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CAMBRIDGE
International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

6460459475

BIOLOGY **9700/42**

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 **28** pages. Any blank pages are indicated.

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1 **(a)** Figure 1.1 is a diagram of a mammalian motor neurone.

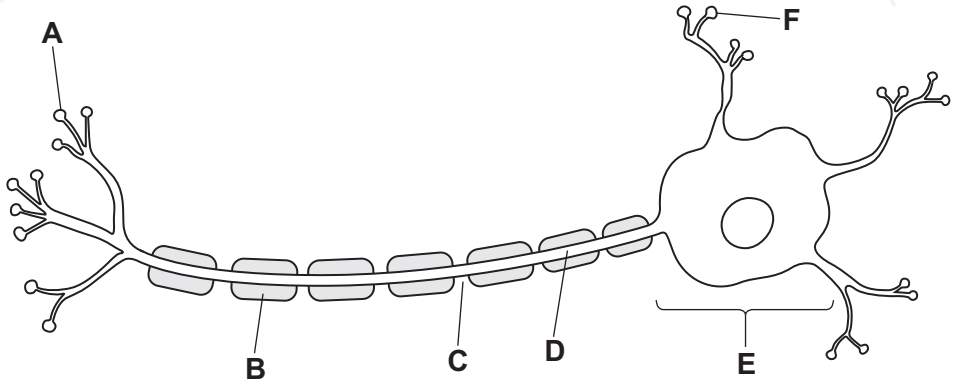


Figure 1.1

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

- a structure that forms a synapse with an intermediate neurone .....
- a structure that forms part of a neuromuscular junction .....
- a structure that provides insulation .....
- **two** structures that allow saltatory conduction. .....

[4]

(b) Outline the events that occur during an action potential.

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2 When a barley seed germinates, gibberellin is released from structure **A**. Gibberellin diffuses to its target cells located in tissue **B**. This causes the cells at **B** to synthesise the enzyme amylase.

(a) Figure 2.1 is a diagram of a longitudinal section through a barley seed.

On Figure 2.1, use label lines and the letters **A** and **B** to identify:

A – the structure where gibberellin is released
B – the location of the target cells for gibberellin that synthesise amylase.

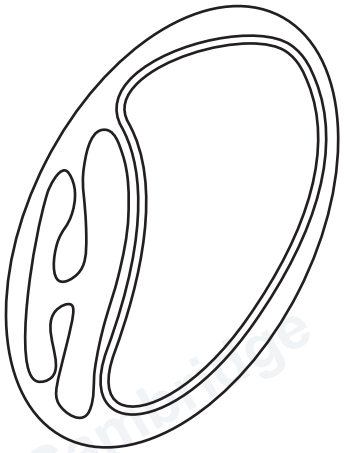


Figure 2.1

[2]

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(b) A gene in the cells of **B** is switched on so that the cells can synthesise amylase.

Figure 2.2 shows the sequence of molecular events that occurs in the cells of **B** during seed germination.

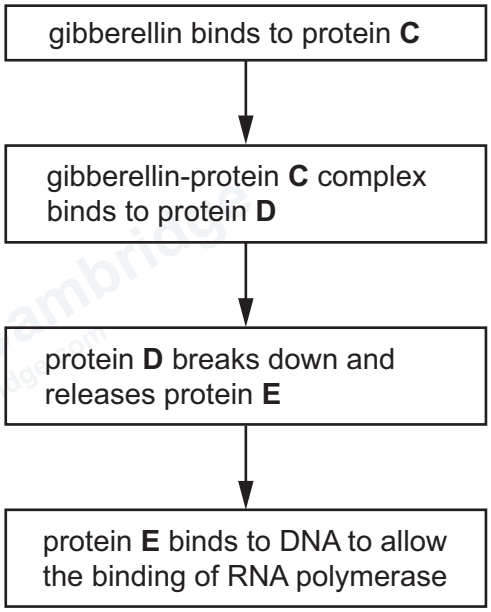


Figure 2.2

(i) Identify proteins **C**, **D** and **E**.

C .....

D .....

E .....

[3]

(ii) After protein **E** binds to DNA, RNA polymerase can bind to DNA.

Identify:

- the region of the DNA that RNA polymerase binds to
- the gene product.

region of DNA .....

gene product .....

[2]

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(c) A variety of pea plant has a homozygous recessive genotype that prevents it from making active gibberellin.

Suggest what effect this homozygous recessive genotype will have on the height of these pea plants.

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3 **(a)** The green-eyed tree-frog, *Litoria genimaculata*, lives in tropical rainforests in Australia. Around 5 million years ago, the tree-frog population split into northern (**N**) and southern (**S**) populations that were separated by a dry area with no rainforest.

6500 years ago, the **N** and **S** tree-frog populations came into contact again as a warmer climate allowed rainforest to grow again in the area between the **N** and **S** populations.

Figure 3.1 is a map showing an area, labelled the contact zone, where **N** and **S** populations of tree-frog currently come into contact.

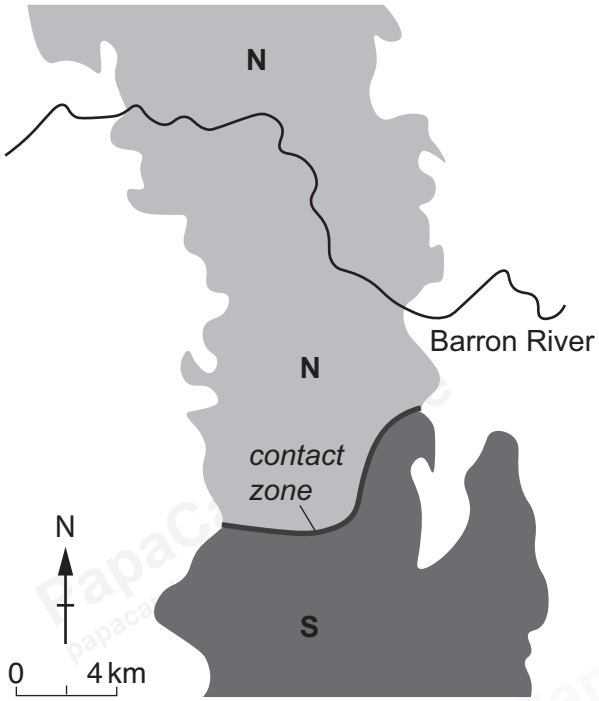


Figure 3.1

(i) **N** tree-frogs and **S** tree-frogs can be distinguished by genetic techniques.

Outline the genetic techniques that could be used to distinguish between **N** and **S** tree-frog DNA.

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(ii) Explain how a period of geographical separation, such as the one that occurred between the **N** and **S** tree-frog populations, can eventually lead to speciation.

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(iii) Scientists were interested in tree-frogs in the contact zone.

The scientists made these observations:

- In the wild, **S** female tree-frogs are strongly attracted to the mating call of **S** male tree-frogs but are **not** attracted to the mating call of **N** male tree-frogs.
- In the laboratory, when an **S** female tree-frog is mated with a male **N** tree-frog, none of the fertilised eggs develop into offspring.

Suggest, with reasons, what these observations show about speciation between **N** tree-frogs and **S** tree-frogs.

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(b) There is a large variation in body length within the population of **N** tree-frogs and within the population of **S** tree-frogs.

Describe the factors that interact to cause this variation in body length.

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4 Genetically modified (GM) crops are grown in many countries around the world. These crops are produced by the process of genetic engineering.

(a) Explain what is meant by the genetic engineering of crops.

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(b) Figure 4.1 shows how the global area of GM crop production changed in the 17 years since GM crops were first grown.

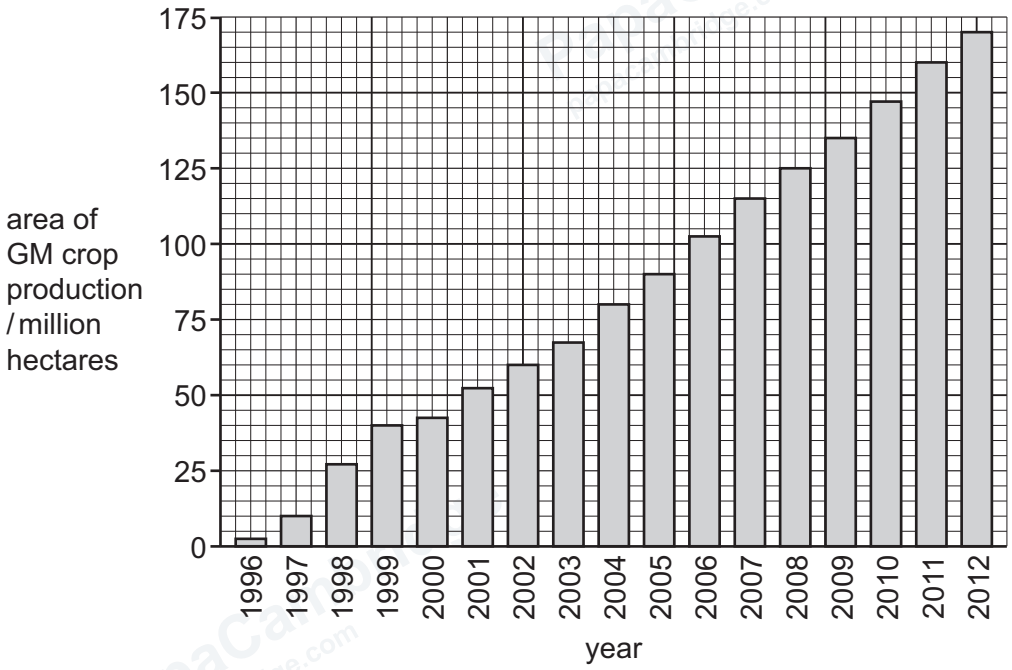


Figure 4.1

Calculate the percentage change in global area of GM crop production between 2000 and 2012.

percentage change = ... % [2]

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(c) With reference to examples, explain how GM crops can improve our food supply.

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5 (a) Pigeons are birds that belong to the Columbidae family. They are distributed throughout the world.

- The two sex chromosomes in female pigeons are known as the **Z** chromosome and the **W** chromosome.
- Male pigeons have two **Z** chromosomes.
- One of the genes controlling feather colour in pigeons is located on the **Z** chromosome. The **W** chromosome does **not** have this gene.
- This gene has three alleles, each coding for a different feather colour.
- The allele for ash-red feathers is dominant to the allele for blue feathers, which is dominant to the allele for brown feathers.

Using the symbols, complete Figure 5.1 to show how a cross between an ash-red male pigeon and a blue female pigeon can produce a brown offspring.

symbols: $\mathbf{Z}^{A}$ = **Z** chromosome with allele coding for ash-red colour
$\mathbf{Z}^{Bl}$ = **Z** chromosome with allele coding for blue colour
$\mathbf{Z}^{Br}$ = **Z** chromosome with allele coding for brown colour
W = **W** chromosome with no gene controlling feather colour

parental phenotypes: ash-red male blue female

parental genotypes: ....

offspring

parental gametes →			
	genotype		genotype
	phenotype		phenotype
	genotype		genotype
	phenotype		phenotype

Figure 5.1

[4]

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(b) State the type of inheritance shown in this cross.

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(c) Describe how you would determine the genotype of an ash-red male pigeon.

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6 **(a)** Neurones in the brain metabolise glucose to produce ATP. Glucose enters brain neurones through transport proteins in the cell surface membrane. These proteins are similar to the transport proteins for glucose found in liver and muscle cells.

State the process by which glucose passes through transport proteins into brain neurones.

..... [1]

(b) Brain neurones use ATP very quickly.

One brain neurone uses 4.7×10^9 molecules of ATP per second.

One striated muscle cell uses 9.8×10^6 molecules of ATP per second.

Calculate how many muscle cells would use the same number of ATP molecules per second as one brain neurone.

Give your answer to the nearest whole number.

number of muscle cells = ... [2]

(c) Suggest reasons why neurones, such as those in the brain, use large numbers of ATP molecules per second.

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(d) When ATP is completely broken down, the compound adenosine is released which then leaves the cell.

- During the day, the extracellular concentration of adenosine increases.
- In brain synapses, adenosine binds to adenosine receptors in the cell surface membrane of postsynaptic brain neurones and inhibits postsynaptic neurone activity.
- This action promotes sleep.
- During sleep, adenosine detaches from its receptor and is recycled to form ATP.
- This action promotes wakefulness (the person is awake).

Caffeine is a compound found naturally in tea and coffee and is added to some drinks. Caffeine has a similar shape to adenosine.

Suggest **and** explain the effect on the sleep pattern of a person who has had a drink containing a lot of caffeine.

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7 The southern damselfly, *Coenagrion mercuriale*, is a flying insect found in most of Europe.

Figure 7.1 shows a southern damselfly.



Figure 7.1

(a) Complete Table 7.1 to show the classification of the southern damselfly.

Table 7.1

domain	Eukarya
kingdom	Animalia
phylum	Arthropoda
.....	Insecta
order	Odonata
.....	Coenagrionidae
genus	.....
species	.....

[2]

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(b) The domain Eukarya includes the kingdoms Animalia and Plantae.

Describe the differences between organisms in Animalia and Plantae.

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(c) Southern damselflies require areas of open vegetation with slow-flowing water in which to lay their eggs.

- Damselfly eggs hatch into larvae within five weeks.
- Damselfly larvae spend two years underwater before emerging as an adult.
- Damselfly larvae eat other insect larvae and freshwater shrimps.
- Adult damselflies live for only a few weeks.

Southern damselfly numbers are decreasing and this species is listed as endangered in the UK.

(i) Suggest possible reasons why the southern damselfly has become endangered in the UK.

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(ii) The mark-release-recapture method has been used to estimate the population size of **adult** southern damselflies.

Suggest why using this method to estimate the population size may be inaccurate.

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8 (a) In the kidney, glomerular filtrate forms in the Bowman's capsule. Some substances are then reabsorbed in the proximal convoluted tubule.

Figure 8.1 is a diagram showing the relationship between the proximal convoluted tubule and a blood capillary.

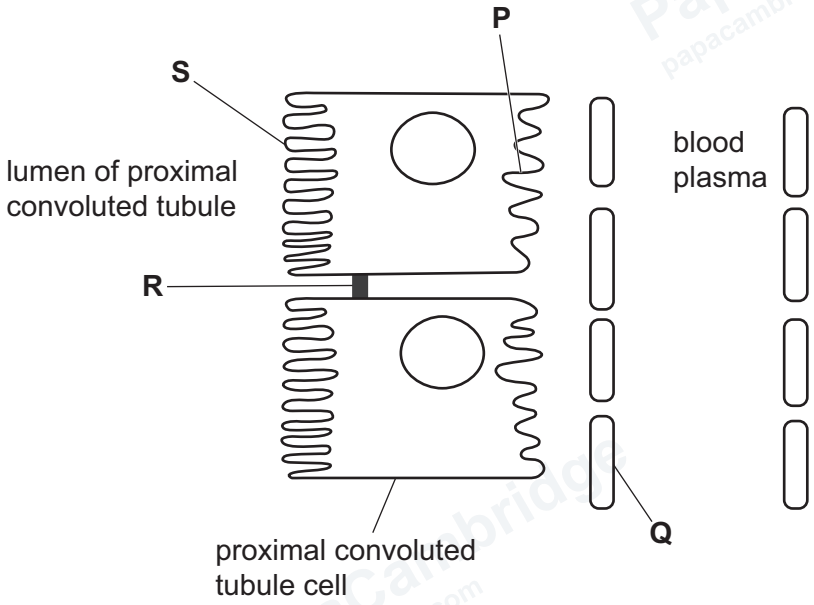


Figure 8.1

Complete Table 8.1 using the letters **P**, **Q**, **R** and **S**. Each letter may be used once, more than once or not at all.

Table 8.1

location of Na^+/K^+ pumps	.....
location of cotransport proteins	.....
structures through which glucose molecules pass	.....
prevents leakage of fluid	.....

[4]

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(b) Osmoregulation is the control of blood water potential in mammals.

Describe the role of ADH in osmoregulation when the water potential of blood **decreases** below the set point and is detected by osmoreceptors in the hypothalamus.

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9 **(a)** Mature red blood cells do **not** contain mitochondria. The only respiratory pathway carried out in red blood cells is glycolysis. The initial reaction in glycolysis is the phosphorylation of glucose using ATP. This reaction is catalysed by the enzyme hexokinase.

An autosomal recessive gene mutation results in less hexokinase being produced, which can lead to hexokinase deficiency disease.

Suggest the effect of the production of less hexokinase on red blood cells **and** suggest a possible symptom for a person with hexokinase deficiency disease.

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(b) Muscle cells contain mitochondria. This means that the Krebs cycle can take place in muscle cells.

Outline the main events in the Krebs cycle.

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(c) If muscle cells do **not** receive enough oxygen, they may carry out respiration in anaerobic conditions.

Describe respiration in anaerobic conditions in muscle cells.

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10 (a) The structure of a chloroplast is related to its function in photosynthesis.

Figure 10.1 is a diagram of a chloroplast.

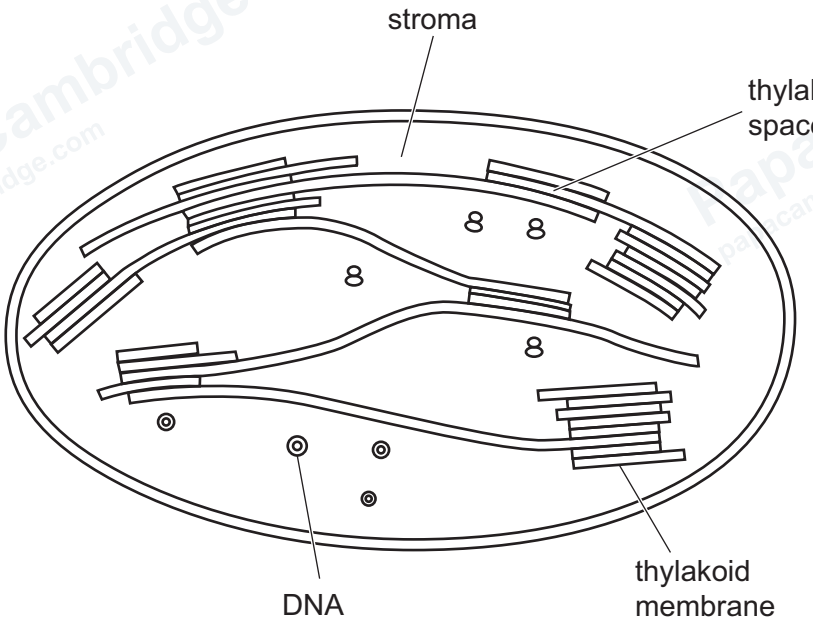


Figure 10.1

With reference to Figure 10.1, outline the relationship between the structure and function of a chloroplast in photosynthesis.

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(b) Chloroplast pigments can be separated and identified by a technique called chromatography.

A student carried out an investigation using paper chromatography to separate the pigments in a solution containing two chloroplast pigments.

The results of the investigation are shown in Figure 10.2.

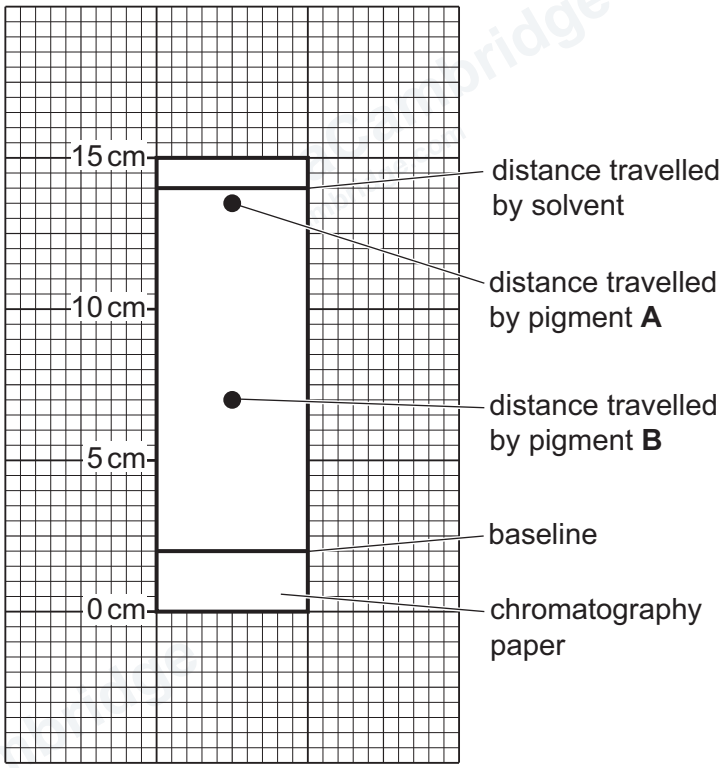


Figure 10.2

(i) The R_f value of pigment **A** is 0.96.

Using Figure 10.2, calculate the R_f value of pigment **B**.

R_f value of pigment **B** ..... [1]

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(ii) Table 10.1 shows the R_f values of some photosynthetic pigments.

Table 10.1

pigment	R_f value
chlorophyll a	0.59–0.68
chlorophyll b	0.40–0.54
carotene	0.94–0.98
xanthophyll	0.15–0.28

Use Table 10.1 to identify pigment **A** and pigment **B**.

pigment **A** .....

pigment **B** .....
[1]

(iii) Describe the role of pigments **A** and **B** in photosynthesis.

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