Exercise walk-through

Photosynthesis ▪ 3.4

eXercise

You must be able to

- write the overall equation and locate the two stages
- describe the **light reactions 光反应** and the **Calvin cycle 卡尔文循环**
- state the inputs and outputs of each stage

Method — The overall reaction

$$6\mathrm{CO_2} + 6\mathrm{H_2O} \xrightarrow{\text{light}} \mathrm{C_6H_{12}O_6} + 6\mathrm{O_2}.$$

Plants use light energy to build glucose from $\mathrm{CO_2}$ and water, releasing $\mathrm{O_2}$.

Method — The light reactions

In the **thylakoid** membranes, light energy splits water (releasing O_2) and makes **ATP** and **NADPH**. Inputs: light, water. Outputs: O_2, ATP, NADPH.

Method — The Calvin cycle

In the **stroma**, the ATP and NADPH power the **Calvin cycle**, which fixes CO_2 into **glucose** (sugar). Inputs: CO_2, ATP, NADPH. Output: sugar.

Method — A worked link

The two stages connect: the light reactions supply the ATP and NADPH that the Calvin cycle needs to build sugar from CO_2.

Practice 2.1 ▪ 2 marks

Write the overall equation for photosynthesis.

Solution 2.1

Worked steps

$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$ (with light) M1 A1.

Practice 2.2 ▪ 1 mark

Where do the light reactions occur?

Solution 2.2

Worked steps

In the thylakoid membranes of the chloroplast B1.

Practice 2.3 ▪ 1 mark

What gas is released by the light reactions?

Solution 2.3

Worked steps

Oxygen B1.

Exam-style 3.1 ▪ 1 mark

The Calvin cycle uses ATP and NADPH to make

A oxygen

B sugar (glucose)

C water

D light

Solution 3.1

A oxygen

B sugar (glucose) ✓

C water

D light

Worked steps

B — sugar (glucose).

Exam-style 3.2 ▪ 2 marks

A plant is photosynthesizing.
(a) State the inputs and outputs of the light reactions.
(b) Explain how the two stages of photosynthesis are connected.

Solution 3.2

Method: The light reactions

Worked steps

(a) Inputs: light and water; outputs: oxygen, ATP, and NADPH M1 A1. (b) The light reactions produce the ATP and NADPH that power the Calvin cycle to fix CO_2 into sugar M1 A1.

Exam-style 3.3 ▪ 2 marks

Explain why the release of oxygen comes from the splitting of water, not from carbon dioxide.

Solution 3.3

Worked steps

The light reactions split water molecules, and the oxygen atoms released come from that water (not from CO_2, whose carbon and oxygen go into sugar) M1 A1.