4(a)

Understand that photosynthesis is the <u>fundamental process</u> by which plants manufacture carbohydrates from raw materials

Raw materials for photosynthesis

Carbondixide is absorbed by the land plants from surrounding atmosphere through leaves by diffusion where as equatic plants absorbed dissolved carbondixide from the surrounding water

Water is absorbed from the soil through the roots and transport to the leaves

Product of photosynthesis

Sugar (glucose)

- Used during respiration
- Converted to sucrose and transported to other parts
- Converted to cellulose
- Converted to protein or fats.
- Converted to starch and stored

By product of photosynthesis

Oxygen

- Used during respiration or
- Diffuses out of the leaves through the stomata,

Importance of photosynthesis

- Makes light energy available to the plants and animals in the form of chemical energy
- Chemical energy stored in fossil fuel is released upon combustion.
- Maintains the balance of atmospheric gases

Question 25

The diagram shows some chemical reactions that occur in plants.

carbon dioxide and water $\xrightarrow{1}$ sugars $\xrightarrow{2}$ amino acids $\xrightarrow{3}$ proteins

Which stage or stages depend on the use of nitrate ions as a raw material?

A 1 only

B 2 only

C 1 and 3 only

D 2 and 3 only

Question 26

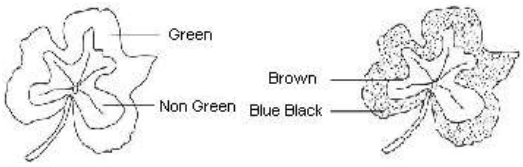
In photosynthesis, which substances are used up, which are produced and which are necessary but remain unchanged after the reaction?

	used up	produced	remain
A	carbon dioxide	water	oxygen
B	chlorophyll	carbon dioxide	water
C	oxygen	starch	cellulose
D	water	oxygen	chlorophyll

4(b) **Investigate the necessity for chlorophyll, light and carbon dioxide (CO_2) for photosynthesis, using appropriate controls**

Investigate that chlorophyll is needed for photosynthesis

- Take a variegated leaf from a plant in bright light.
- Make an outline of the leaf.



- Test for starch
- **Observe the color change**

The part that was green is turned blue black where as the white part turn brown

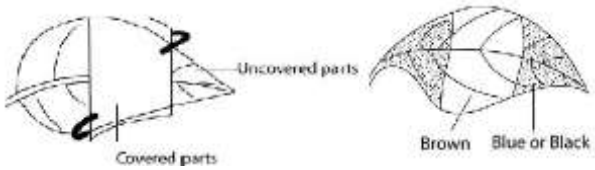
Explain the colour change

The green part of the plant turned blue black shows that the starch is synthesized in the green part by photosynthesis.

Investigate that light is needed for photosynthesis

1. Destarch a potted plant
2. Cover one of the leaves with black paper.
3. Expose to light for 4 to 6 hrs
4. Detach the leaf.
5. Test the leaf for starch.

Observe the color change



Test for Starch:

- boiling in water.

Denatures enzymes

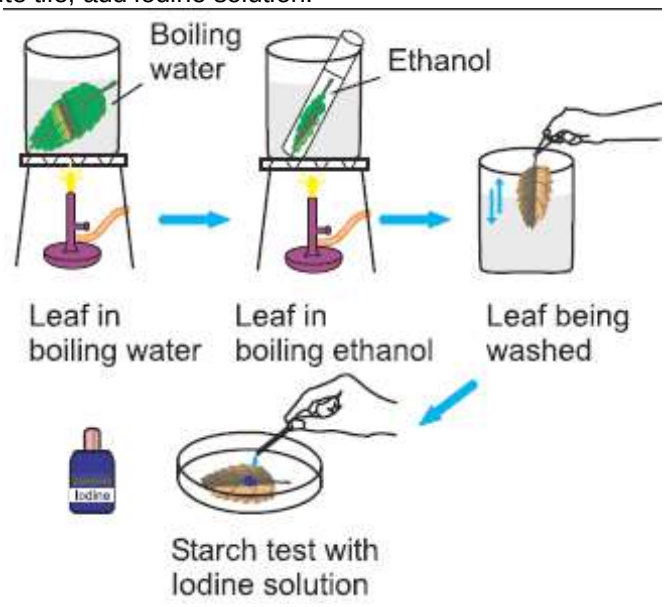
Removes wax

- Boil the leaf in ethanol using a water bath.

As chlorophyll dissolves in ethanol.

Ethanol in highly inflammable. (leaf becomes white + brittle)

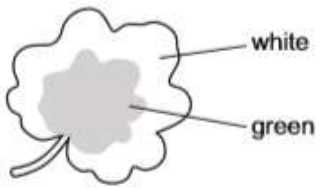
- Dip in water – softens the leaf.
- Place the leaf on a white tile, add iodine solution.



	Investigate that CO_2 is needed for photosynthesis 1. Destarch two potted plants by placing them in the dark for two to three days 2. Cover one with a plastic bag. 3. Place a beaker with a chemical that absorbs CO2 in one of them 4. Leave the other uncovered. 5. Leave in bright light for 4 to 6 hrs. 6. Detach a leaf from each plant 7. Test them for starch.

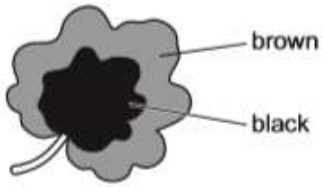
Question 27

A leaf was picked from a plant that had been in sunlight for eight hours.

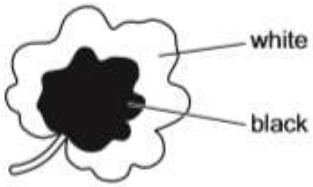


What does this leaf look like after it is tested with iodine solution?

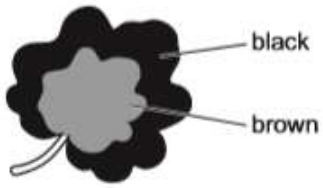
A



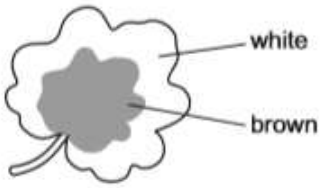
B



C

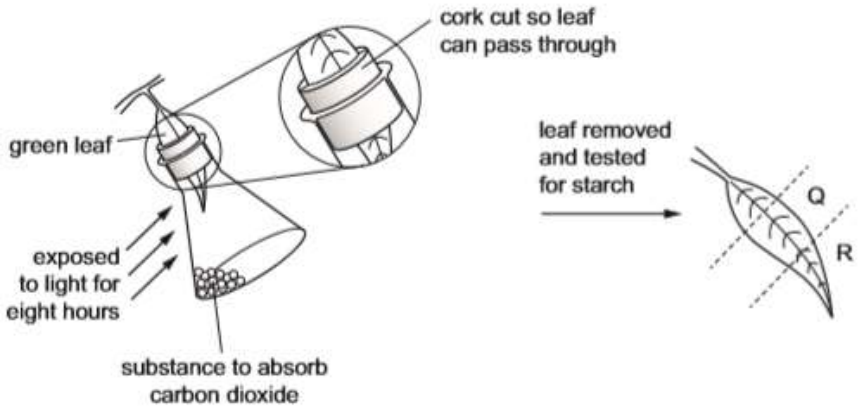


D



Question 28

7 A plant is kept in the dark for two days. One of its leaves is used in an experiment to investigate photosynthesis as shown in the diagram.

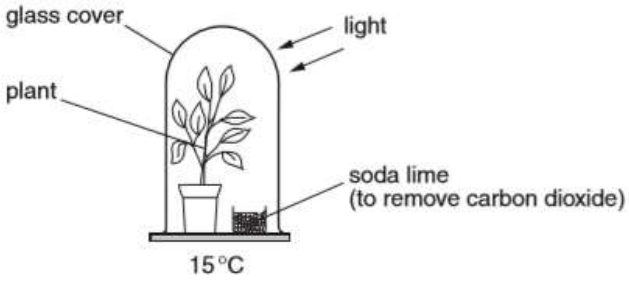


What are the colours of Q and R, when the leaf is tested for starch using iodine solution?

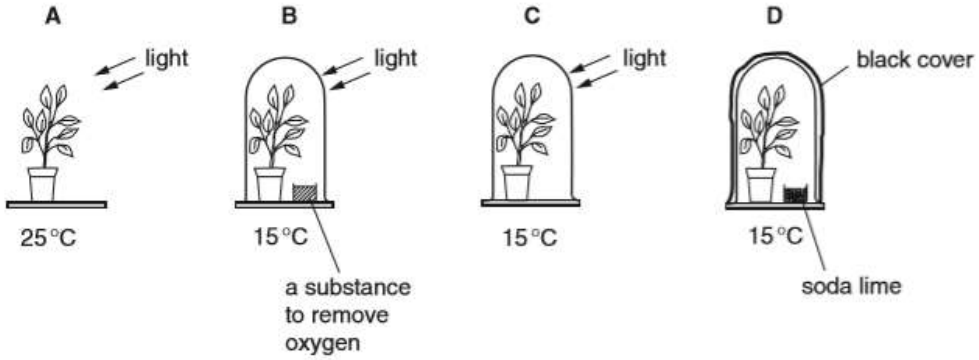
	Q	R
A	blue/black	brown
B	brown	brown
C	blue/black	blue/black
D	brown	blue/black

Question 29

The diagram shows an experiment to find out whether carbon dioxide is needed for photosynthesis.



Which is the most suitable control for this experiment?



4(c) **State the equation (in words or symbols) for photosynthesis**

Equation for photosynthesis:

Word equation:

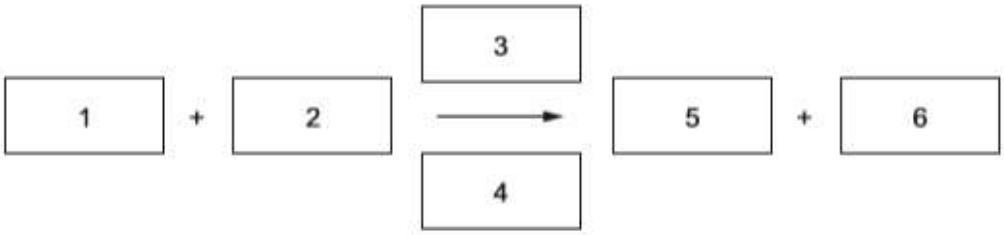
$$\text{carbon dioxide} + \text{water} \xrightarrow[\text{chloroplast}]{\text{light}} \text{glucose} + \text{oxygen}$$

Symbolic equation:

$$6CO_2 + 6H_2O \xrightarrow[chloroplast]{light} C_6H_{12}O_6 + 6O_2$$

Question 30

The equation for photosynthesis is represented below.



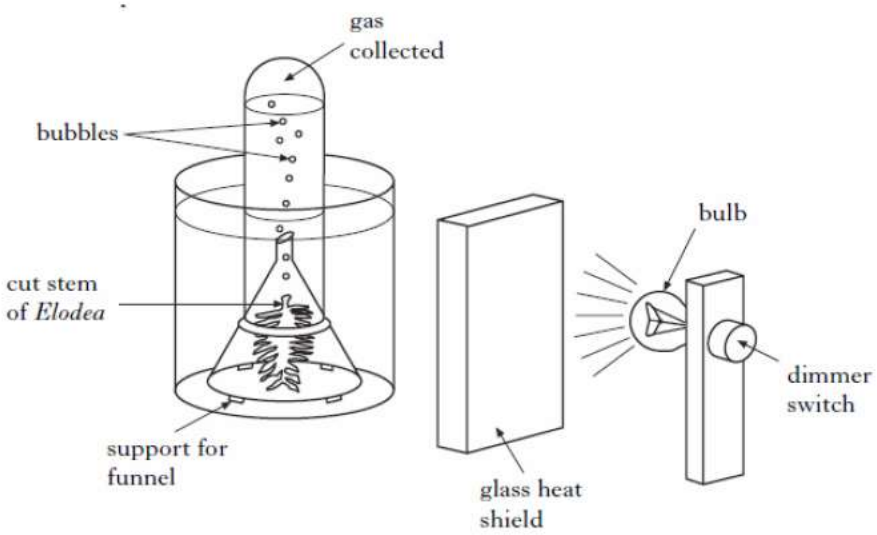
Which words should be in the boxes?

	1	2	3	4	5	6
A	oxygen	carbon dioxide	sunlight	chlorophyll	glucose	water
B	glucose	carbon dioxide	chlorophyll	sunlight	water	oxygen
C	carbon dioxide	water	sunlight	chlorophyll	glucose	oxygen
D	water	oxygen	chlorophyll	sunlight	glucose	carbon dioxide

4(d) **Investigate and state the effect of varying light intensity, carbon dioxide concentration and temperature on the rate of photosynthesis (e.g. in submerged aquatic plants)**

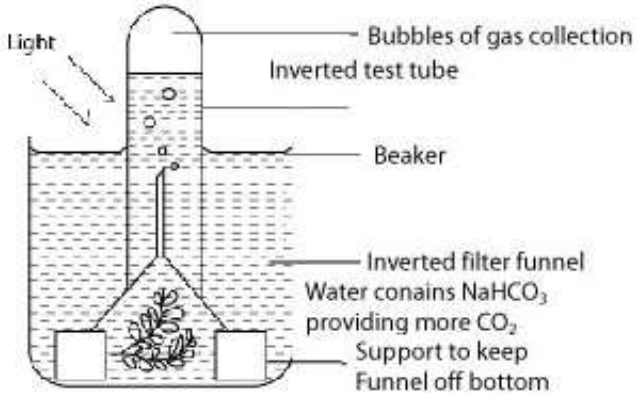
Investigate the effect of light intensity on the rate of photosynthesis

1. Take a beaker half filled with water.
2. Place a water weed in it.
3. Invert a funnel on the weed in the beaker.
4. A test tube is inverted on the neck of the funnel as shown in the apparatus in the fig below.
5. This apparatus is placed on the side of a table.
6. Place a lamp at a certain distance from the apparatus
7. Turn on the lamp and record the number of bubbles of oxygen released in a minute
8. Maintain the temperature constant.
9. Repeat this experiment by changing the distance of the lamp.



Investigate the effect of Carbon dioxide concentration on the rate of photosynthesis

1. Take a beaker half filled with water.
2. Place a water weed in it.
3. Invert a funnel on the weed in the beaker.
4. A test tube is inverted on the neck of the funnel as shown in the apparatus.
5. Add 1% calcium carbonate into the water in the beaker and record the number of bubbles of oxygen released in a minute
6. Maintain the light and Temperature constant
7. Repeat this experiment by changing the carbon dioxide concentration of the water in the beaker.

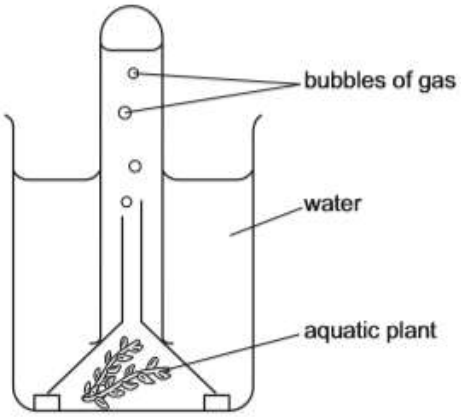


Investigate the effect of temperature on the rate of photosynthesis

1. Take a beaker half filled with water.
2. Place a water weed in it.
3. Invert a funnel on the weed in the beaker.
4. A test tube is inverted on the neck of the funnel as shown in the apparatus.
5. Set the temperature of the water bath at 20^{o}C and record the number of bubbles of oxygen released in a minute
6. Maintain the light and Carbondioxide concentration constant
7. Repeat this experiment by changing the temperature of the water bath at 30^{o}C and 40^{o}C.

Question 31

The diagram shows an experiment to investigate the volume of gas produced by an aquatic plant under different conditions of light intensity and temperature.



Which conditions result in the greatest production of gas by the plant?

	light intensity	temperature / °C
A	high	5
B	low	5
C	high	25
D	low	25

Question 32

A student investigates the effect of different colours of light on the rate of photosynthesis.

In three separate experiments, he shines red, blue, or green light onto an aquatic plant. The number of oxygen bubbles produced by the plant is counted.

Each experiment is carried out three times and the average number of bubbles calculated.

colour of light	average number of bubbles produced / minute
red	48
blue	37
green	12

What explains the results?

A Chlorophyll absorbs red and blue light more than green light.

B Green light is absorbed by the water.

C Most of the green light is absorbed by the chlorophyll.

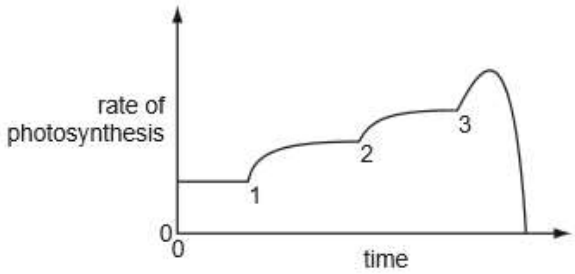
D Red light is used least in photosynthesis.

4(e)	**Understand the concept of limiting factors in photosynthesis**

Question 33

Temperature, light intensity and carbon dioxide concentration are three limiting factors in photosynthesis.

In an experiment, each factor is increased in turn. The graph shows the results.

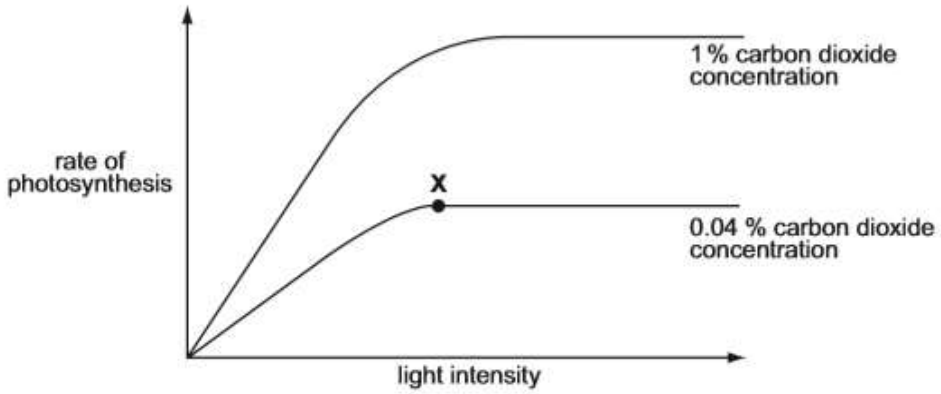


Which numbered points represent when each factor was increased?

	carbon dioxide concentration	light intensity	temperature
A	1	2	3
B	2	3	1
C	3	1	2
D	3	2	1

Question 34

The graph shows how the rate of photosynthesis of a plant varies with light intensity at two different carbon dioxide concentrations. The temperature is kept constant at 20 °C.



Which factor is limiting the rate of photosynthesis at point **X**?

A availability of chlorophyll

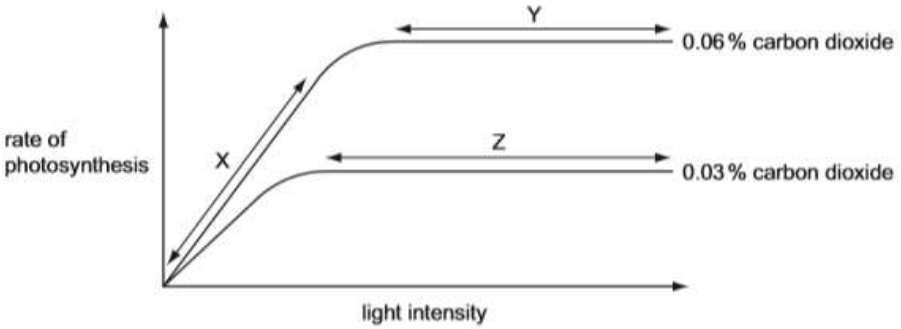
B availability of water

C concentration of carbon dioxide

D intensity of light

Question 35

2 The graph shows the rate of photosynthesis of a plant at increasing light intensities at two different carbon dioxide concentrations. The temperature is kept constant.



What may be limiting the rate of photosynthesis at X, Y and Z?

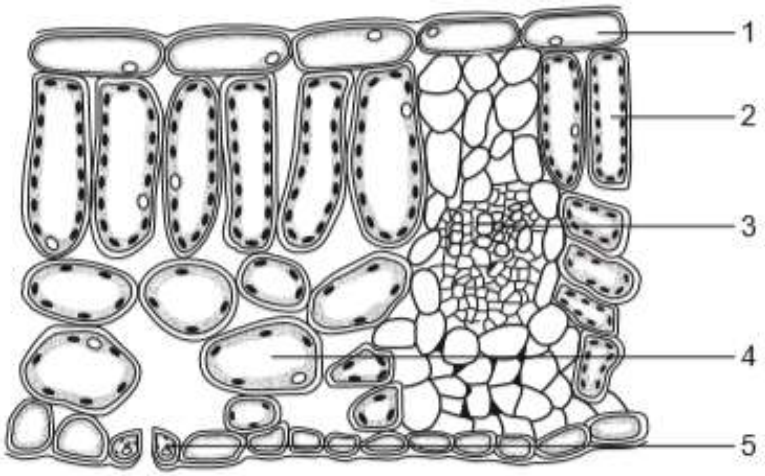
	X	Y	Z
A	carbon dioxide	light intensity	carbon dioxide
B	carbon dioxide	light intensity	light intensity
C	light intensity	carbon dioxide	carbon dioxide
D	light intensity	carbon dioxide	light intensity

4(f) **Describe the intake of carbon dioxide and water by plants**

Raw materials for photosynthesis
Carbondixide is absorbed by the land plants from surrounding atmosphere through leaves by diffusion where as equatic plants absorbed dissolved carbondixide from the surrounding water
Water is absorbed from the soil through the roots by diffusion and osmosis and transport to the leaves through xylem by transpiration pull

Question 36

5 The diagram shows a transverse section of a leaf.

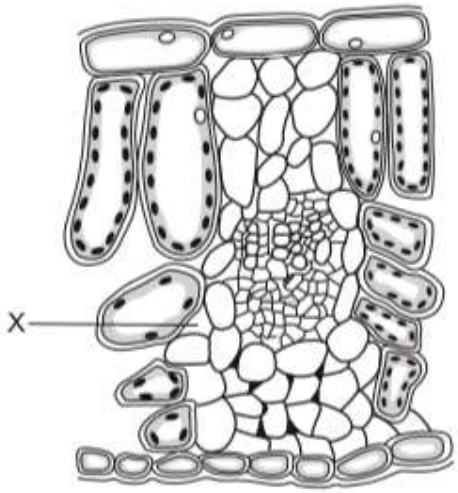


Which cells absorb carbon dioxide?

A 1, 2 and 3 **B** 2, 3 and 4 **C** 2, 4 and 5 **D** 1, 3 and 5

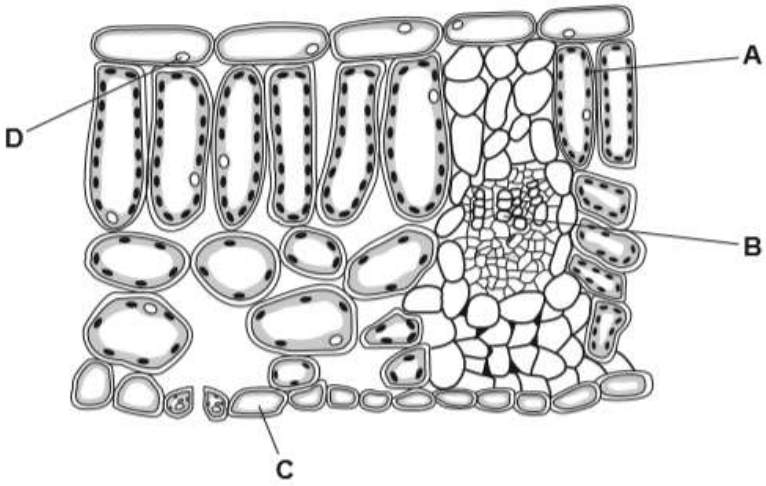
Question 37

The diagram represents a cross section of part of a leaf.



How does the oxygen content of the air at X compare to normal atmospheric air, when the leaf is in the light and when it is in the dark?

	in the light	in the dark
A	lower	the same
B	lower	higher
C	higher	the same
D	higher	lower

4(g)	**Understand that chlorophyll traps light energy and converts it to chemical energy for the formation of carbohydrates and their subsequent storage**
	Question 38 The diagram represents a cross section of a leaf under the microscope. Where is light energy converted into chemical energy? 

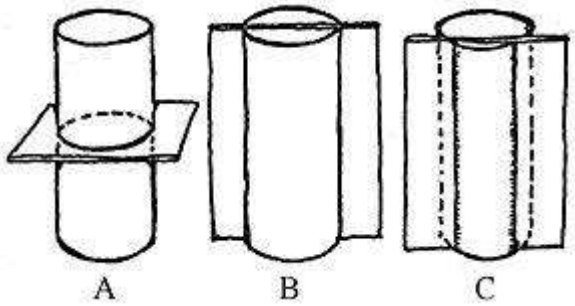
4(h)	**Explain why most forms of life are completely dependent on photosynthesis**
	Importance of photosynthesis • Makes light energy available to the plants and animals in the form of chemical energy • Chemical energy stored in fossil fuel is released upon combustion. • Maintains the balance of atmospheric gases

4(i)

Identify and label the cuticle, cellular and tissue structure of a dicotyledonous leaf, as seen in cross-section under the microscope, and describe the significance of these features in terms of function, i.e.

- **distribution of chloroplasts – photosynthesis**
- **stomata and mesophyll cells – gas exchange**
- **vascular bundles – transport.**

Cross section
A section cut at right angle to the length of an object

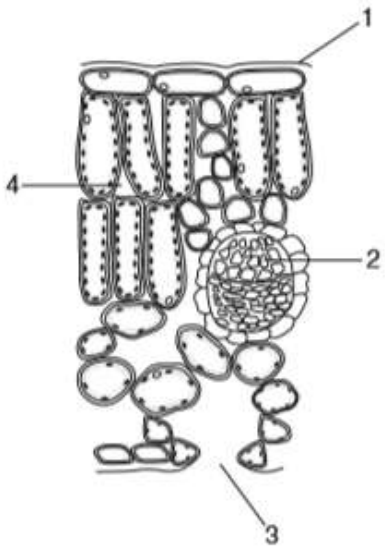


Longitudinal section
A section cut along the length of an object

Structure	Adaptation
Cuticle	• transparent, allows light to pass • waxy, prevents water loss
Upper epidermis	• Single layer of cells, less interception to light • Transparent, allows light to pass • No intercellular spaces, prevents water loss
Palisade mesophyll	• Cells are vertical and light easily hits the chloroplasts inside the cell. • Sap vacuole pushes the chloroplasts to the periphery. • More chloroplasts • Immediately below the upper epidermis
Spongy mesophyll	• Lobed cells, loosely arranged so leave intercellular spaces for gases exchange • Moist cell walls for gases exchange.
Vascular Bundle	• Xylem provides water and minerals to the leaf • Phloem carries the products of photosynthesis out of the leaf
Lower epidermis	• Has numerous stomata

Question 39

The diagram shows a cross-section of a leaf.



Where in the leaf does gaseous exchange occur?

A 1 and 2

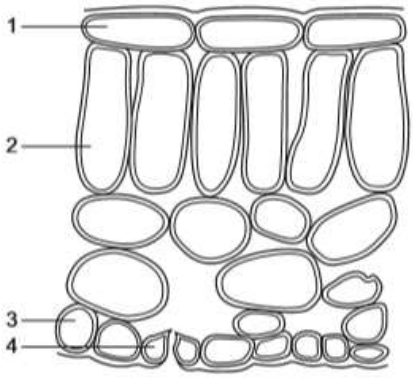
B 1 and 3

C 2 and 3

D 3 and 4

Question 40

The diagram shows cells in a section through a leaf of a typical green plant.
(No cell contents are shown.)



Which cells usually contain chloroplasts?

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

Question 41

The element nitrogen is needed to form

A fat.

B protein.

C starch.

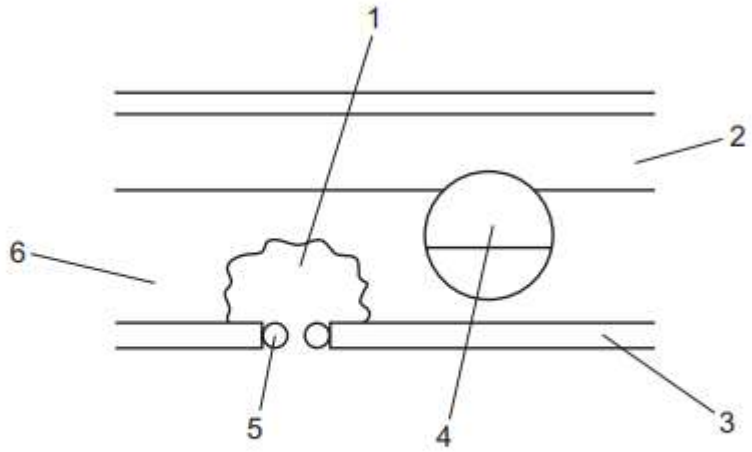
D sugar.

Question 42

What describes the upper cuticle of a leaf?
A a permeable layer allowing water to enter the leaf
B a single layer of cells containing many chloroplasts
C a single layer of transparent cells allowing light to enter the leaf
D a thin non-cellular layer preventing water loss from the leaf

Question

The diagram shows a cross-section of a dicotyledonous leaf.



Which labelled parts of the leaf carry out photosynthesis?

A 1, 2 and 3 **B** 1, 3 and 4 **C** 2, 5 and 6 **D** 4, 5 and 6

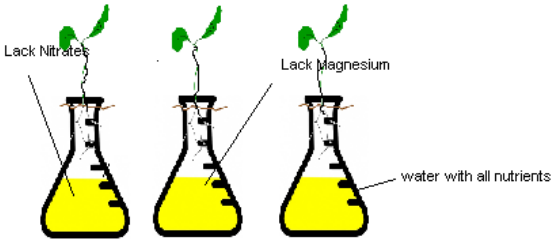
4(j) **Understand the effect of a lack of nitrate and magnesium ions on plant growth**

Describe and Explain effects of

i) Lack of nitrate – stunted growth.
Nitrate needed for protein synthesis
ii) Lack of magnesium cause yellowing of leaves
Magnesium needed for chlorophyll synthesis

Describe an experiment to investigate the affect of nitrates on the growth of a plant

1. Take to potted plants
2. Remove them from the soil and carefully wash their roots.
3. Place one in a culture solution provided with all nutrients and the other in lacking nitrates as shown in figure.
4. Maintain the temperature light and carbon dioxide constant.
5. After three weeks observe any changes in the two plants.
6. Repeat the experiment and take an average



Question 43

Which characteristic is the result of a deficiency of magnesium in plants?

A large green leaves

B purple spots on leaves

C reduced root growth

D yellow areas between leaf veins

Question 44

What is the effect of a lack of nitrate ions on plant leaves?

A all leaves are very dark green

B leaves lose their yellow colour

C the leaves wilt

D young leaves grow very slowly

Question 45

What are the signs of magnesium deficiency and nitrogen deficiency in leaves of plants?

1 purple spots on leaves

2 reduced growth of roots

3 reduced growth with loss of leaf colour

4 yellowing of leaves between the veins

	magnesium deficiency	nitrogen deficiency
A	2	1
B	2	3
C	4	1
D	4	3