AP BIOLOGY • EXERCISE SHEET

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 ATP $\rightarrow$ ADP + 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:

$$\text{ATP} \rightarrow \text{ADP} + P_i + \text{energy}.$$

Recharging

The energy from respiration is used to **rebuild** ATP from ADP + 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 ATP $\rightarrow$ ADP + P_i + energy.

2.3 Energy from respiration rebuilds ATP from ADP + P_i.

3.1 A —ADP + phosphate.

3.2 (a) ATP $\rightarrow$ ADP+P_i+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 ADP + P_i (used), and respiration re-adds the phosphate to remake ATP (recharged); this cycle repeats continuously.