Solutions

Each answer shows the steps, then the **result**.

2.1

- **carbon dioxide + water → glucose + oxygen**

2.2

- magnesium ions are needed to make **chlorophyll**

2.3

- nitrate is needed to make **amino acids and proteins**
- without proteins the plant cannot build new cells, so **growth is stunted**

2.4

- a limiting factor is the factor in **shortest supply**, which holds back the rate

2.5

- $6\mathbf{CO_2} + 6\mathbf{H_2O} \rightarrow \mathbf{C_6H_{12}O_6} + 6\mathbf{O_2}$

3.1 B

- photosynthesis needs **chlorophyll** (and light)
- A is a mineral; C is a product; D is not required for the reaction itself

3.2

(a)

- another factor is now **limiting**
- e.g. CO_2 concentration or temperature

(b)

- **carbon dioxide concentration** (or temperature)

3.3

- any **two** of: stored as starch / made into cellulose / used in respiration / converted to sucrose

3.4

(a)

- the gas is **oxygen**
- it is a product, so more bubbles mean a **faster rate**

(b)

- **light intensity** is limiting
- temperature makes no difference because it is **not limiting** here

(c)

- light is no longer limiting, so both lines **level off**
- at 25 °C the enzymes work **faster** than at 15 °C
- **temperature** was limiting the 15 °C line

(d)

- enzymes are **denatured** at 45 °C
- active sites change shape, so the reaction **almost stops**

(e)

- any **two** of: lamp distance / CO_2 concentration / pondweed mass / volume of water / time counted

(f)

- the rate would **increase**
- at high light, CO_2 is limiting, so supplying more **removes that limit**