

3.3 Cellular Energy and ATP

Name: _____ Class: _____ Date: _____

Total: 10 marks

Objective

Build the skills to answer exam questions on **cellular energy and ATP**.

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

1 Worked examples

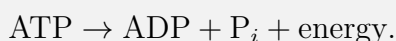
Study these first. Each one shows the method for a question type used later —follow the steps and you can do the Practice and Exam-style questions yourself.

■ 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.

■ Releasing energy

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



■ Recharging

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

■ A worked link

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

2 Practice

Now apply the methods above.

2.1 What does ATP stand for and store? [1]

2.2 Write the reaction when ATP releases energy. [1]

2.3 How is ATP recharged? [1]

3 Exam-style questions

3.1 Energy is released from ATP when it is converted to [1]

- **A** ADP + phosphate
- **B** glucose
- **C** DNA
- **D** a lipid

3.2 A muscle cell uses ATP to contract.

(a) Write the hydrolysis reaction of ATP. [2]

(b) Explain how this powers the contraction (coupling). [2]

3.3 Explain why ATP is described as a "rechargeable" energy currency. [2]

4 Go further

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

- work through the **3.3 Cellular Energy and ATP** lesson on the **Learn** page;
- read the **Cellular Energy and ATP** section of the AP Biology handout on the **Know** page.

Solutions

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

2.2 $\text{ATP} \rightarrow \text{ADP} + \text{P}_i + \text{energy}$.

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

3.1 A —ADP + phosphate.

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

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