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CAMBRIDGE
International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8743303534

BIOLOGY **9700/43**

Paper 4 A Level Structured Questions **May/June 2026**

2 hours

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen. Do **not** use correction fluid or tape.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 100.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **24** pages. Any blank pages are indicated.

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1 **(a)** Figure 1.1 is a diagram of a neuromuscular junction.

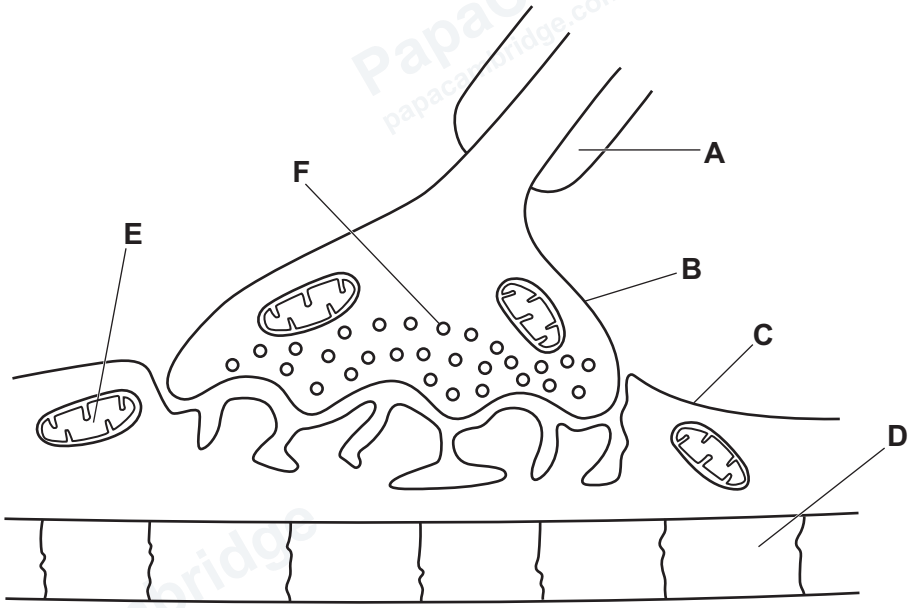


Figure 1.1

Use the letters **A**–**F** in Figure 1.1 to identify a structure:

- that contains a neurotransmitter .....
- where the Krebs cycle occurs .....
- that depolarises when a neurotransmitter binds to its receptors .....
- that contains troponin. .....

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(b) In mammals, control and coordination is provided by the nervous system and the endocrine system.

One role of the endocrine system is to allow the body to exercise for an extended time, such as running continuously for an hour.

Explain the importance of the endocrine system when a mammal runs continuously for an hour.

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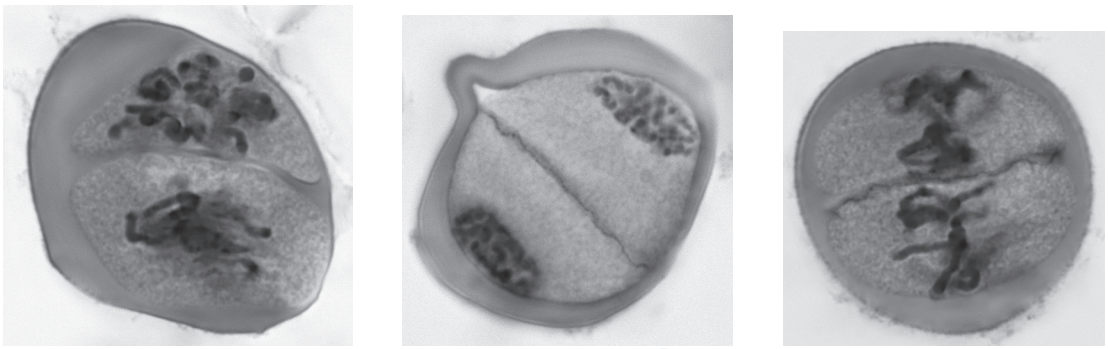
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2 Meiosis is a process that includes reduction division.

(a) The cells that carry out meiosis in the male reproductive organ of plants are known as pollen mother cells.

Figure 2.1 shows photomicrographs of three different stages of meiosis in pollen mother cells from *Lilium*, a lily plant.



A **B** **C**

Figure 2.1

Name the stages of meiosis shown in cells **A**, **B** and **C** in Figure 2.1.

A .....

B .....

C .....

[3]

(b) Homologous chromosomes pair up and then separate into different daughter cells during meiosis.

Explain what is meant by a homologous pair of chromosomes.

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(c) Explain the need for reduction division to occur during meiosis.

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3 Sickle cell anaemia is a disease caused by a mutation in the *HBB* gene.

The presence of the mutant *HBB* allele in the genome of a person can be detected using a variety of techniques.

(a) DNA can be extracted and purified from cell samples taken from a person. The polymerase chain reaction (PCR) can be used to amplify the region of DNA containing the mutant *HBB* allele, if it is present in the genome of the person.

This PCR process amplifies only the mutant *HBB* allele and not other DNA sequences.

Outline the steps involved in PCR **and** explain how PCR can be carried out so that **only** the mutant *HBB* allele is amplified.

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(b) Restriction enzymes and electrophoresis can be used to determine the alleles of the *HBB* gene that make up the genotype of a person.

The restriction enzymes:

- produce one fragment when only the mutant *HBB* allele is present
- produce two smaller fragments when only the normal *HBB* allele is present.

Figure 3.1 shows the results of electrophoresis of DNA samples from four people, **1** to **4**. Only DNA fragments from the *HBB* gene locus are shown.

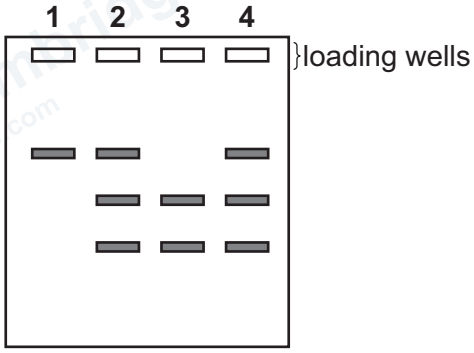


Figure 3.1

State which people, **1**–**4**, show:

a genotype that is homozygous for the normal *HBB* allele .....

a genotype that is homozygous for the mutant *HBB* allele .....

a genotype that is heterozygous for the *HBB* gene .....

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(c) Microarray analysis can be used to detect the mutant *HBB* allele in the genome of a person.

Outline how microarray analysis is used to detect the presence of the mutant *HBB* allele in the genome of a person.

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4 The leopard, *Panthera pardus*, is a large mammal found in a number of countries in Africa and Asia.

(a) Most leopards have yellow-brown fur with black spots, but 11% of leopards have black fur.

Figure 4.1 shows the two types of leopard.





Figure 4.1

In the gene that controls fur colour in leopards, the allele that results in black fur is recessive.

Assuming the Hardy-Weinberg principle applies to leopard populations, calculate the percentage of leopards that are heterozygous for the gene that controls fur colour.

Use the equations:

$$p + q = 1$$

$$p^2 + 2pq + q^2 = 1$$

key

p = frequency of the dominant allele
q = frequency of the recessive allele
p^2 = frequency of homozygous dominant genotype
$2pq$ = frequency of heterozygous genotype
q^2 = frequency of homozygous recessive genotype

Show your working **and** give your answer to the nearest whole number.

percentage of heterozygous leopards ..... [3]

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(b) Fur colour in leopards shows discontinuous variation. The mass of leopards shows continuous variation.

Compare the genetic basis of discontinuous variation and continuous variation.

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(c) Scientists think that the leopard populations in Asia were established by the migration of leopards from Africa approximately 500 000 years ago.

African and Asian leopards are considered to be the same species, but there are many genetic differences between them.

Suggest why there are many genetic differences between African leopards and Asian leopards.

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5 There are several different human blood group systems.

Each blood group system is based on the presence or absence of certain antigens attached to the cell surface membranes of red blood cells.

In the ABO blood group system, the *ABO* gene, known as gene *I*, has three alleles. The gene is located on an autosome.

- Allele $\mathbf{I^A}$ codes for an enzyme that adds antigen A to the cell surface membrane.
- Allele $\mathbf{I^B}$ codes for an enzyme that adds antigen B to the cell surface membrane.
- Allele $\mathbf{I^O}$ codes for a non-functional enzyme, so no antigen is added.
- $\mathbf{I^O}$ is recessive to $\mathbf{I^A}$ and $\mathbf{I^B}$.
- $\mathbf{I^A}$ and $\mathbf{I^B}$ are codominant.

(a) Explain what is meant by the term recessive **and** the term codominant.

recessive .....

.....

codominant .....

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[2]

(b) Complete Table 5.1 to show the possible genotypes of the blood groups in the ABO system.

Table 5.1

blood group	genotypes
A	
B	
AB	
O	

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(c) In the Rhesus blood group system, a gene codes for a protein known as the Rhesus factor. This protein is an antigen found on the surface of red blood cells.

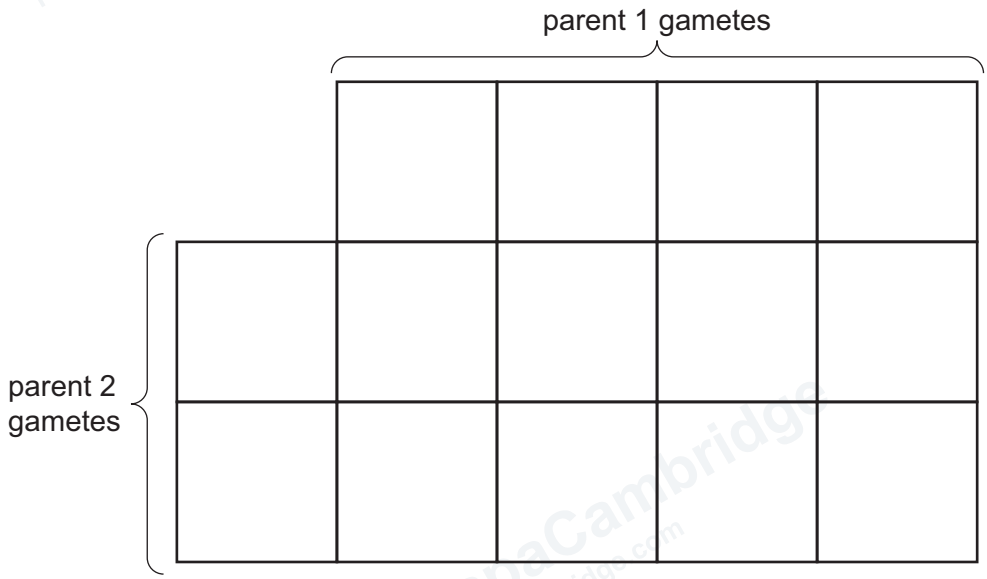
- The dominant allele **D** codes for the Rhesus factor.
- The recessive allele **d** results in no Rhesus factor.
- A person who has the Rhesus factor is described as Rhesus positive (Rh+).
- A person who lacks the Rhesus factor is described as Rhesus negative (Rh–).
- The gene coding for the Rhesus factor is on a different autosome from the *ABO* gene.

Complete the Punnett square in Figure 5.1 to show the possible blood groups of children from these parents.

- Parent 1 is heterozygous for blood group B and heterozygous for the Rhesus factor.
- Parent 2 has blood group O and is heterozygous for the Rhesus factor.

parental phenotypes: **B Rh+** **O Rh+**

parental genotypes:



ratio of offspring phenotypes:

Figure 5.1

[5]

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6 **(a)** In the kidney, ultrafiltration occurs when blood enters the glomerulus through the afferent arteriole.

Describe the process of ultrafiltration.

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(b) Caffeine is a natural compound present in tea and coffee. Caffeine is also added to some drinks. Some people produce more urine after having a drink containing caffeine than after drinking an equivalent volume of water.

Suggest ways in which caffeine may cause an increase in urine production in some people.

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7 The ring-tailed lemur, *Lemur catta*, is a primate that is found only on the island of Madagascar.

Figure 7.1 shows a ring-tailed lemur.

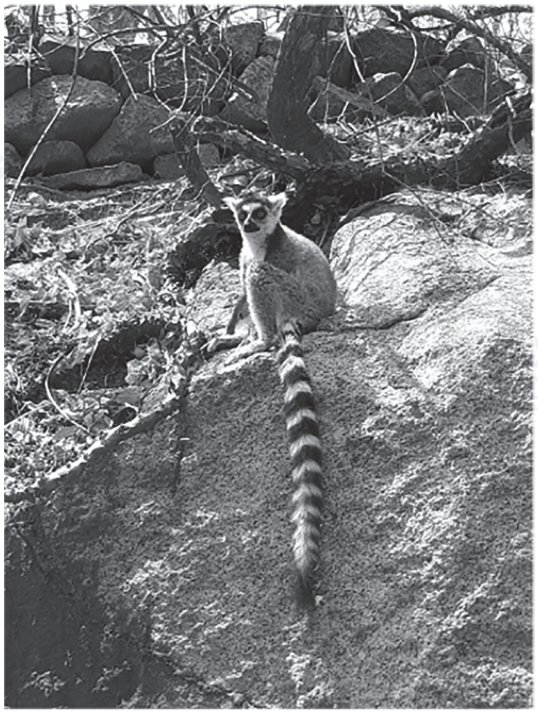


Figure 7.1

(a) Ring-tailed lemurs are classified as endangered on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species™. There are approximately 2000 ring-tailed lemurs in the wild in Madagascar.

Suggest reasons why the ring-tailed lemur has become endangered.

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(b) Zoos have a role in protecting endangered species.

Outline the methods of assisted reproduction used by zoos in the conservation of endangered mammals such as the ring-tailed lemur.

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(c) One important food source for the ring-tailed lemur is the hissing cockroach, *Gromphadorhina portentosa*. The hissing cockroach is a large, flightless insect that lives on forest floors in Madagascar.

(i) The mark-release-recapture method was used to estimate the size of a population of the hissing cockroach.

- 33 cockroaches were trapped, marked and released.
- A few days later 46 cockroaches were trapped, of which 9 were marked.

The Lincoln index is used to estimate the size of a population.

The formula for the Lincoln index is:

$$N = \frac{n_1 \times n_2}{m_2}$$

Key

N = estimate of population size
n_1 = number of individuals captured in first sample
n_2 = number of individuals (both marked and unmarked) captured in second sample
m_2 = number of marked individuals recaptured in second sample

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Use the Lincoln index to estimate the size of this population of hissing cockroaches.

Give your answer to the nearest whole number. Show your working.

estimate of size of population = ... [2]

(ii) Suggest why the mark-release-recapture method is a suitable method to use when estimating the population size of the hissing cockroach.

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8 **(a)** Figure 8.1 is a diagram of a section through a barley seed.

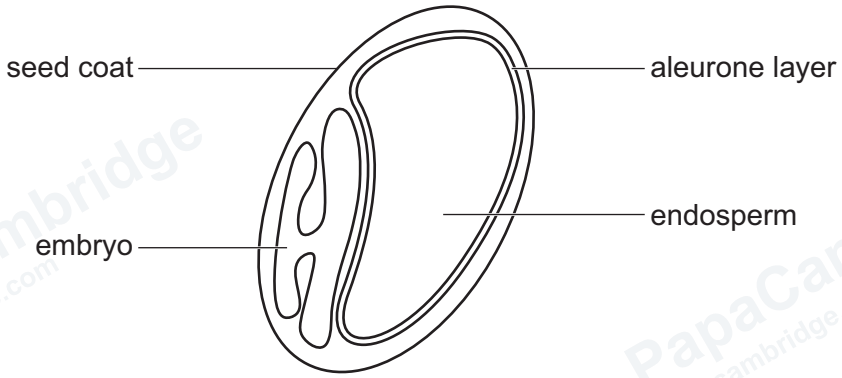


Figure 8.1

Complete Table 8.1 by naming the part of the seed from Figure 8.1 that matches the function stated.

Table 8.1

function	part of seed
gibberellin synthesis	.....
starch store	.....
amylase synthesis	.....
maltose production	.....

[4]

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(b) The plant hormone auxin has an important role in the growth of plants. When auxin molecules bind to receptors in the cell surface membrane of young cells, a series of events is triggered that results in cell elongation.

Figure 8.2 outlines this series of events.

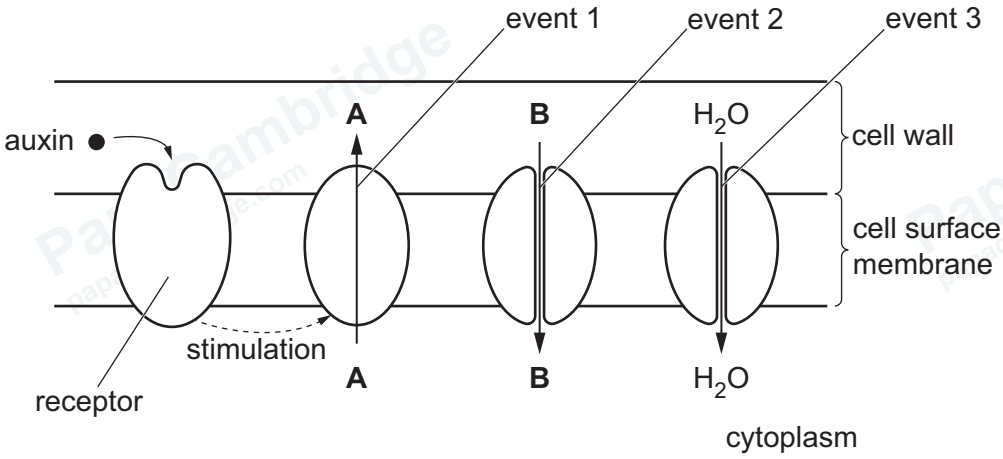


Figure 8.2

(i) Describe event 1 in Figure 8.2 **and** explain how this event is important for the process of cell elongation.

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(ii) Explain how event 2 leads to event 3 and results in cell elongation.

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9 **(a)** The structure of a mitochondrion is related to its function in respiration.

Figure 9.1 is a diagram of a mitochondrion.

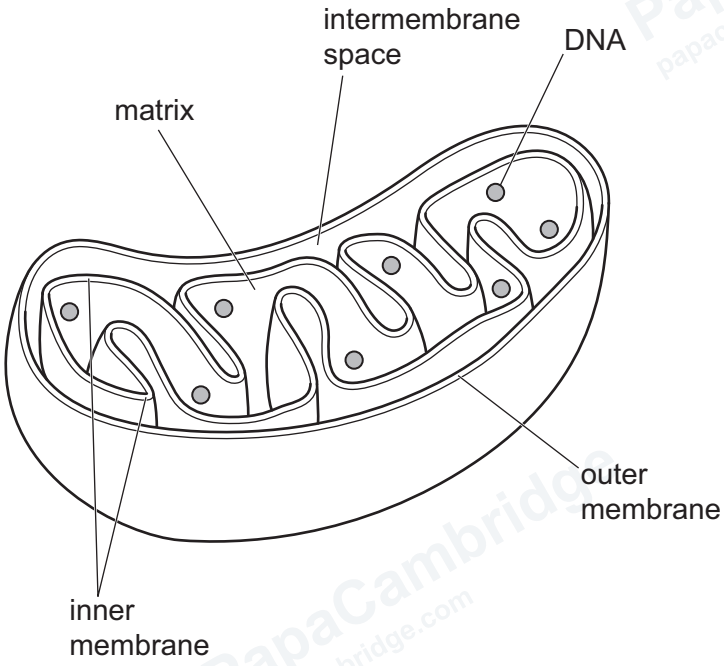


Figure 9.1

With reference to Figure 9.1, outline the relationship between the structure and function of a mitochondrion in respiration.

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(b) Table 9.1 shows the mean percentage of cell volume occupied by mitochondria in three different cell types.

Table 9.1

cell type	mean percentage of cell volume occupied by mitochondria
heart muscle cell	48
liver cell	17
red blood cell	0

Suggest why the three cell types shown in Table 9.1 have different mean percentages of cell volume occupied by mitochondria.

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(c) Glycolysis occurs in the cytoplasm and produces pyruvate which, in aerobic conditions, can enter the mitochondrion.

Outline how a molecule of glucose is converted to molecules of pyruvate during glycolysis.

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10 (a) The photoactivation of chlorophyll is an essential process in the conversion of light energy to chemical energy during the light-dependent stage of photosynthesis.

Photoactivation of chlorophyll leads to the synthesis of ATP.

Outline how the photoactivation of chlorophyll leads to the production of ATP.

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(b) (i) ATP produced in the light-dependent stage passes to the Calvin cycle of the light-independent stage.

Name **two** compounds in the Calvin cycle that are formed using this ATP. Do **not** give abbreviations for these compounds.

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[2]

(ii) Reduced NADP is also produced in the light-dependent stage.

Outline the role of reduced NADP in the light-independent stage.

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(iii) Some glycerate 3-phosphate (GP) molecules produced in the Calvin cycle are used to produce a type of molecule that is **not** an intermediate in the Calvin cycle.

Name the type of molecule that can be produced from GP that is **not** an intermediate in the Calvin cycle.

..... [1]

(c) Environmental factors affect the rate of photosynthesis.

Figure 10.1 shows the effect of carbon dioxide concentration on the rate of photosynthesis.

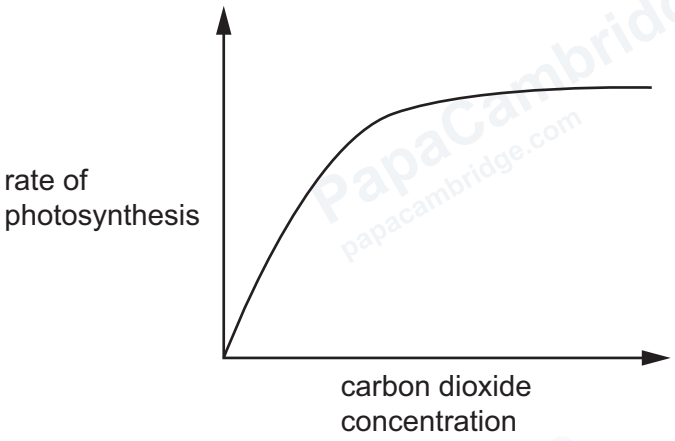


Figure 10.1

Explain the reasons for the relationship shown in Figure 10.1.

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