

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

BIOLOGY

2804

Central Concepts

Wednesday **23 JANUARY 2002** Morning 1 hour 30 minutes

Candidates answer on the question paper.

Additional materials:

Electronic calculator

Candidate Name	Centre Number	Candidate Number										
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TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers, in blue or black ink, in the spaces on the question paper.
- Read each question carefully before starting your answer.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	13	
2	18	
3	8	
4	11	
5	14	
6	17	
7	9	
TOTAL	90	

This question paper consists of 12 printed pages.

Answer **all** the questions.

- 1 Fig. 1.1 shows the relationship between various metabolic processes.

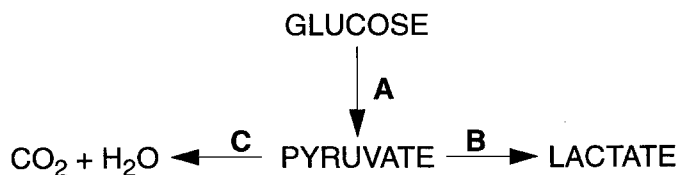


Fig. 1.1

- (a) (i) Identify the three metabolic processes.

A

B

C [3]

- (ii) State the letter of the pathway in which acetyl coenzyme A is involved.

..... [1]

- (iii) State the letter of the pathway in which ATP is utilised.

..... [1]

In an investigation, mammalian liver cells were homogenised (broken up) and the resulting homogenate centrifuged. Portions containing only nuclei, ribosomes, mitochondria and cytosol (residual cytoplasm) were each isolated. Samples of each portion, and of the complete homogenate, were incubated in four ways,

- 1 with glucose;
- 2 with pyruvate;
- 3 with glucose plus cyanide;
- 4 with pyruvate plus cyanide.

Cyanide inhibits carriers in the electron transport chain, such as cytochromes. After incubation the presence or absence of carbon dioxide and lactate in each sample was determined.

The results are summarised in Table 1.2.

Table 1.2

	samples of homogenate										
	complete		nuclei only		ribosomes only		mitochondria only		cytosol		
	carbon dioxide	lactate	carbon dioxide	lactate	carbon dioxide	lactate	carbon dioxide	lactate	carbon dioxide	lactate	
1. glucose	✓	✓	X	X	X	X	X	X	X	X	✓
2. pyruvate	✓	✓	X	X	X	X	✓	X	X	X	✓
3. glucose and cyanide	X	✓	X	X	X	X	X	X	X	X	✓
4. pyruvate and cyanide	X	✓	X	X	X	X	X	X	X	X	✓

X = absent ✓ = present

(b) (i) With reference to this investigation, name **two** organelles not involved in respiration.

1.[1]
2.[1]

(ii) Explain why carbon dioxide is produced when mitochondria are incubated with pyruvate but **not** when incubated with glucose.

.....

[3]

(iii) Explain why, in the presence of cyanide, lactate production does occur, but not carbon dioxide production.

.....

[3]

This investigation may be repeated using yeast cells instead of liver cells.

(c) State the products that would be formed by the incubation of glucose with cytosol from yeast.

.....[1]

[Total : 13]

2 Fig. 2.1 is an electronmicrograph of a chloroplast.

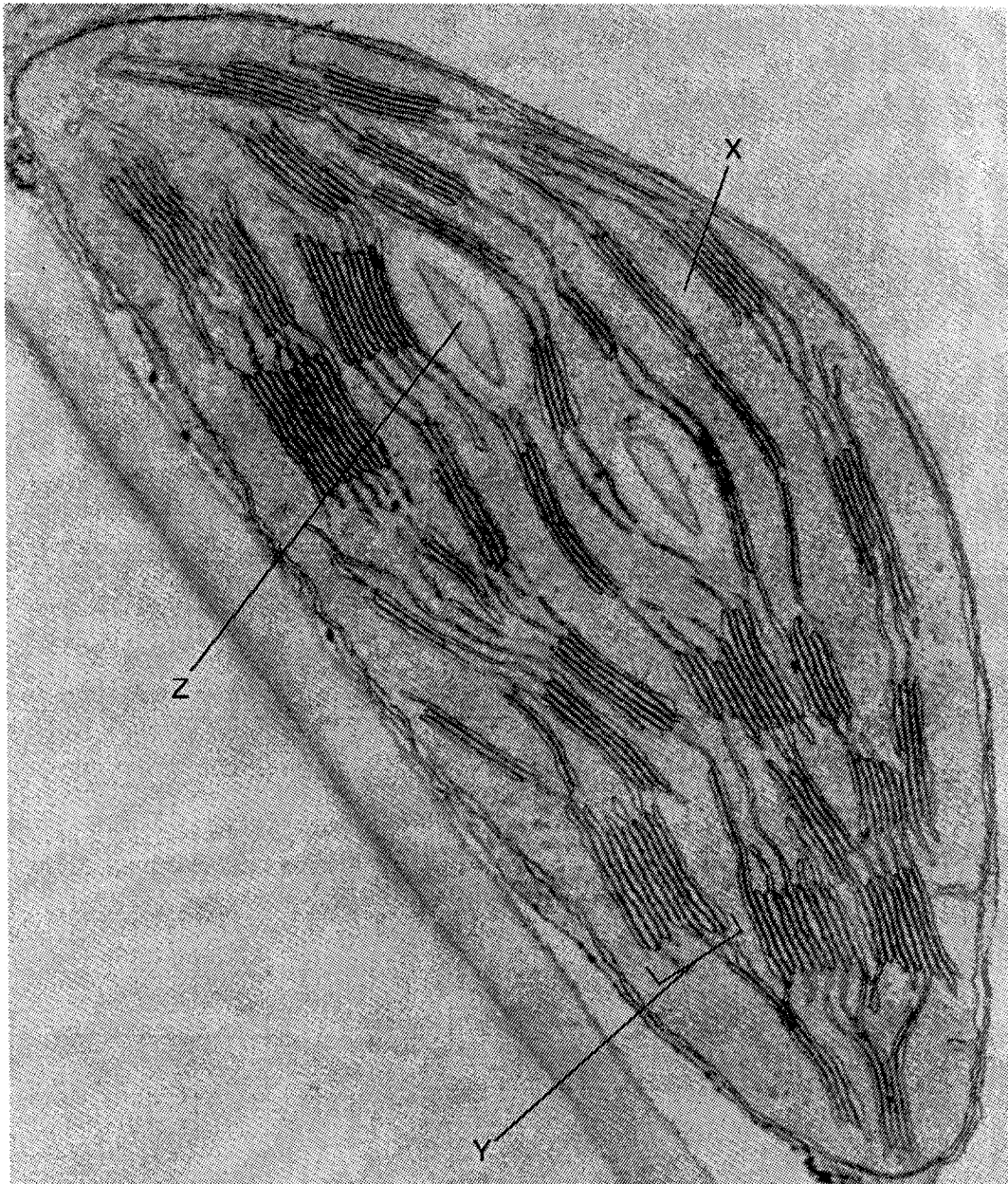


Fig. 2.1

(a) (i) Name X to Z.

X

Y

Z

[3]

(ii) On Fig.2.1 indicate with a label line marked with the letter W where photophosphorylation takes place. [1]

Fig. 2.2 gives an outline of the Calvin cycle.

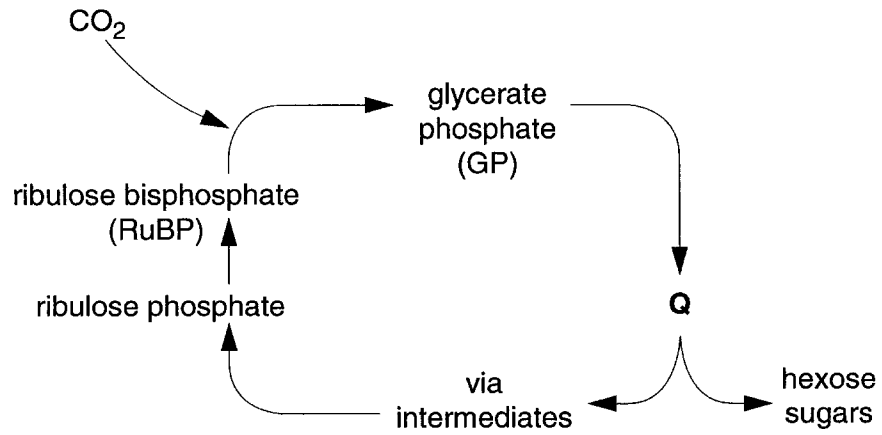


Fig. 2.2

(c) (i) Indicate on Fig. 2.2, by using the letter **P**, where the ATP from photophosphorylation is utilised in the Calvin cycle. [2]

(ii) Name the enzyme involved in the fixation of carbon dioxide.

.....[1]

(iii) Name substance **Q**.

.....[1]

(iv) State **two** macromolecules, other than carbohydrates, that can be formed from substance **Q**.

.....
.....[2]

[Total : 18]

3 (a) Explain what is meant by the term *intraspecific competition*.

.....

[2]

Wheatgrass, *Agropyron spicatus*, was the dominant plant species on the semi-arid grasslands of north western USA prior to the introduction of European species. These species were introduced to improve the productivity of the grassland for grazing. One such species was cheatgrass, *Bromus tectorum*, which invaded and dominated land previously colonised by wheatgrass.

An experiment was carried out in which seeds from the two species were mixed together in different proportions and sown in plots of equal area. The sowing density was the same in all plots. The mean root lengths of each species were determined when they were grown separately and in mixtures of different proportions. Table 3.1 shows the results of this experiment carried out on the two grasses.

Table 3.1

	mean root length / cm	
	wheatgrass	cheatgrass
grown separately	64.4	82.8
4 wheatgrass : 1 cheatgrass	56.9	85.4
1 wheatgrass : 1 cheatgrass	47.2	91.1
1 wheatgrass : 4 cheatgrass	41.0	82.1

(b) With reference to Table 3.1,

(i) state **two** conclusions that can be drawn from the data;

1.

 2.

[4]

(ii) suggest how cheatgrass outcompetes wheatgrass.

.....

[2]

[Total : 8]

4 (a) Explain the meanings of the following terms:

allele

.....

recessive

.....

sex linkage

.....[6]

In humans a certain rare sex linked recessive allele results in a change to the shape of the iris. This condition is known as a cleft iris.

(b) Using the symbols **B** and **b** show all the possible genotypes and phenotypes of the children of a man with a cleft iris and a woman who has only the normal allele.

parental genotypes

gametes

offspring genotypes

offspring phenotypes[4]

A woman with a normal iris who is a carrier of the cleft iris allele becomes pregnant by a man with a normal iris.

(c) State the probability that their first child will have a cleft iris.

.....[1]

[Total : 11]

5 In sickle cell anaemia, the presence of the mutant allele Hb^S in place of the normal Hb^A results in the substitution of one amino acid at a critical position in the haemoglobin molecule. The frequency of Hb^S is much higher on the West Coast of Africa than in most parts of the world. The frequency of the allele is correlated with the distribution of malaria. It has been shown that heterozygotes possess an advantage in childhood over normal individuals as they have increased resistance to malaria. They also have sufficient amounts of normal haemoglobin in the blood to prevent severe anaemia.

(a) (i) Using the information given in the passage, state whether the likely life expectancy is high or low in West Africa for individuals with the following genotypes. In each case give a reason for your answer.

Hb^AHb^A

.....

Hb^AHb^S

.....

Hb^SHb^S

.....[6]

(ii) Explain how a change in the structure of DNA can lead to an alteration in the haemoglobin molecule.

.....

.....

.....

.....

.....

.....[4]

(b) Explain why populations of West African descent living in the USA have a decreased frequency of the Hb^S allele compared with present day West African populations.

.....

.....

.....

.....

.....

.....[4]

[Total : 14]

6 Fig. 6.1 represents the relationship between parts of two nerve cells (neurones).

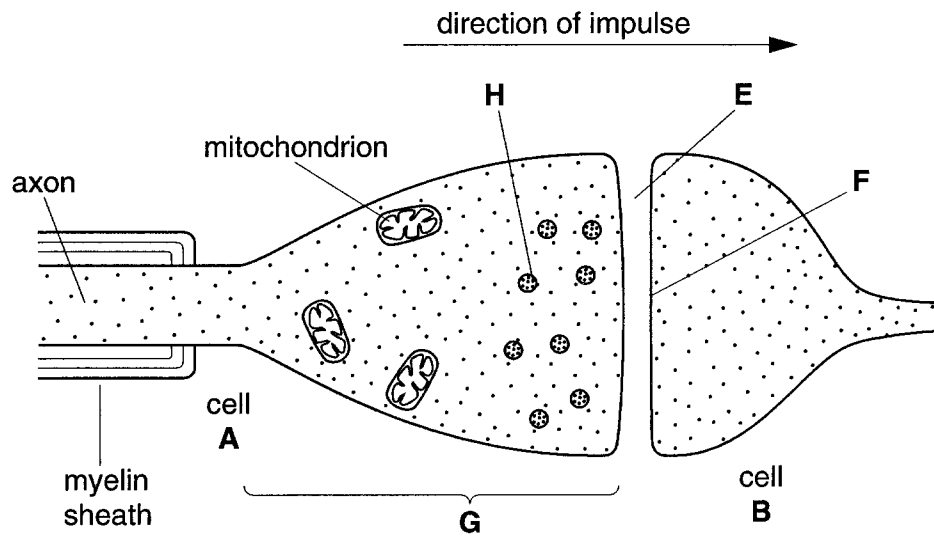


Fig. 6.1

(a) Name E to H.

E

F

G

H

[4]

(b) Describe how a nerve impulse passes from cell A to cell B. (In this question, 1 mark is available for the quality of written communication.)

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