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About

(PURE) BIOLOGY

(TOPICAL)

About Thinking Process

When solving problems, we first analyse the questions and then gather relevant information until we are able to determine the answers. But for presentation reason, we need to organise, rearrange and then present ONLY the required workings and solutions.

Thinking process reveals the extra but relevant information which is not required as part of the solutions.

About MCQ with HELPs

Explanations are given so that students know exactly why the answer is the right one.

period	2010 to 2022
contents	June & November, Paper 1 & 2, Worked Solutions
form	Topic By Topic
compiled for	O Levels
special features	Thinking Process, MCQ with HELPs

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'O' Level Biology 5090 (Topical)

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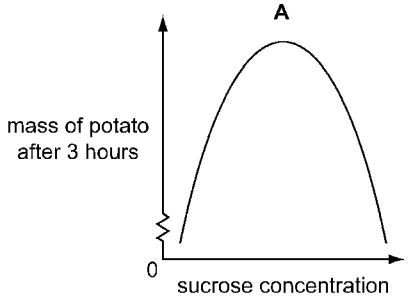
UNIT 3 Diffusion and Osmosis

MCQ Section

1. Identical pieces of potato are placed in sucrose solutions of different concentrations. After three hours, the mass of each potato piece is measured.

Which graph shows the results of this experiment?

A



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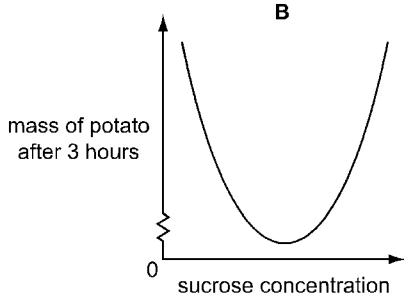

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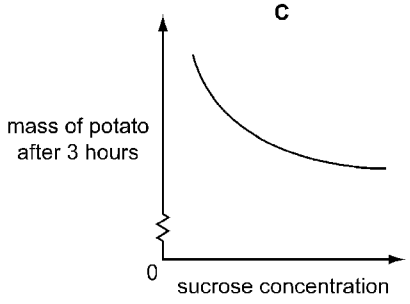

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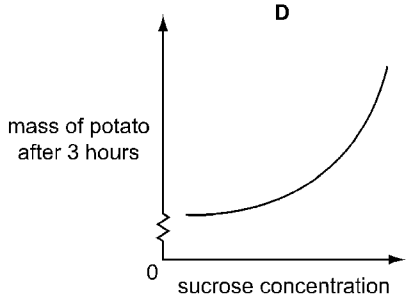


[J10/P1/Q4]

2. Which of these processes require energy from respiration?

	diffusion	osmosis
A	✓	✓
B	✓	×
C	×	✓
D	×	×

key

✓ = energy required

× = energy not required

[J10/P1/Q5]

3. Four identical pieces of potato are treated in two stages, as shown.

Which piece of potato will be largest after 2 hours?

	stage 1	stage 2
A	boiled in water for 10 minutes	placed in 10 % salt solution for 2 hours
B	boiled in water for 10 minutes	placed in distilled water for 2 hours
C	unboiled	placed in 10 % salt solution for 2 hours
D	unboiled	placed in distilled water for 2 hours

[N10/P1/Q14]

4. Below is a series of cell processes.

1 mineral ions entering root hair cells
2 glucose uptake by villus cells
3 water entering root hair cells

Which of these involve active transport?

A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

[J11/P1/Q2]

1. C By increasing sucrose concentration, water moves out of potato tissue, thus decreasing its mass. Sucrose concentration of 0.0% (distilled water) will allow potato pieces to absorb water by osmosis and increase in mass occurs.

2. D In fact, neither diffusion, nor osmosis requires energy from respiration. Active transport requires ATP or energy from respiration.

3. D In unboiled potato, metabolic processes continue. When placed in water, it moves into potato cells by endosmosis and causes the cells to expand by turgor pressure. Hence overall pieces of potato will be enlarged due to expansion.

4. C Mineral ions are taken up against the concentration gradient. Similarly glucose can diffuse but can be taken up by active transport. Water moves by osmosis.

5. The sentence describes the uptake of water by a plant.

Water moves into the root hairs of a plant by osmosis through a .....1.... permeable cell membrane, ...2... a water potential gradient.

Which words correctly complete gaps 1 and 2?

	1	2
A	fully	down
B	fully	up
C	partially	down
D	partially	up

[J11/P1/Q3]

6. Which process needs energy from respiration?

A movement of carbon dioxide into the alveoli

B movement of oxygen into red blood cells

C uptake of glucose by cells in the villi

D uptake of water by root hair cells

[N11/P1/Q2]

7. The mass of a cube of fresh potato is found. It is then placed in a test-tube containing a dilute solution of sucrose. After an hour, its mass has increased.

Which process has occurred and what has happened to the concentration of the sucrose in the solution in the test-tube?

	process	sucrose concentration
A	active transport	decreased
B	active transport	increased
C	osmosis	decreased
D	osmosis	increased

[N11/P1/Q3]

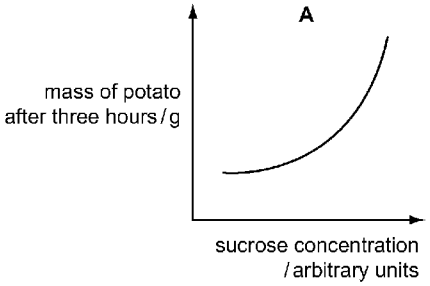
8. Which processes can **only** occur through a membrane?

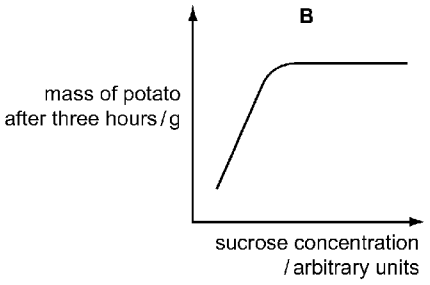
	active transport	diffusion	osmosis
A	✓	✓	✓
B	✓	✓	×
C	✓	×	✓
D	×	✓	✓

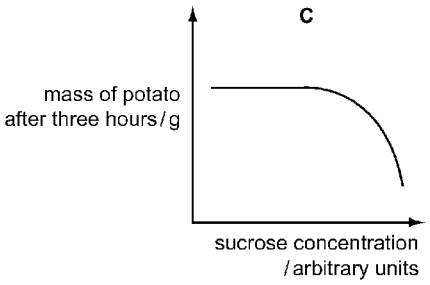
[J12/P1/Q2]

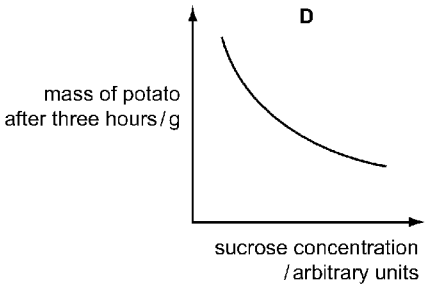
9. Identical pieces of potato are placed in sucrose solutions of different concentrations. After three hours, the mass of each potato piece is measured.

Which graph shows the results of this experiment?









[J12/P1/Q3]

5. C Osmosis occurs through a partially permeable membrane down a water potential gradient, i.e., from higher to lower water potential.

6. C Uptake of glucose by cells in the villi is done by active transport which needs energy. Movement of CO_2 and O_2 occurs by diffusion while uptake of water is done by osmosis.

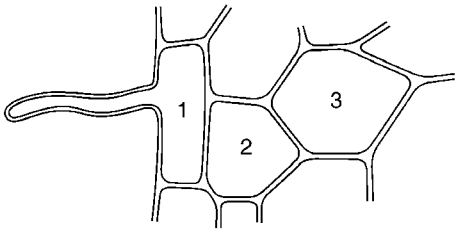
7. D Potato cells also contain sucrose. As cube of potato is placed in a dilute solution which has comparatively higher water potential, so endosmosis occurs and its mass increases due to inward movement of water. Due to decrease in water content, sucrose concentration of the solution increases.

8. C Diffusion does not need any separating membrane like partially permeable membrane. It can occur through any medium.

9. D In a solution with a low sucrose concentration, the potato pieces will take in water by endosmosis. As the sucrose concentration increases, there is less increase in mass and eventually no increase, rather decrease in mass occurs as water moves out by exosmosis.

Thinking Process

10. The diagram shows some cells in the root of a plant that is absorbing water from the soil.



How does the water potential of the cell marked 2 differ from the water potentials of the cells marked 1 and 3?

A higher than cell 1 and cell 3

B higher than cell 1 and lower than cell 3

C lower than cell 1 and higher than cell 3.

D lower than cell 1 and lower than cell 3

[N12/P1/Q3]

11. What is an example of active transport?

A movement of glucose molecules into the cells of the villi

B movement of glucose molecules down a concentration gradient

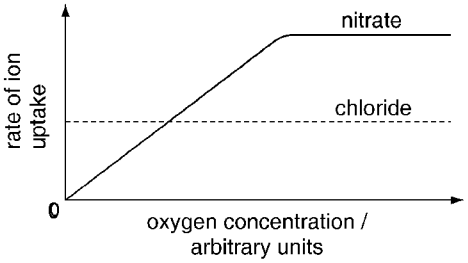
C movement of ions in blood plasma

D movement of water in the transpiration stream

[J13/P1/Q2]

12. The roots of a plant are placed in a dilute solution containing chloride and nitrate ions.

The graph shows how the rate of uptake of chloride and nitrate ions by the roots of the plant varies with oxygen concentration.

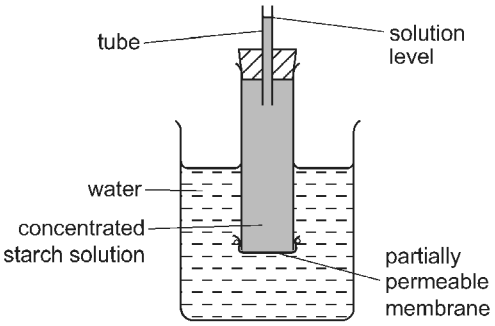


What can be concluded about how chloride and nitrate ions enter the roots?

	chloride	nitrate
A	active transport	active transport
B	active transport	diffusion
C	diffusion	active transport
D	diffusion	diffusion

[J13/P1/Q3]

13. The diagram represents apparatus used to investigate osmosis.



Which molecules will move across the partially permeable membrane and which change will occur in the solution level?

	molecules	solution level
A	starch	fall
B	starch	rise
C	water	fall
D	water	rise

[N13/P1/Q2]

14. The small intestine of a person contains a lower concentration of glucose than is present in the blood.

The cells of the villi absorb glucose.

By which process is the glucose absorbed?

A by active transport against the concentration gradient

B by active transport with the concentration gradient

C by diffusion against the concentration gradient

D by diffusion with the concentration gradient

[N13/P1/Q3]

MCQ Answers

10. C As water moves from cell 1 (root hair cell) to cell 2 and then cell 3, gradually water potential decreases from cell 1 to 3.

11. A Cells of villi use active transport to absorb maximum glucose from small intestine.

12. C Constant line for chloride shows that its uptake is not affected by oxygen supply, whereas uptake of nitrate requires oxygen supply until the mechanism reaches its maximum.

13. D Beaker contains water, so it has highest water potential, while starch solution has lower water potential. So water moves by osmosis through partially permeable membrane, which causes solution level in tube to rise.

14. A For movement of a substance from lower to higher concentration, active transport is required. It is an energy dependent process.

Thinking Process

MCQ Answers

15. Which statement is always correct when oxygen is diffusing out of a plant cell?

A The concentration of carbon dioxide is higher inside the cell than outside.

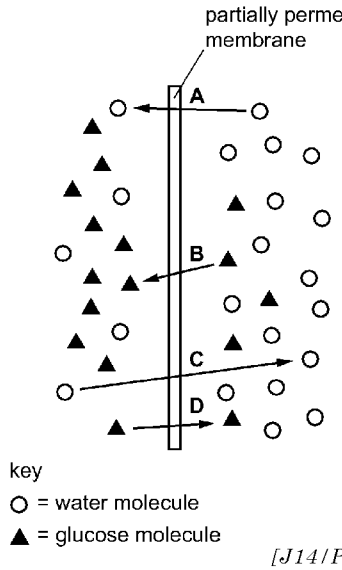
B The concentration of carbon dioxide is higher outside the cell than inside.

C The concentration of oxygen is higher inside the cell than outside.

D The concentration of oxygen is higher outside the cell than inside.

[J14/P1/Q2]

16. The diagram represents the passage of water molecules and glucose molecules across a partially permeable cell surface membrane. Which arrow indicates osmosis?



[J14/P1/Q3]

17. Active transport, diffusion and osmosis are described below.

1 the movement of ions or molecules across the cell membrane against a concentration gradient using energy

2 the movement of ions or molecules from a region of high concentration to a region of low concentration down a concentration gradient

3 the movement of water molecules from a region of their higher concentration to a region of their lower concentration through a partially permeable membrane

What links the descriptions with their names?

	diffusion	osmosis	active transport
A	1	3	2
B	2	1	3
C	2	3	1
D	3	2	1

[N14/P1/Q2]

18. A cube of fresh potato is weighed. It is then placed in a test-tube containing a dilute solution of sucrose. After an hour, its mass has increased.

Which process has occurred and what has happened to the concentration of the sucrose in the solution in the test-tube?

	process	sucrose concentration
A	active transport	decreased
B	active transport	increased
C	osmosis	decreased
D	osmosis	increased

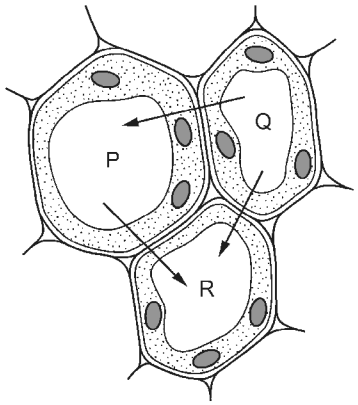
[N14/P1/Q3]

19. Which processes are responsible for the uptake of ions from the soil by a plant and the uptake of glucose into the villi of a human?

	uptake of ions by a plant	uptake of glucose into the villi
A	active transport	active transport
B	active transport	osmosis
C	diffusion	osmosis
D	osmosis	active transport

[J15/P1/Q2]

20. The diagram shows three plant cells labelled P, Q and R. The arrows show the direction of water movement by osmosis.



15. C Oxygen is diffusing down the concentration gradient, so it moves outside.

16. A Osmosis is movement of water molecules from region of higher to lower water potential across a partially permeable membrane.

17. C Osmos means water, so osmosis refers to movement of water molecules. Diffusion occurs down the concentration gradient while active transport occurs against a concentration gradient.

18. D Dilute solution has higher water potential, so water moves into potato cells down water potential gradient, so the concentration of sucrose in solution increases.

19. A Both processes involve active transport.

UNIT 5 Plant Nutrition

THEORY Section

Question 1

A container is filled with water. Nutrient salts and several floating water plants are then added to the water. Fig. 2.1 shows a graph of the concentration of nitrate ions in the water over the following ten days.

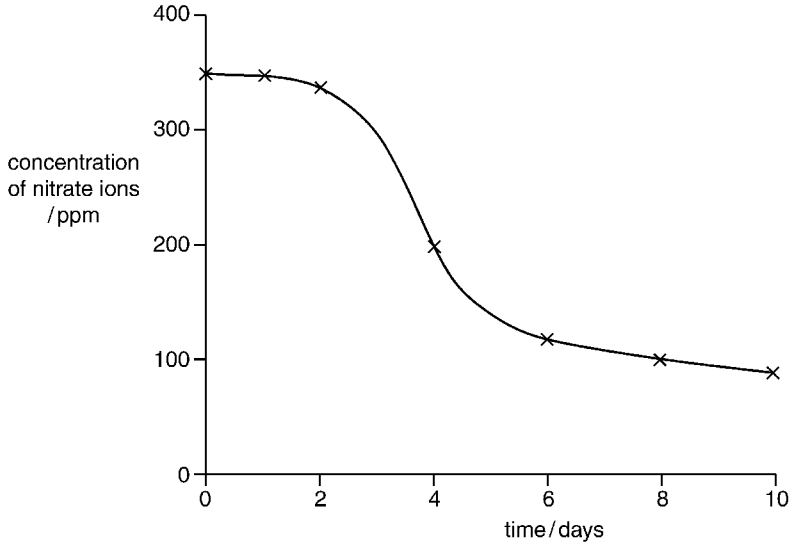


Fig. 2.1

(a) Use the graph to estimate the concentration of nitrate ions on day 5. [2]

The plants in the container grew at their fastest rate between days 2 and 5.

(b) (i) Explain why they grew fastest during this time. [3]

(ii) Suggest **one** way in which the rate of growth could have been further increased during this time. [1]

(c) A second container was set up in exactly the same way except that a chemical that slows down the rate of respiration was added to the water. Suggest and explain the effect that this chemical would have on the rate of growth of the plants. [3]

[J10/P2/Q2]

Solution

(a) 135 - 145 ppm (parts per million)

(b) (i) Initially there was higher concentration of nitrates in water which were absorbed by plants and used to make amino acids and proteins. It caused fastest growth. With passing days concentration of nitrates decreased.

(ii) Rate of growth is increased by keeping the constant optimum temperature.

(c) It will cause slower uptake of nitrates by active transport, because slow rate of respiration provides lesser energy needed for active transport of minerals. Proteins are also manufactured more slowly and rate of growth and metabolic rate of plant slows down.

COMMENT on **ANSWER**

"**(a)** Perpendicular is drawn on graph for day 5 at *x*-axis and concentration of nitrate ions in ppm is read by corresponding perpendicular drawn on *y*-axis.

(b) **(i)** Protoplasm of cells in plants is synthesized rapidly by absorption of nitrates and cell division occurs. Initially plants are not yet fully grown, so there is less competition for nutrients.

(ii) More light and addition of more nitrates or removal of some water plants to decrease competition many increase rate of growth. "

Question 2

(a) Describe how a molecule of carbon dioxide in the air becomes part of a carbohydrate molecule stored in a leaf of a plant. [7]

(b) Describe how a carbohydrate molecule stored in a leaf of a plant can become a starch molecule stored in the root. [3]

[J10/P2/Q6]

Solution

(a) Carbon dioxide enters through stomata into the intercellular or air spaces of leaf by diffusion and dissolves in water droplets. Then it enters palisade and spongy mesophyll cells. Mesophyll cells contain chloroplasts, where water reacts with carbon dioxide in the presence of light which is absorbed by chlorophyll pigment. Photolysis of water also occurs by which oxygen is produced. Due to reaction between water and carbon dioxide, glucose is formed which is also converted to starch.

$$6CO_2 + 6H_2O \xrightarrow[\text{Chlorophyll}]{\text{Light}} C_6H_{12}O_6 + 6O_2$$

(b) Starch in leaf is broken down by amylase and sucrose is synthesized from glucose. It is dissolved in solution and as a part of cell sap translocated through phloem from cells of leaf into the cells of root where it is stored as starch

COMMENT on **ANSWER**

"(a) In leaf, guard cells of stomata also use CO_2 in photosynthesis to make sucrose. Guard cells contain many chloroplasts. Here formation of sucrose helps in osmosis and thereby, in opening of stomata

(b) When cell sap enters roots cells, then sucrose is again converted to starch for storage."

Question 3

Fig. 3.1 shows a water plant, bladderwort, that lives under water in a small lake. The bladderwort traps then digests small water animals such as water fleas.

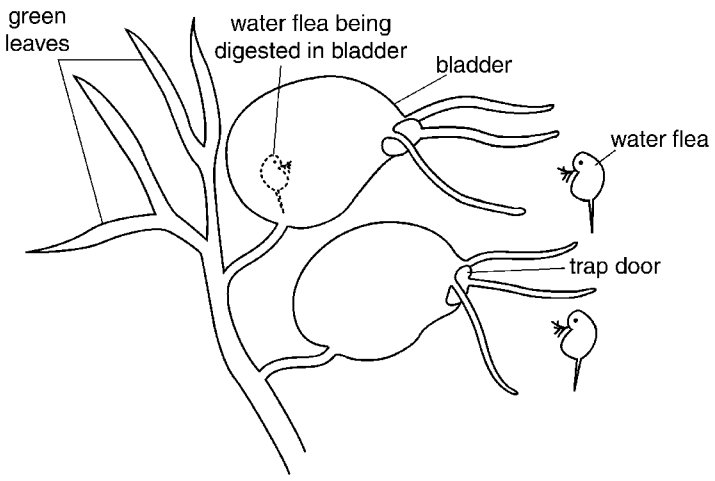


Fig. 3.1

(a) (i) State the process by which the plant is likely to obtain its carbohydrates. [1]

(ii) Suggest how the raw materials for this process are made available to the plant. [4]

The plant is able to supplement its nitrogen requirements by absorbing products from the digested water fleas.

(b) (i) Name an enzyme the plant must produce in its bladder in order to allow it to carry out this process. [1]

(ii) Name the chemicals absorbed by the bladder after digestion and suggest how the plant uses them. [3]

(c) State the form in which nitrogen-containing chemicals are absorbed by a plant growing on land. [1]

[N10 / P2 / Q3]

Solution

(a) (i) Photosynthesis.

(ii) CO_2 from atmosphere/ air/ environment is absorbed and water already present in plant reacts with it to form glucose and release oxygen, i.e., $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$. Glucose is further converted into other carbohydrates like sucrose and starch.

(b) (i) Protease/some named protease.

(ii) *name:* Amino acids

use: Amino acids are used to make plant proteins. Some are used for growth and repair process.

(c) Nitrates.

COMMENT on **ANSWER**

"**(a)** **(ii)** CO_2 is dissolved in lake water from air or through respiration of bladderwort itself. Only equation of photosynthesis is not enough. It must be explained.

(b) **(i),(ii)** Pepsin, trypsin are also proteases which digest proteins to make amino acids and peptones. Amino acids are also used to make components of protoplasm or cytoplasm."

Question 4

Fig. 6.1 and Fig. 6.2 show two tissues found in plants.

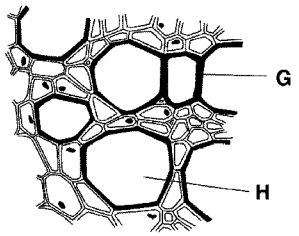


Fig. 6.1

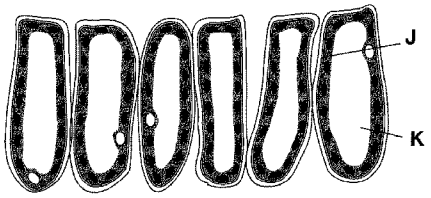


Fig. 6.2

Identify the tissues and describe their functions. Your descriptions should make appropriate reference to the importance of **G**, **H**, **J** and **K**.

[N12 / P2 / Q6]

Solution

name of tissue in Fig. 6.1: Xylem

description: Wall (G) of Xylem vessels or cells is strengthened by deposition of lignin. It provides support to Xylem and keeps its wall firm or straight. Xylem has hollow lumen of its vessels which helps in carriage of water. Mineral ions or salts are also soluble in water, so a solution of salts / minerals is transported by Xylem.

name of tissue in Fig. 6.2: Palisade mesophyll

description: This tissue is found in leaves and photosynthesis occurs here to make carbohydrates. J is the cell membrane of mesophyll cells which is partially / differentially / selectively permeable. So it allows or controls entry into or out of cell of water by osmosis or diffusion of substances. Water is used in photosynthesis. K is a space representing a vacuole containing cell sap. Due to photosynthesis, soluble substances make cell sap containing sucrose, amino acids and water. Due to difference of water potential, water may fill the vacuole and develop turgidity.

COMMENT on **ANSWER**

"Note that in Fig. 6.1 xylem consists of cylindrical vessel cells and hexagonal tracheid cells. Both have lignified cell walls. Apart from transport of water and minerals, xylem also provides support to stems, branches and leaves.

In Fig. 6.2 palisade mesophyll contains rectangular, columnar cells which are closely packed and chloroplasts are mainly visible along with vacuole and nucleus. Photosynthesis occurs here, i.e., $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$"

Question 5

Fig. 4.1 shows a large jar in which plants are growing.

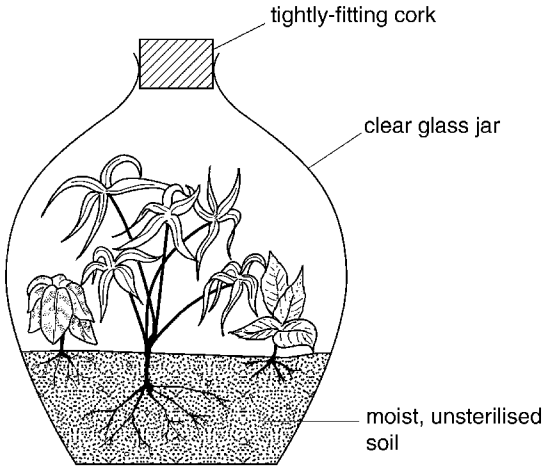


Fig. 4.1

This jar provides an environment in which plants can live for many months without adding water or removing the tightly-fitting cork to allow air to enter.

(a) State the reason for placing the jar where it can receive a supply of sunlight. [1]

(b) Suggest why the plants in the jar show only very limited growth compared with similar plants growing under natural conditions. [3]

(c) The cork prevents atmospheric air from entering the jar. Explain how the plants are able to remain alive without a continuous supply of fresh air. [4]

(d) Explain why no water needs to be added to the jar. [3]

[N13 / P2 / Q4]

Solution

(a) Jar is placed in sunlight for photosynthesis by which plant can make food or glucose and starch.

(b) Jar provides limited salts or minerals. There are limited nitrates so limited proteins are produced. There is limited magnesium, so limited chlorophyll is synthesized. Also there is limited CO_2, so lesser photosynthesis occurs and there is limited production of food or glucose and starch.

(c) Both respiration and photosynthesis are occurring in plants growing in jar. Due to respiration, CO_2 is released, which is used for photosynthesis, while photosynthesis releases oxygen, which, in turn, is used for respiration. So plants are exchanging CO_2 and O_2 in the closed environment of jar.

(d) Water evaporates from soil and is also diffused out of leaves by transpiration. Respiration in plants also produces water. Water from air inside condenses and returns to soil. Some water is absorbed and used by plants.

COMMENT on **ANSWER**

❝ (b) Jar has limited space or volume, so there is limited area for growth of plants.

(c) Soil in the jar contains microorganisms like bacteria, fungi etc, which are decomposers. Due to these organisms gases are also produced to be used by plants. ❞