1

Worked steps

Adenosine triphosphate; it stores energy (in its phosphate bonds) **B1**.

Practice 2.2 ■ 1 mark

Write the reaction when ATP releases energy.

Solution 2.2

Method: Releasing energy

Worked steps

$\text{ATP} \rightarrow \text{ADP} + \text{P}_i + \text{energy}$ **B1**.

Practice 2.3 ■ 1 mark

How is ATP recharged?

Solution 2.3

Worked steps

Energy from respiration rebuilds ATP from $\text{ADP} + \text{P}_i$ **B1**.

Exam-style 3.1 ■ 1 mark

Energy is released from ATP when it is converted to

A ADP + phosphate

B glucose

C DNA

D a lipid

Solution 3.1

Method: A worked link

A ADP + phosphate



B glucose

C DNA

D a lipid

Worked steps

A — ADP + phosphate.

Exam-style 3.2 ■ 2 marks

A muscle cell uses ATP to contract.

- (a) Write the hydrolysis reaction of ATP.
- (b) Explain how this powers the contraction (coupling).

Solution 3.2

Method: A worked link

Worked steps

(a) $\text{ATP} \rightarrow \text{ADP} + \text{P}_i + \text{energy}$ **M1** **A1**. (b) The energy released is coupled to the contraction, providing the energy the muscle proteins need to move **M1** **A1**.

Exam-style 3.3 ■ 2 marks

Explain why ATP is described as a “rechargeable” energy currency.

Solution 3.3

Method: ATP is the energy currency

Worked steps

ATP is hydrolyzed to $\text{ADP} + \text{P}_i$ (used), and respiration re-adds the phosphate to remake ATP (recharged); this cycle repeats continuously **M1** **A1**.