

A Level Biology A
H420/01 Biological Processes

Question Set 3

- 3 (a) Light intensity, carbon dioxide concentration and temperature are all limiting factors in photosynthesis.

Explain what is meant by a **limiting factor**.

A factor that limits the rate of a reaction when in short supply.

[2]

- 3 (b) (i) An investigation was carried out into the effect of adding different volumes of water on the survival of seedlings. There were 60 seedlings in each group. The results are shown in Table 18.

Volume of water added to soil (cm ³)	Day	Number of seedlings surviving
10	3	60
	6	59
	9	59
	12	58
	15	57
	18	57
20	3	60
	6	57
	9	54
	12	54
	15	54
	18	53
30	3	60
	6	58
	9	56
	12	50
	15	50
	18	48
40	3	60
	6	48
	9	40
	12	34
	15	26
	18	20
60	3	60
	6	41
	9	21
	12	6
	15	2
	18	2

Table 18

Summarise the conclusions that can be drawn from these data.

[3]

As the volume of water added to soil increases, the number of seedlings surviving decreases. For example when 10cm³ of water is added, 57 seedlings survive by day 18 whereas when 60cm³ is added, only 2 seedlings survive by day 18. Up to the third day, the volume of water added to the soil does not affect seedling survival. For each volume, 60 seedlings survive to day 3.

- 3 (b) (ii) Water can fill air spaces in the soil surrounding the roots.

This prevents oxygen from reaching root hair cells.

Using your knowledge of aerobic and anaerobic respiration, explain why overwatering can kill plants.

[6]

Overwatering prevents oxygen from reaching root hair cells. In the absence of oxygen, pyruvate molecules cannot be passed across the mitochondrial membrane into the matrix, so the link reaction and therefore the Krebs cycle and oxidative phosphorylation cannot occur. There is also no oxygen to act as the final electron acceptor in the electron transport chain. Thus, aerobic respiration cannot occur. The plant must convert to anaerobic respiration in which only glycolysis occurs. Pyruvate is converted to ethanal and CO_2 . Ethanal serves as a hydrogen acceptor, enabling the reoxidation of NADH to NAD, producing ethanol and allowing glycolysis to continue. However, sustained anaerobic respiration will lead to the eventual death of plant cells. The build-up of ethanol becomes toxic, disrupting the structure of cell membranes and eventually leading to cell death. Moreover, less ATP is produced than in aerobic respiration, only 2 ATP by substrate level phosphorylation. Less ATP is therefore available for the absorption of minerals via active transport in root hair cells so the plant will be unable to produce, or will produce significantly fewer amino acids, DNA, chlorophyll etc. The plant will thus develop various nutrient deficiencies, limiting growth and reducing the rate of important reactions such as respiration and photosynthesis. Moreover a water potential gradient in root hair cells will not be generated, reducing the movement of water into root cells by osmosis. The rate of photosynthesis decreases and the plant may die.

- 3 (c) (i) Soluble mineral ions are present in soil.

Explain why water molecules can form hydrogen bonds with nitrate (NO_3^-) ions.

[2]

Water is a polar molecule and NO_3^- is negatively charged so hydrogen bonds can form between the O on NO_3^- and H on H_2O .

- 3 (c) (ii) Fig. 18 shows a process that occurs in the cell surface membrane of the endodermis in the root.

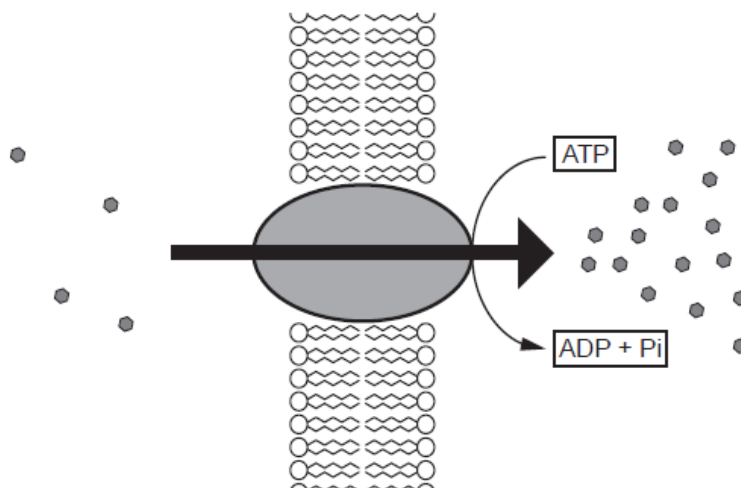


Fig. 18

Explain how the events shown in Fig. 18 cause water to enter the endodermis. [2]

Minerals and ions move across the endodermal cell surface membrane against the concentration gradient via active transport. This reduces the water potential of endodermal cells, so water moves across the cell surface membrane by osmosis, down the water potential gradient, into endodermal cells.

3 (d) Explain why a plant leaf is described as an organ. [4]

It is made up of a group of tissues adapted to perform a specific function. For example the leaf is made up of spongy mesophyll tissue and palisade mesophyll tissue which both function in photosynthesis.

Total Marks for Question Set 3: 19

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