

The Life of Plants

Question Paper

Level	Pre U
Subject	Biology
Exam Board	Cambridge International Examinations
Topic	The Life of Plants
Booklet	Question Paper

Time Allowed: 27 minutes

Score: /22

Percentage: /100

1 Molecules can be transported in several ways.

- 1 cohesion/tension
- 2 diffusion
- 3 mass flow
- 4 osmosis

Which row shows a correct method of transport for each situation?

	into capillaries	in phloem	out of stomata	in xylem
A	1	2	3	4
B	2	1	4	3
C	3	4	1	2
D	4	3	2	1

answer [1]

2 Stomatal opening is correlated with which one of the following events?

- A accumulation of potassium ions in the neighbouring epidermal cells by active uptake from the guard cells
- B membrane potential generated by ion movement so that the inside of the guard cell is more positive in charge relative to the outside
- C more negative water potential inside guard cells with respect to the external environment of the guard cells
- D proton pumps in the cell surface membrane of guard cells allow active uptake of hydrogen ions from neighbouring epidermal cells

answer [1]

- 3 Animals and plants use different types of transport systems and these are driven by energy from various sources.

Four sources are shown below.

- 1 chemical energy from ATP released at globular proteins
- 2 chemical energy from ATP released at fibrous proteins
- 3 kinetic energy
- 4 heat of vaporisation

Which sources are required for circulation, translocation and transpiration?

	circulation	translocation	transpiration
A	1	2	3
B	2	1	4
C	3	4	1
D	4	3	2

- 4 Many xerophytes have the following characteristics.

- 1 Crassulacean acid metabolism (CAM), with reversed stomatal cycles
- 2 high concentration of solutes in the vacuoles
- 3 cells have a more negative water potential (Ψ) than other plants
- 4 high root to shoot ratio
- 5 reduced leaf area and sunken stomata

Halophytes are plants adapted to live in salty habitats.

Which characteristics of xerophytes could also be found in halophytes?

- A 1, 2 and 4 only
- B 2, 3 and 5 only
- C 3, 4 and 5 only
- D 1, 2, 3, 4 and 5

5 What happens during the light-dependent reactions of photosynthesis?

- 1 ADP is hydrolysed.
- 2 ADP is phosphorylated.
- 3 ATP is hydrolysed.
- 4 ATP is phosphorylated.
- 5 NADP is oxidised.
- 6 NADP is reduced.

A 1 and 5 only

B 2 and 6 only

C 1, 4 and 5 only

D 2, 3 and 6 only

The processes numbered 1 to 7 in the table represent different photosynthetic processes in C3, C4 and CAM plants.

process number	process
1	cyclic photophosphorylation
2	non-cyclic photophosphorylation
3	photolysis of water
4	regeneration of ribulose biphosphate
5	C3 plant, light-independent stage
6	C4 plant, light-independent stage
7	CAM plant, light-independent stage

Match each of the following to the correct process number.

- 6** Carbon fixation occurs to produce organic acid which is stored overnight in vacuoles.

answer [1]

- 7** The ATP that is produced involves photosystem 1, but not photosystem 2.

answer [1]

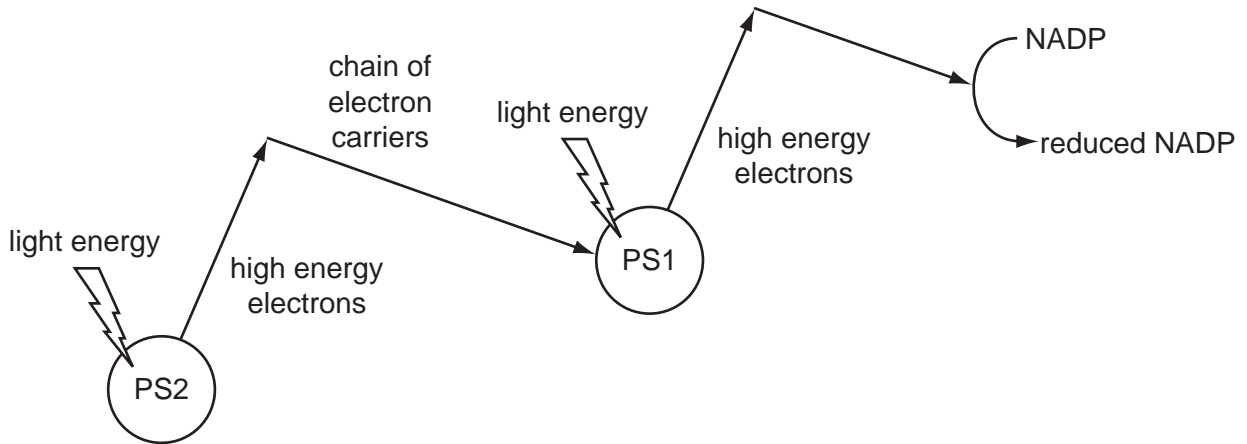
- 8** Carbon fixation occurs in the mesophyll cells and the products are transported to bundle sheath cells for decarboxylation.

answer [1]

- 9** The coenzyme NADP is reduced.

answer [1]

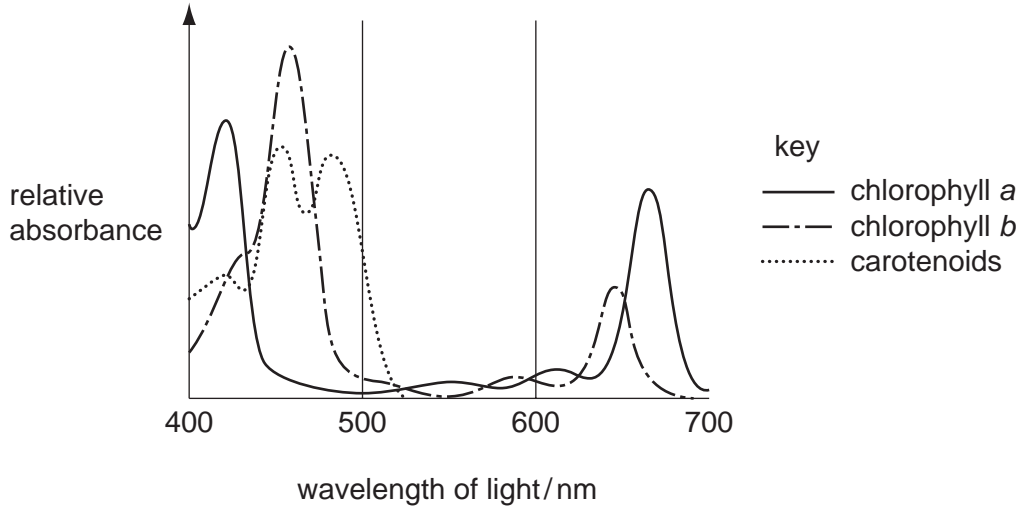
10 The diagram shows some of the processes in the light-dependent stage of photosynthesis.



For the light-dependent stage to continue, photosystem two (PS2) must gain electrons. Where do these electrons come from?

- A electron carriers
- B reduced NADP
- C photolysis
- D the formation of ATP

11 The graph shows the absorption spectra of some pigments found in chloroplasts.



Which statements are correct?

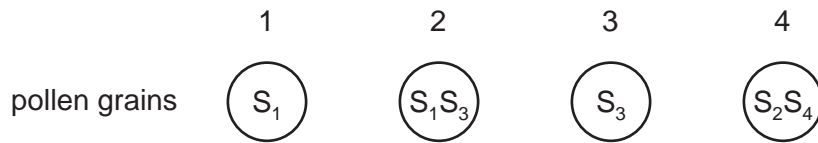
- 1 Having several pigments, rather than one, increases the efficiency of photosynthesis.
- 2 Most leaves are green as chlorophyll absorbs light in the blue and red regions of the spectrum.
- 3 Photosynthesis will be fastest in light at the red end of the spectrum, as red light has higher energy than blue light.
- 4 Prior to leaf fall, chlorophyll is broken down, leaving carotenoids which makes leaves look yellow or red.

- A** 1 and 2 only
B 1 and 3 only
C 1, 2 and 4 only
D 2 and 4 only

- 12 Many plants cannot be fertilised by pollen from their own flowers. This is known as self-incompatibility. In some species one or two S genes are responsible, each of which may have many different alleles.

If a pollen grain has an S allele which matches an allele in the genotype of the stigma then the pollen grain fails to germinate or the pollen tube fails to grow through the style.

Which pollen grains would germinate on the stigma of a flower that only included alleles S_3 and S_4 of the S gene?



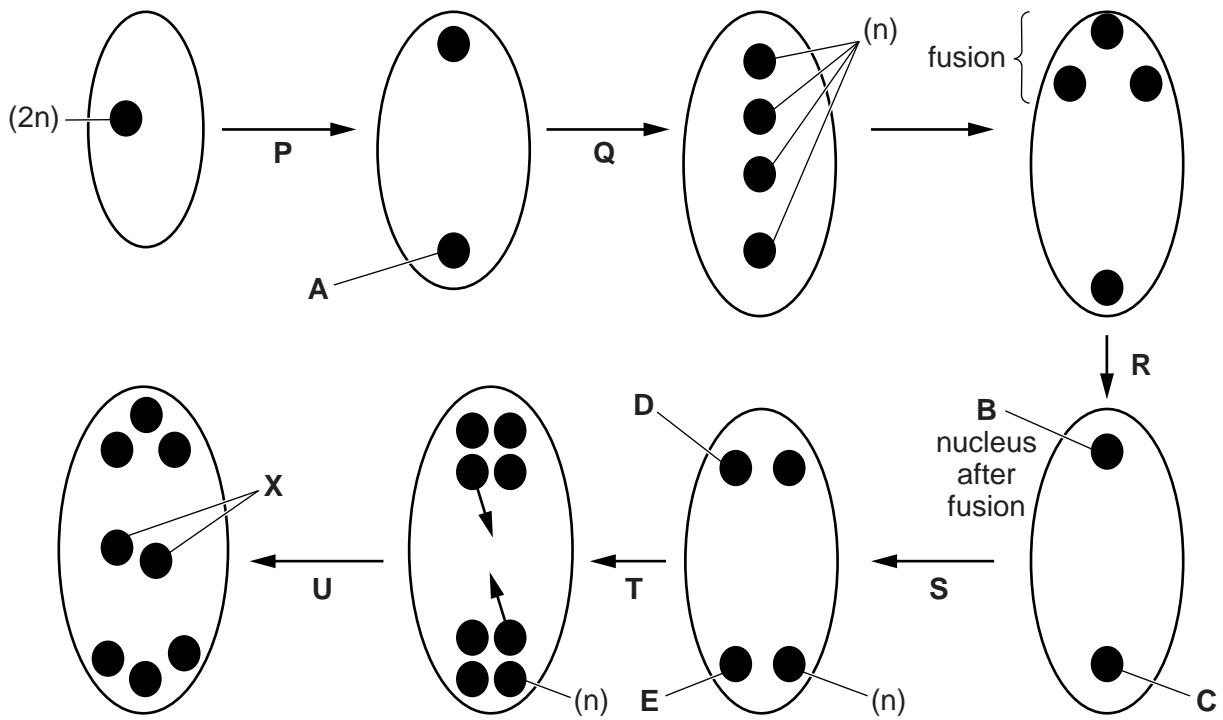
- A** 1 only **B** 2 and 4 only **C** 3 only **D** 3 and 4 only

answer [1]

Questions 13, 14 and 15

The development of the embryo sac in flowering plants involves both mitosis and meiosis. Details of this development can vary in different plants.

The diagrams summarise the development of the egg cell within the embryo sac of *Lilium* sp. Some of the nuclei have been labelled to indicate the ploidy: n = haploid; $2n$ = diploid.



13 Which stage or stages, from P, Q, R, S and T, represent meiosis II?

answer[1]

14 Which nucleus, A, B, C, D or E, is the first triploid nucleus to be formed?

answer[1]

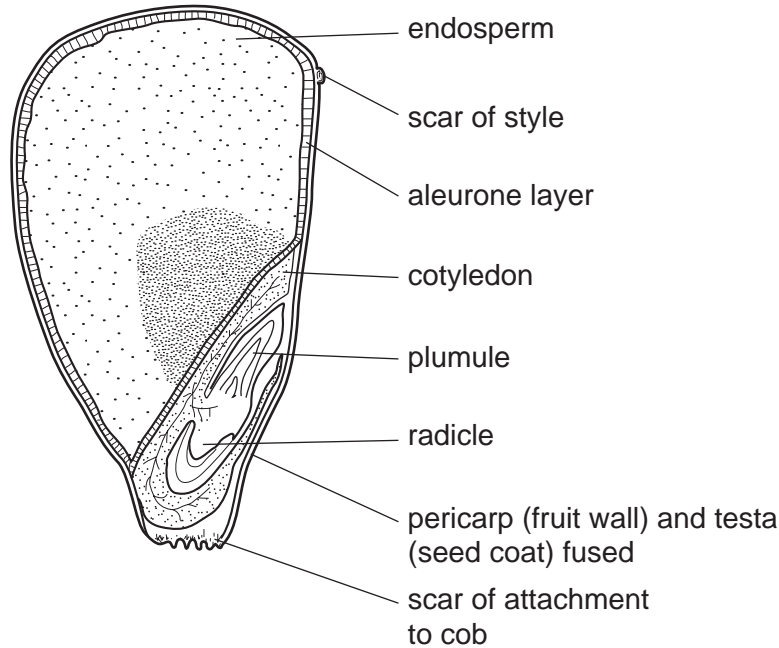
15 The endosperm in most flowering plants results from a double fusion event. Endosperm formation in the example shown in the diagrams is from a triple fusion event involving both nuclei labelled X and the male gamete nucleus, which is haploid.

Following fertilisation, what is the ploidy, $2n$, $3n$, $4n$, $5n$ or $6n$, of the endosperm nucleus?

answer[1]

- 16 Maize plants that express the dominant allele, P, have purple cobs.

The diagram shows a single maize kernel (fruit), with a purple pericarp, taken from a plant with the genotype PP which had been pollinated by a plant with the genotype pp.



Which statement correctly describes the kernel?

- A** Its pericarp and testa are genetically different because they originate from different individuals.
- B** Its pericarp and testa both have the genotype pp because they originate from the same individual.
- C** Its endosperm is diploid and originates from the PP parent.
- D** Its endosperm is triploid and its genotype may be PPp.

- 17 Dioecious plant species are adapted to transfer pollen effectively to the stigma of another individual.

Which adaptations are used in wind pollination?

- 1 anther enclosed in petal
- 2 anther pendulous
- 3 feathery stigma
- 4 stigma sticky knob
- 5 pollen rough
- 6 pollen small

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

- 18 The phenotypes of 200 offspring of a dihybrid test cross were recorded. The cross involved petal colour and fertility of the anthers of sweet pea flowers. The table shows the observed and expected numbers of each phenotype.

phenotype	purple petals fertile anthers	purple petals sterile anthers	maroon petals fertile anthers	maroon petals sterile anthers
observed numbers	87	14	16	83
expected numbers	50	50	50	50

A chi-squared (χ^2) test was performed and the probability of the difference between the observed and expected results being due to chance was found to be <0.001 .

Which conclusions may be drawn from this probability?

- 1 The difference is significant.
- 2 The difference is due to chance.
- 3 The difference is **not** due to chance.
- 4 The difference is due to some factor such as linkage of the genes concerned.

- A 1 only
B 3 and 4 only
C 1, 2 and 4 only
D 1, 3 and 4 only

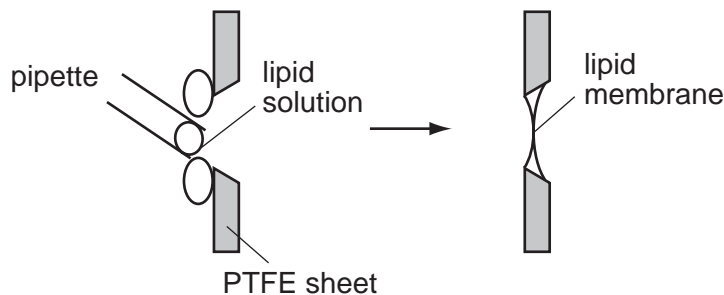
19 The presence of auxin can lead to changes in a plant cell, such as the promotion of cell elongation.

Which is a correct description of a change in a plant cell caused by the presence of auxin?

- A A decrease in pH optimises conditions for respiratory enzymes and the rate of aerobic respiration increases.
- B In the cell wall, cross-links between cellulose microfibrils break owing to acid hydrolysis.
- C Proteins responsible for binding to transcription factors are destroyed and gene transcription begins.
- D The cell is stimulated to activate proton pumps and transport hydrogen ions across the cell surface membrane into the cell.

answer[1]

20 Lipid membranes can be formed in the laboratory by painting phospholipids over a PTFE sheet with a hole in it.



Such a lipid membrane is impermeable to water-soluble materials including charged ions such as Na^+ or K^+ .

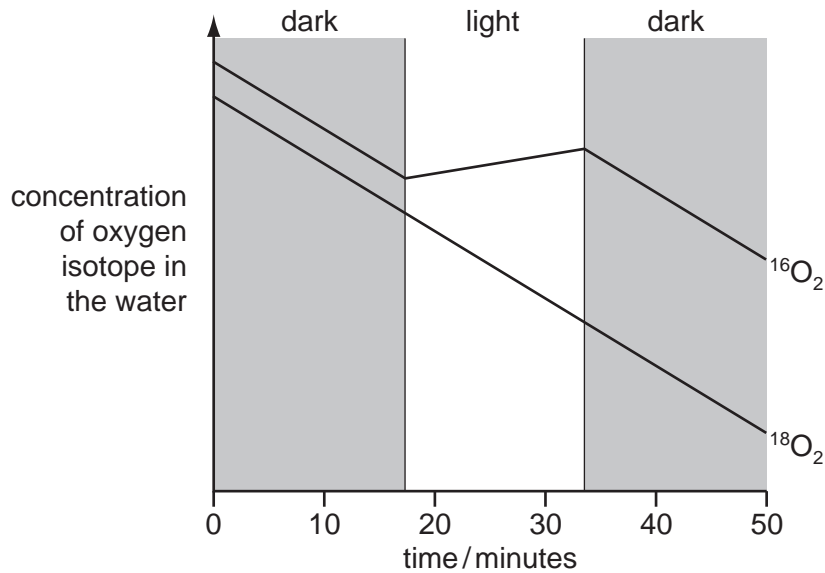
In one experiment with Na^+ ions, no current flowed across the membrane until a substance called gramicidin was added, at which time current flowed.

Which statement is consistent with this information and your knowledge of membrane structure?

Gramicidin becomes incorporated into the membrane and is

- A a carbohydrate molecule found only on the outside of the membrane.
- B a non-polar lipid which passes all the way through the membrane.
- C a protein molecule with both hydrophilic and hydrophobic regions.
- D a protein molecule which has only hydrophobic regions.

- 21 The common isotope of oxygen is ^{16}O . Air containing $^{16}\text{O}_2$ and $^{18}\text{O}_2$ was bubbled through a suspension of algae for a limited period. After this, the concentration of these two isotopes of oxygen in the water was monitored for the next 50 minutes whilst the algae were subjected to periods of dark and light. The results are shown in the diagram.



What is the best explanation for these results?

- A** Both isotopes of oxygen are used by the algae in the dark in respiration, but in the light oxygen is produced from water in photorespiration.
- B** The algae can distinguish chemically between the two isotopes.
- C** The algae produce oxygen from the water which is used in photosynthesis, but only in the light.
- D** The two isotopes have different rates of diffusion.
- 22 What would be shown by a microscopic examination of a root tip squash?
- 1 cells with large nuclei at interphase
 - 2 cells not dividing and nuclei undergoing mitosis
 - 3 nuclei with paired homologous chromosomes visible
 - 4 cell walls forming
- A** 1, 2 and 3 **B** 1, 2 and 4 **C** 1, 3 and 4 **D** 2, 3 and 4