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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

6282618134

BIOLOGY **9700/04**

Paper 4 Structured Questions A2 Core **October/November 2008**

2 hours

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces provided at the top of this page.
Write in dark blue or black pen.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Section A
Answer **all** questions.

Section B
Answer **one** question.
Circle the number of the Section B question you have answered in the grid below.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
8	
9	
Section B	
10 or 11	
Total	

This document consists of **20** printed pages, **2** lined pages and **2** blank pages.

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Section A

For Examiner's Use

Answer **all** the questions.

1 The African hunting dog, *Lycaon pictus*, is a carnivore which hunts in packs in areas of East Africa.

Fig. 1.1 shows an African hunting dog.



Fig. 1.1

(a) The African hunting dog has cells that are eukaryotic while bacteria have cells that are prokaryotic.

Describe the differences between eukaryotic and prokaryotic cells **with respect to their DNA**.

.....

.....

..... [2]

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(b) In some parts of East Africa *L. pictus* is becoming an endangered species.

For Examiner's Use

Suggest reasons why *L. pictus* is becoming an endangered species.

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.....[3]

(c) One way of protecting *L. pictus* is to create conservation areas.

Describe two **other** methods of conserving endangered species such as *L. pictus*.

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.....[2]

[Total: 7]

2 Fig. 2.1 shows the CFTR (cystic fibrosis transmembrane conductance regulator) protein in a plasma (cell surface) membrane.

For Examiner's Use

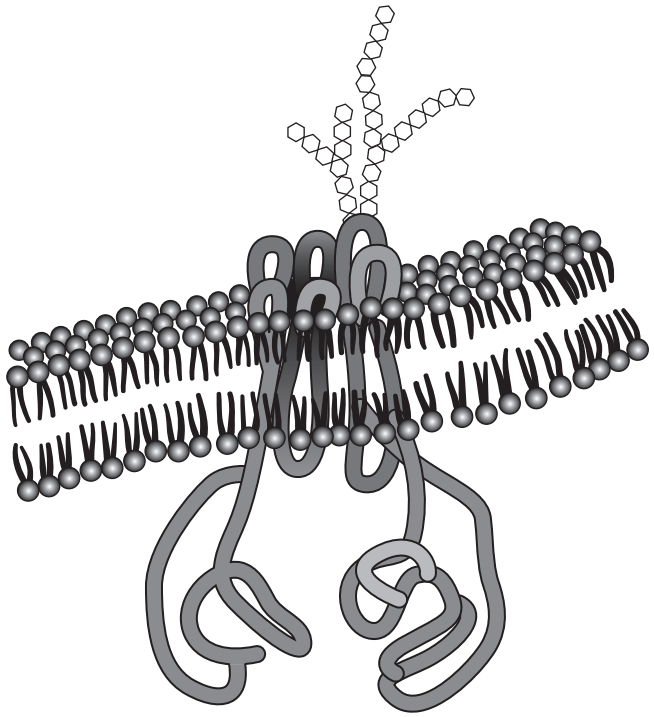


Fig. 2.1

(a) (i) Describe the normal function of the CFTR protein.

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.....

.....[2]

(ii) On Fig. 2.1, use the letter **E** to indicate the external face of the membrane. State how you identified this face.

.....

.....[1]

(b) Cystic fibrosis is caused by a recessive allele of the *CFTR* gene.

(i) Explain the meaning of the term *recessive allele*.

.....

.....

.....[2]

(ii) Explain how cystic fibrosis affects the function of the lungs.

For Examiner's Use

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.....[3]

(c) As cystic fibrosis is caused by a recessive allele of a single gene, it is a good candidate for gene therapy. Trials were undertaken in the 1990s, attempting to deliver the normal allele of the *CFTR* gene into cells of the respiratory tract, using viruses or liposomes as vectors.

Explain how viruses deliver the allele into cells.

.....

.....

.....[2]

(d) In some people with cystic fibrosis, the allele has a single-base mutation which produces a 'nonsense' (stop) codon within the gene.

For Examiner's Use

(i) Explain how this mutation would prevent normal CFTR protein being produced.

.....

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..... [2]

(ii) A new type of drug, PTC124, enables translation to continue through the nonsense codon. Trials in mice homozygous for a *CFTR* allele containing the nonsense codon have found that animals treated with PTC124 produce normal CFTR protein in their cells. The drug is taken orally, and is readily taken up into cells all over the body.

Using your knowledge of the progress towards successful gene therapy for cystic fibrosis, suggest why PTC124 could be a simpler and more reliable treatment for this disease.

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..... [3]

[Total: 15]

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QUESTION 3 starts on page 8

3 Sorghum is a cereal crop that grows well in very dry (arid) conditions.

For Examiner's Use

(a) Outline **two** structural features of sorghum that adapt it to survive in arid environments.

.....

.....

.....[2]

(b) An investigation was carried out to measure the effect of lack of water on the leaves of sorghum plants.

- Several well-watered sorghum plants were kept in conditions of normal light and temperature.
- Watering was then stopped for 6 days, and resumed on day 7.
- The water potential of the cells in the leaves, the concentrations of abscisic acid in the leaves and stomatal resistance were measured each day.

A high stomatal resistance indicates that most stomata are partially or completely closed.

The results are shown in Fig. 3.1.

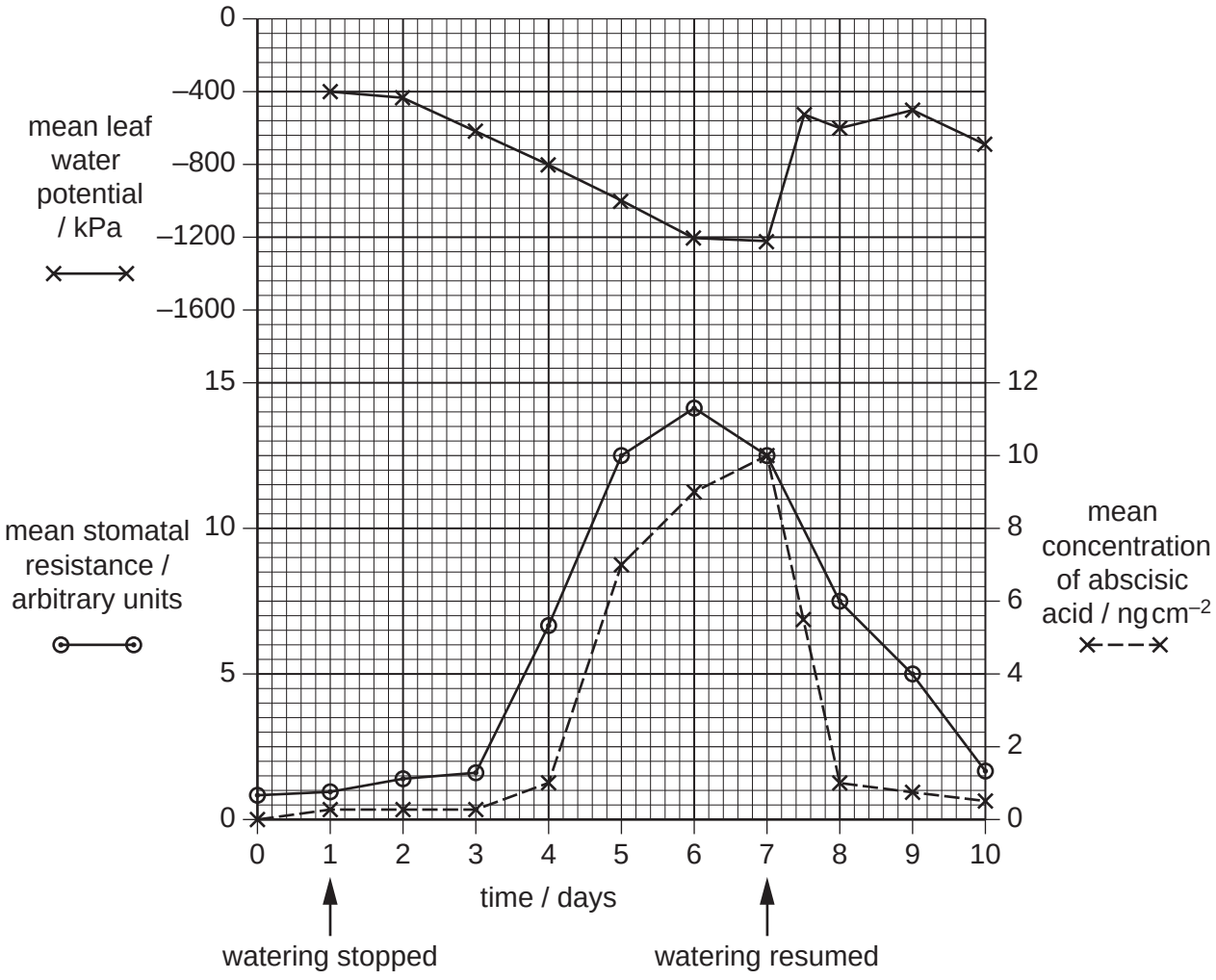


Fig. 3.1

With reference to Fig. 3.1,

For Examiner's Use

(i) describe **and** explain the changes in abscisic acid concentration over the 10 day period

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.....[3]

(ii) explain the changes in stomatal resistance over this period.

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.....[2]

(c) Explain how the changes you have described in **(b)** help sorghum to survive in arid conditions.

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.....[2]

[Total: 9]

For Examiner's Use

4 **(a)** Outline the hybridoma method for the production of a monoclonal antibody.

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.....[4]

(b) Herceptin is a monoclonal antibody used in the treatment of some breast cancers. It binds strongly to molecules of a receptor protein, HER2, that is produced in abnormally large quantities in the plasma (cell surface) membranes of about 30% of human breast cancers.

Investigations have been made into the most effective way to use Herceptin to treat breast cancer.

One experiment investigated the ability of different treatments to induce cell death in breast cancer cells.

Herceptin and X-ray treatment were used both separately and together. The results are shown in Fig. 4.1.

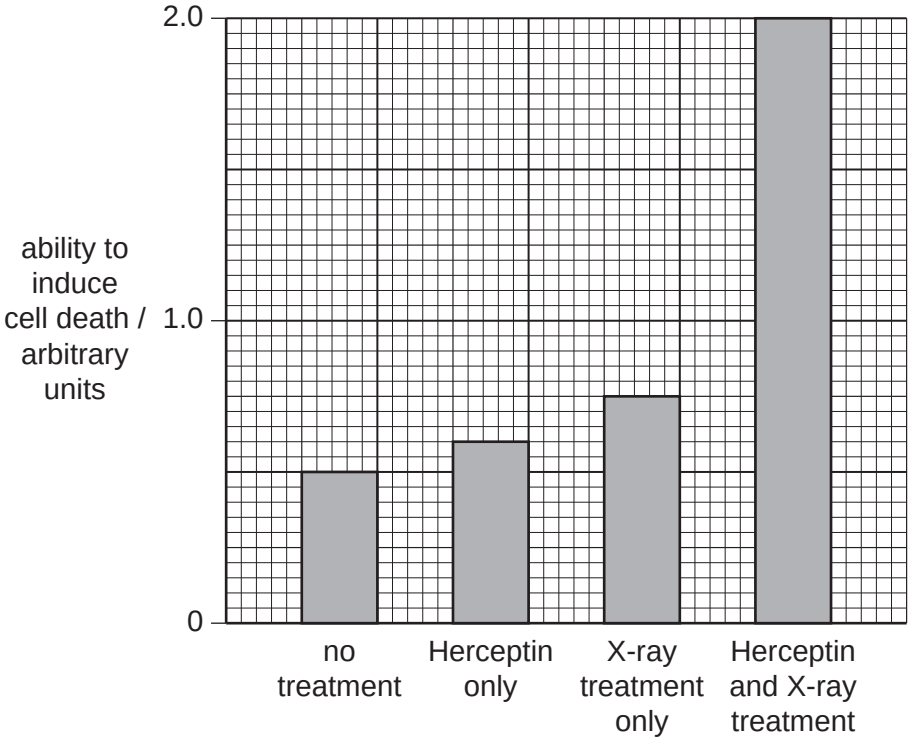


Fig. 4.1

With reference to Fig. 4.1,

For Examiner's Use

(i) compare the effects on breast cancer cells of the different treatments

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.....[3]

(ii) calculate the percentage increase in the ability to induce cell death of using Herceptin **and** X-ray treatment compared with using Herceptin only.

Show your working.

..... [2]

(c) A second experiment investigated the effect of increasing doses of X-rays on the survival of breast cancer cells in the presence and absence of Herceptin. The results are shown in Fig. 4.2.

For Examiner's Use

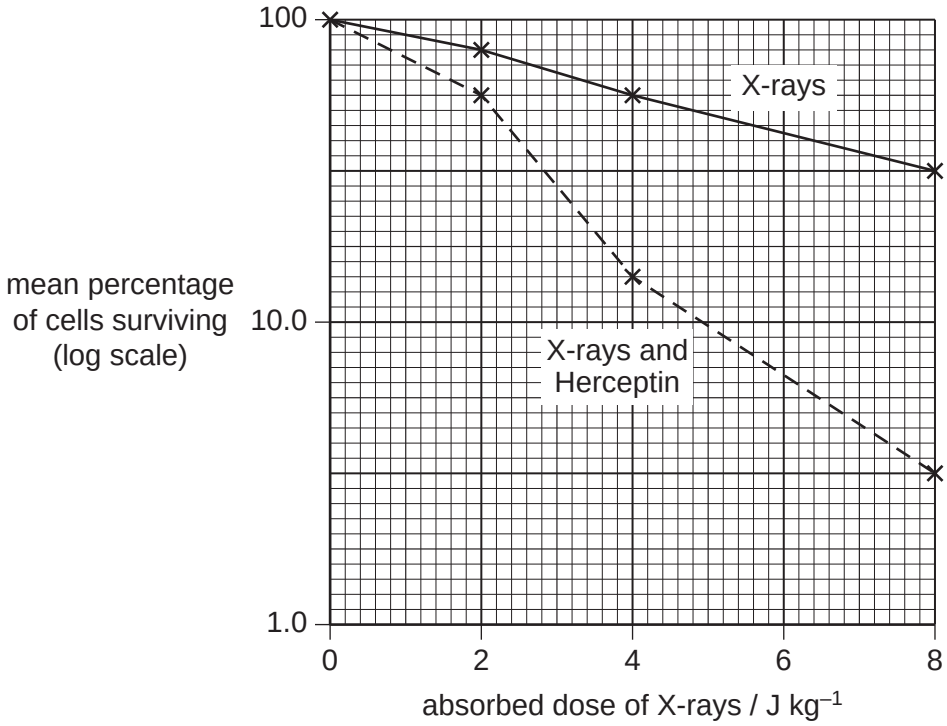


Fig. 4.2

With reference to Fig. 4.2,

(i) compare the effects of increasing doses of X-rays on cells in the presence and absence of Herceptin

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.....[3]

(ii) suggest an explanation for the effect of Herceptin.

.....

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.....[2]

[Total: 14]

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5 **(a)** Complete Table 5.1 to show, for each of the two hormones, follicle stimulating hormone (FSH) and progesterone,

- the site of secretion
- the target tissue(s)
- the action of the hormone during the human menstrual cycle.

For Examiner's Use

Table 5.1

hormone	site of secretion	target tissue(s)	action during human menstrual cycle
FSH	....	....	....
progesterone	....	....	....

[6]

(b) Explain the biological basis of the oestrogen/progesterone contraceptive pill.

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.....[3]

[Total: 9]

6 Fig. 6.1 shows the structure of ATP.

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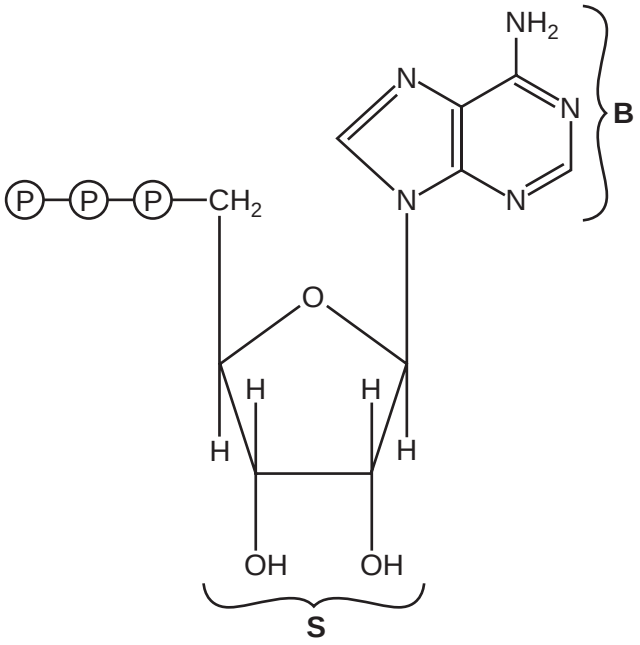


Fig. 6.1

(a) (i) Name the nitrogenous base labelled **B**.

.....[1]

(ii) Name the sugar labelled **S**.

.....[1]

(b) ATP is described as having a universal role as the energy currency in all living organisms. Explain why it is described in this way.

.....

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.....[4]

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(c) State **precisely** two places where ATP is synthesised in cells.

For Examiner's Use

1 .....

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2 .....

.....[2]

[Total: 8]

7 Fig. 7.1 shows a section through part of the cortex of a kidney.

For Examiner's Use

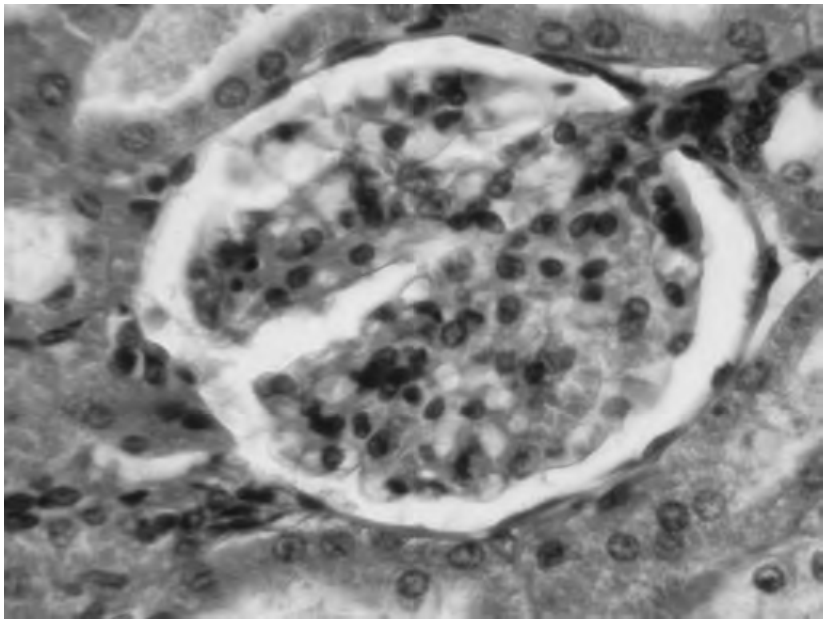


Fig. 7.1

(a) On Fig. 7.1, draw label lines and use the letters **G** and **R** to identify :

- a glomerulus with the letter **G**.
- a renal capsule with the letter **R**. [2]

(b) State the name of the hormone that is involved in the control of the water potential of the blood.

..... [1]

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(c) Table 7.1 shows the concentration of some compounds in the fluids of a glomerulus, a renal capsule and a collecting duct of the kidney.

For Examiner's Use

Table 7.1

compound	concentration / g 100 cm^{-3}		
	blood plasma entering glomerulus	filtrate in renal capsule	urine in collecting duct
water	90	90	96
proteins	8.0	0.0	0.0
glucose	0.1	0.1	0.0
urea	0.03	0.03	2.0

With reference to Table 7.1,

(i) explain why proteins occur in the blood entering the glomerulus but not in the filtrate in the renal capsule

.....

.....

.....[2]

(ii) explain why there is glucose present in the filtrate but not in the urine

.....

.....

.....[2]

(iii) explain the difference in the concentration of urea between the filtrate and urine.

.....

.....

.....[2]

[Total: 9]

8 In mice there are several alleles of the gene that controls the intensity of pigmentation of the fur.

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The alleles are listed below in order of dominance with **C** as the most dominant.

C = full colour
$\mathbf{C^{ch}}$ = chinchilla
$\mathbf{C^{h}}$ = himalayan
$\mathbf{C^{p}}$ = platinum
$\mathbf{C^{a}}$ = albino

The gene for eye colour has two alleles. The allele for black eyes, **B**, is dominant, while the allele for red eyes, **b**, is recessive.

A mouse with full colour and black eyes was crossed with a himalayan mouse with black eyes. One of the offspring was albino with red eyes.

Using the symbols above, draw a genetic diagram to show the genotypes and phenotypes of the offspring of this cross.

[6]

[Total: 6]

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QUESTION 9 starts on page 20

9 In the majority of photosynthetic organisms, fixation of carbon dioxide occurs in the Calvin cycle.

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Fig. 9.1 is an outline of this cycle.

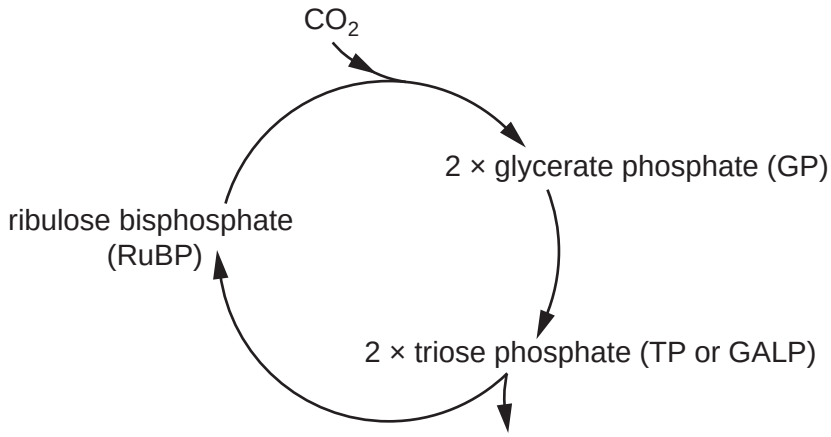


Fig. 9.1

(a) State,

(i) the name of the five carbon sugar in the cycle

.....[1]

(ii) the name of the enzyme that fixes carbon dioxide

.....[1]

(iii) where in the chloroplast the Calvin cycle occurs

.....[1]

(iv) the name of another compound that is produced in the light-dependent stage of photosynthesis that is used in the Calvin cycle.

.....[1]

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(b) Fig. 9.2 shows the changes in the relative concentrations of RuBP and GP produced in the Calvin cycle before and after a light source is switched off. All other conditions are constant.

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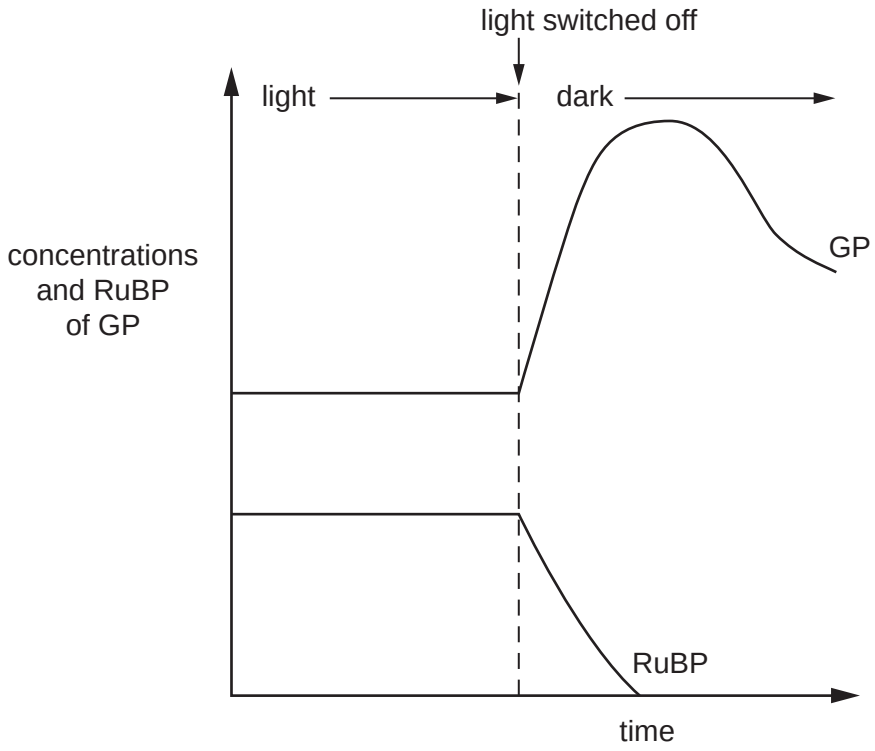


Fig. 9.2

Explain the changes in the relative concentrations of RuBP and GP **after** the light source is switched off.

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.....[4]

[Total: 8]

Section B

Answer **one** question.

For Examiner's Use

10 **(a)** Describe the structure of a motor neurone. [7]

(b) Explain how an action potential is transmitted along a motor neurone. [8]

[Total: 15]

11 **(a)** Explain the role of isolating mechanisms in the evolution of new species. [8]

(b) Describe and explain, using an example, the process of artificial selection. [7]

[Total: 15]

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Question 1 Fig. 1 © www.adenbartdreamteam.nl/Images/Mauritania/AnimalsMauritania001.bmp

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