Answers to end-of-chapter questions Chapter 6: Plant nutrition

1

	Obtained from	Used for
Nitrates	the soil	making amino acids and proteins
Water	the soil	photosynthesis, maintaining turgor / supporting tissues, transporting substances
Magnesium	the soil	making chlorophyll
Carbon dioxide	the air	photosynthesis

2 a A chloroplast is an organelle that contains the pigment, chlorophyll. (A chloroplast is surrounded by two membranes. Folded membranes inside the chloroplast have molecules of chlorophyll on them.) Photosynthesis takes place inside chloroplasts, with the help of chlorophyll, which absorbs energy from light.

b The palisade layer is closer to the upper surface of the leaf than the spongy layer. The cells in the palisade layer are tall and thin, while the cells in the spongy layer are more rounded. The palisade cells contain more chloroplasts than the spongy cells. More photosynthesis takes place in palisade cells than in spongy cells. There are larger air spaces in the spongy layer than in the palisade layer.

c Organic substances have been made by living organisms, e.g. carbohydrates, proteins, vitamins. Inorganic substances have not been made by organisms, e.g. magnesium ions, water.

d Guard cells are pairs of sausage-shaped cells found in the epidermis of leaves (usually in the lower epidermis). The hole in between the pair of guard cells is a stoma.

3 a Carbon dioxide + water → glucose + oxygen.

b Carbon dioxide enters the leaf through stomata, by diffusion from the air. Water enters the root hairs, by osmosis from the soil and is then transported up the xylem to the leaf.

c Glucose is used to make starch, or to provide energy by respiration. Oxygen diffuses out of the leaf into the air, through the stomata.

4 a Carbon dioxide diffuses through the stoma and then through the air spaces, allowing it to reach the cells in the palisade layer. Oxygen diffuses in the opposite direction when photosynthesis is taking place. (When you have learnt about transport in plants, you will also find out that the air spaces are important for allowing the movement of water vapour out of the leaf.)

b This means that light can pass straight through these cells, so little light is lost before it reaches the palisade cells, where it is used in photosynthesis.

c The larger the surface area, the more sunlight will hit the leaf. This means that more energy can be absorbed by chlorophyll, so more photosynthesis can take place.

d The veins bring water from the soil to the leaf cells. By branching, they can bring water close to every cell. The cells need water for photosynthesis, and to maintain their turgor, helping the leaf to be held out straight.

e The membranes are surfaces on which chlorophyll molecules are held. This provides a large surface area of chlorophyll which can absorb energy from the light that hits it.

5 a sucrose. This is a soluble sugar, which can dissolve in water for transport. It is not too reactive.

b starch. This is an insoluble polysaccharide, which can be stored as solid grains in cells and not interfere with the reactions that take place in the cell. (It also does not affect the water potential of the cell; if sucrose was stored, this would tend to draw excess water into the cell by osmosis.)

6 The carbon dioxide molecule could move into a leaf by diffusion, through the stoma and air spaces. It could pass through the cell wall and cell membrane of a palisade cell, cross the cytoplasm and enter a chloroplast. Here, it could react with water to form glucose.
The glucose could be converted to sucrose and transported (in the phloem) down to the root. Here, it could be converted to starch for storage.

7 a i F; [1]

ii A; [1]

iii D. [1]

b i little light is lost before it reaches the palisade cells, where it is used in photosynthesis; [1]

ii the waxy cuticle prevents water loss through this surface of the leaf; [1]

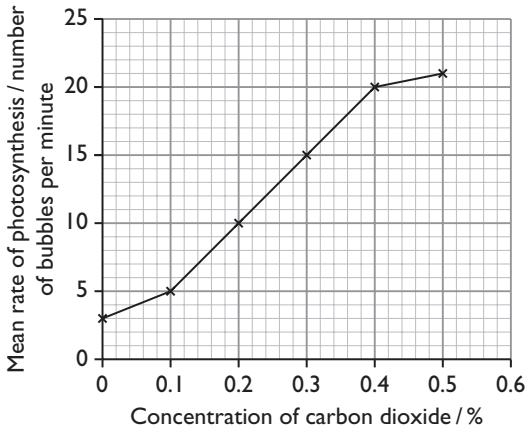
iii bring water to the leaf;
take sucrose away from the leaf;
help to support the leaf; [max 2]

c i carbon dioxide;
water; [2]

ii some is used in respiration to release energy;
some is converted to starch for storage;
some is used to make cellulose cell walls for new cells;
some is converted to sucrose for transport to other parts of the plant;
some is converted, with the addition of nitrogen, to amino acids;
some is converted to, fats / lipids; [max 4]

8 a lamp kept at the same distance / light intensity kept constant;
similar pieces of pond plant used;
temperature kept constant / reference to water bath and thermometer;
number of bubbles counted over the same time period;
same volume of solution in the test tube; [max 4]

b i 10; [1]

ii 

suitable scales on both axes **and** fully labelled;
all points correctly plotted **and** straight lines drawn between points / best fit line drawn; [2]

c rate of photosynthesis increases;
carbon dioxide is used in photosynthesis;
carbon dioxide is a limiting factor; [max 2]

d any number between 19 and 23;
explanation about how the line was extrapolated;
carbon dioxide is not a limiting factor;
temperature / light intensity, may be a limiting factor; [max 3]

e tap water contains some dissolved carbon dioxide;
bubbles may have contained oxygen from photosynthesis; [max 1]