UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

6945617635

BIOLOGY **9700/42**

Paper 4 A2 Structured Questions **May/June 2010**

2 hours

Candidates answer on the Question Paper.

Additional Materials: Answer Paper available on request.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams, graphs, or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions in Section A and **one** question from Section B.
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	
Section A	
1	
2	
3	
4	
5	
6	
7	
8	
Section B	
9 or 10	
Total	

This document consists of **20** printed pages, **3** lined pages and **1** blank page.

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Section A

Answer **all** the questions.

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1 The American crocodile, *Crocodylus acutus*, was classified as an endangered species by the USA in 1975. It is found in estuarine regions of southern Florida.

Fig. 1.1 shows an American crocodile.



Fig. 1.1

The salinity of the water was thought to play a part in the distribution of the American crocodile.

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Fig. 1.2 shows the number of American crocodile nest sites in areas with water of varying salinity in southern Florida.

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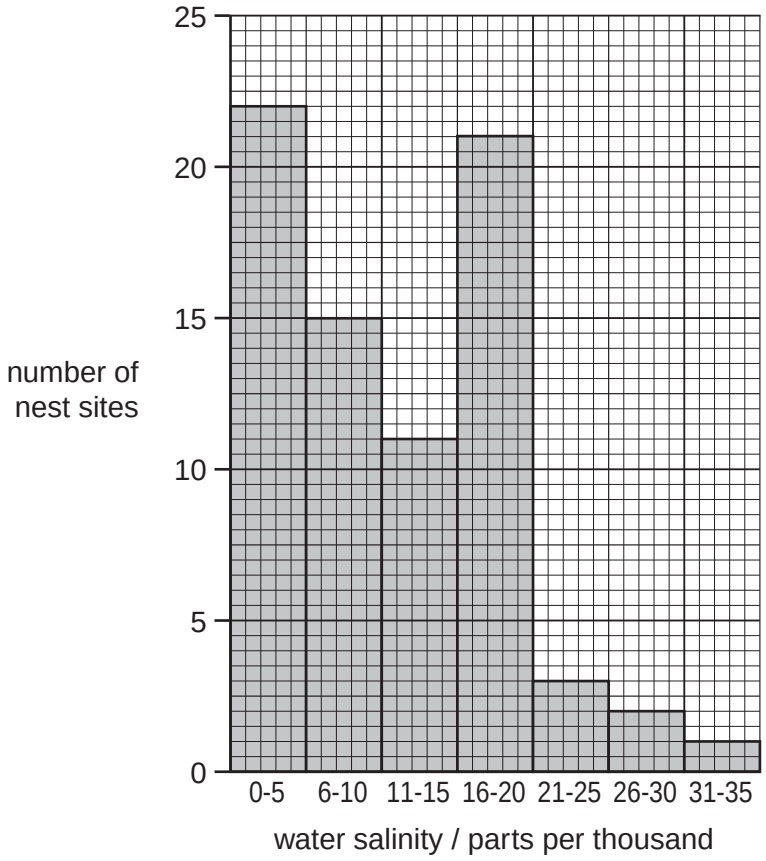


Fig. 1.2

(a) Describe the results shown in Fig. 1.2.

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..... [3]

(b) Much conservation work has been done in the Everglades National Park in Florida, which is a large wetland area. As a result the number of nest sites has increased from 8 in 1975 to 31 in 2000. This has led to a rise in the number of crocodiles.

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(i) Calculate the percentage increase in nest sites between 1975 and 2000.

Show your working.

answer .....% [2]

(ii) Suggest two reasons why the population of crocodiles in the Everglades National Park has increased.

1. .....

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2. .....

..... [2]

[Total: 7]

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2 Follicle stimulating hormone (FSH) and luteinising hormone (LH) both consist of two polypeptide chains, the α and β chains.

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- The α chains of FSH and LH are identical.
- The β chain of FSH has 111 amino acids and that of LH 121 amino acids.
- FSH and LH bind to different receptors in the cell surface membranes of their target cells.
- This binding leads to steroid synthesis by the target cells.

(a) Explain why FSH does not bind to a LH receptor.

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..... [3]

(b) Name the cells of a human female that carry

(i) FSH receptors .....

..... [1]

(ii) LH receptors. .....

..... [1]

(c) Describe what happens when FSH binds to its receptors on its target cells.

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[Total: 8]

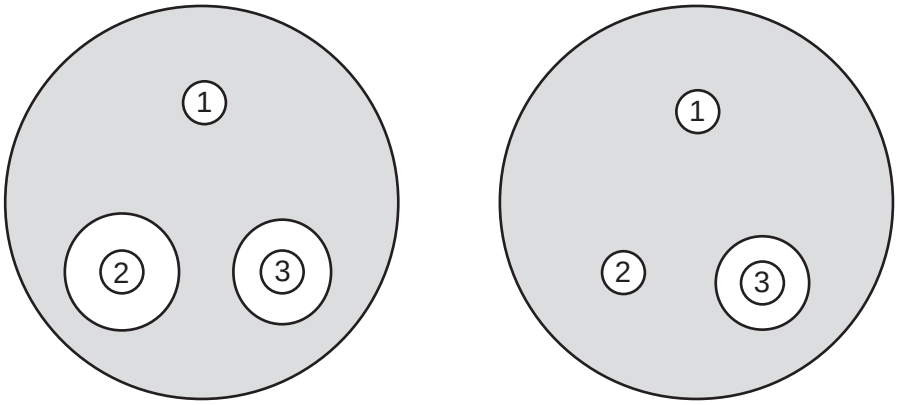
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3 The sensitivity of bacteria to antibiotics can be tested using the disc diffusion method. An inoculum of the bacteria is spread onto agar culture plates and then filter paper discs impregnated with antibiotic are pressed onto the surface of the agar. The plates are incubated. Bacteria grow as a 'lawn' across the agar, but a circular zone (the zone of inhibition) appears around any disc where bacterial growth is inhibited.

Two species of bacteria, **A** and **B**, were grown on separate culture plates in the presence of three types of filter paper disc:

1 – no antibiotic (control)
2 – penicillin V, a natural penicillin
3 – carboxypenicillin, a synthetic penicillin.

The appearance of the incubated plates is shown in Fig. 3.1.



bacterium **A** bacterium **B**

Fig. 3.1

(a) With reference to Fig. 3.1, explain the effect of penicillin V on bacterium **A**.

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Bacteria **A** and **B** have different outer layers, as shown in Fig. 3.2.

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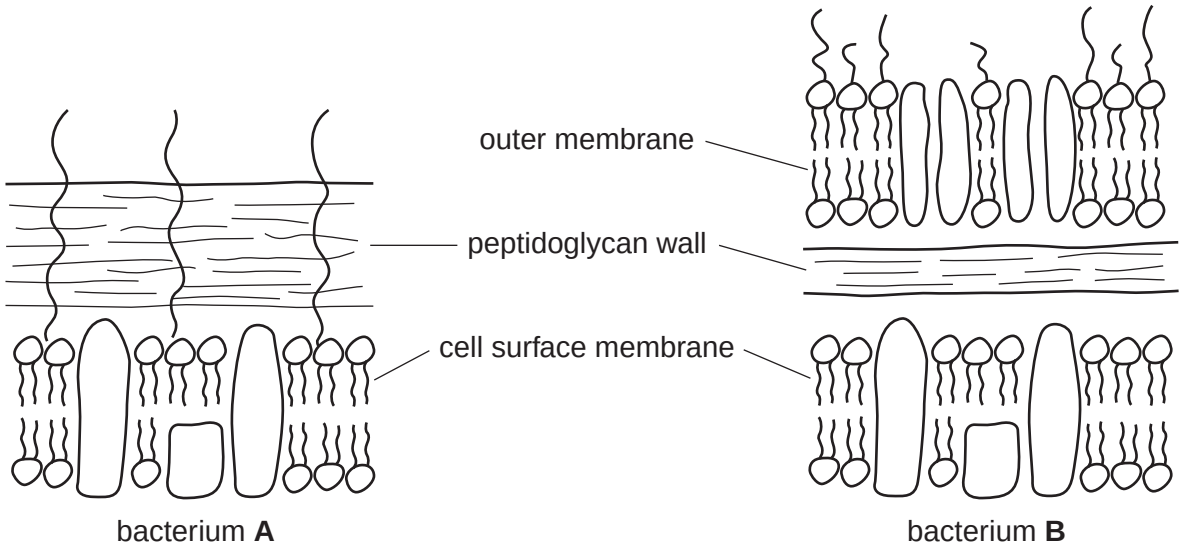


Fig. 3.2

(b) With reference to Fig. 3.1 and Fig. 3.2

(i) describe how the outer layers of bacterium **B** differ from those of bacterium **A**

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..... [2]

(ii) explain the different effects of penicillin V on bacteria **A** and **B**

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..... [2]

(iii) suggest how the synthetic penicillin, carboxypenicillin, is able to affect the growth of bacterium **B**.

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..... [2]

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(c) Distinguish between batch culture and continuous culture of microorganisms.

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(d) Explain why batch culture rather than continuous culture is used in the production of penicillin.

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[Total: 15]

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Question 4 starts on page 10

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4 Cereal crops, such as sorghum and rice, are a major source of nutrients all over the world.

(a) Explain why cereal crops are important components of many people's diets.

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(b) Alpha amylase is an enzyme produced in germinating seeds, where it hydrolyses starch. Fig. 4.1 shows the effect of temperature on alpha amylase in germinating seeds of sorghum and rice.

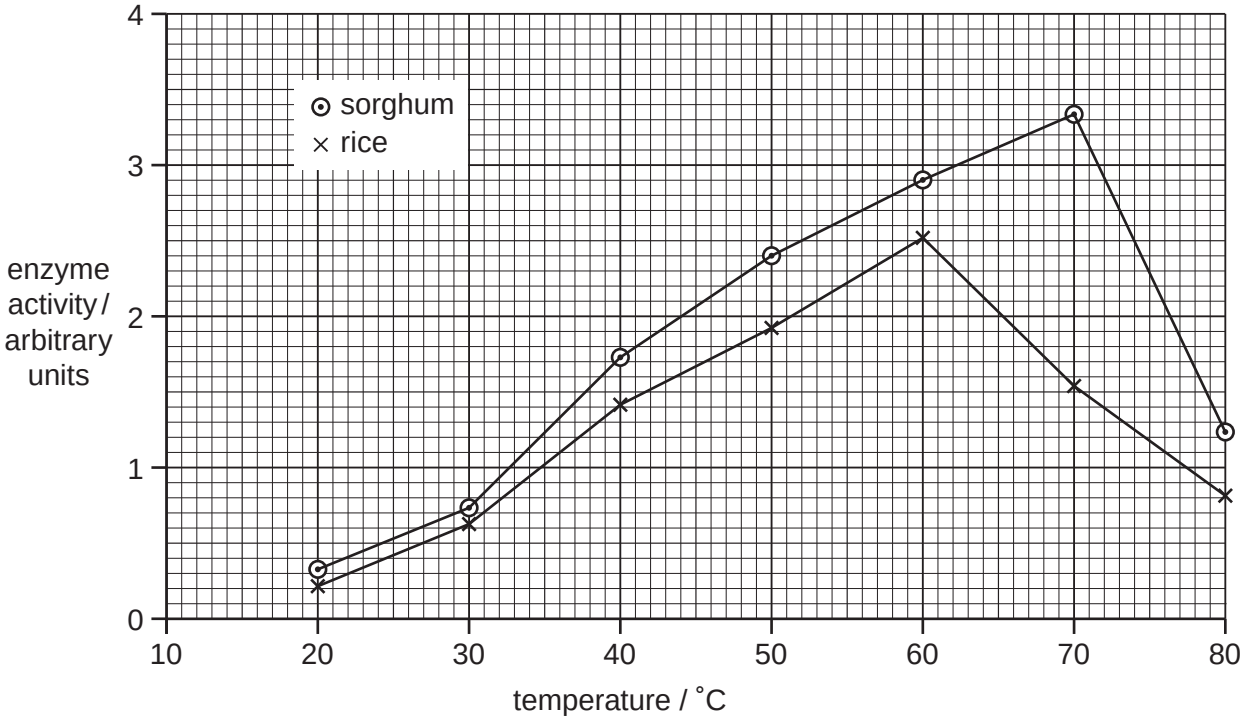


Fig. 4.1

(i) Name the part of the seed that contains starch.

..... [1]

(ii) With reference to Fig. 4.1, compare the effects of temperature on alpha amylase in sorghum and rice.

For Examiner's Use

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(iii) With reference to the types of bonding in proteins, suggest how differences in the tertiary structure of alpha amylase in rice and sorghum could explain the differences in their activities shown in Fig. 4.1.

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(c) Sorghum does not grow well at low temperatures. An investigation was carried out into the response of sorghum to low temperatures at different light intensities.

- Sorghum plants were kept at 25 °C in a light intensity of 215 W m^{-2} for several weeks, and then at 10 °C for three days.
- The temperature was then increased to 25 °C again for seven days.
- The investigation was repeated at light intensities of 170 W m^{-2} and 50 W m^{-2}.
- Day length and carbon dioxide concentration were kept constant throughout.

The uptake of carbon dioxide, as mg CO_2 absorbed per gram of leaf dry mass, was measured

- at 25 °C before cooling
- at on each of the three days at 10 °C
- for seven days at 25 °C.

The results are shown in Table 4.1.

Table 4.1

light intensity / W m^{-2}	carbon dioxide uptake / mg CO_2 g^{-1}				
	at 25 °C, before cooling	during cooling at 10 °C			at 25 °C (mean over days 4 to 10)
		day 1	day 2	day 3	
215	50.1	3.0	0.4	0.2	0.2
170	48.2	5.5	2.9	1.2	1.5
50	22.4	3.0	1.2	0.7	9.2

With reference to Table 4.1

(i) describe **and** explain the effect of light intensity on the rate of carbon dioxide uptake **before cooling**

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(ii) describe the effect of light intensity on the ability of sorghum plants to survive cooling.

For Examiner's Use

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..... [2]

[Total: 15]

5 The fruitfly, *Drosophila*, has many different species. Three of these species, *Drosophila pseudoobscura*, *D. persimilis* and *D. miranda*, are thought to be closely related.

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Samples of these three species were collected from the western United States of America. Fig. 5.1 shows where these species naturally occur.

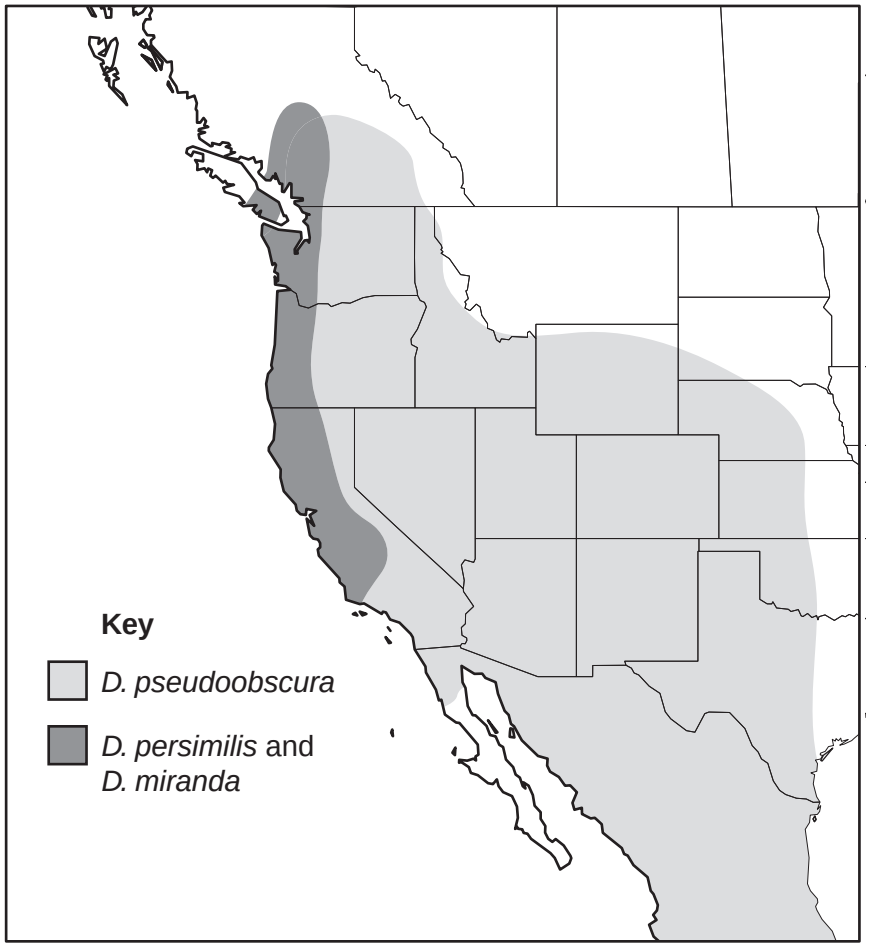


Fig. 5.1

The base sequences of four regions of DNA of each species were sequenced. The divergence of these base sequences in *D. pseudoobscura* and *D. persimilis* from the sequences in *D. miranda* was calculated. The results are shown in Table 5.1.

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Table 5.1

DNA region	*Drosophila* species	percentage divergence of base sequence from that of *D. miranda*
1	*pseudoobscura*	2.5
	persimilis	2.4
2	*pseudoobscura*	8.1
	persimilis	7.3
3	*pseudoobscura*	2.1
	persimilis	1.7
4	*pseudoobscura*	1.9
	persimilis	1.7

(a) With reference to Table 5.1, describe the evidence that *D. miranda* may be more closely related to *D. persimilis* than to *D. pseudoobscura*.

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..... [2]

(b) Suggest why there is more divergence in some regions of DNA than in others.

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[Turn over

(c) The area where *D. pseudoobscura* is found is separated from the areas where the other two species are found by a high range of mountains.

For Examiner's Use

Explain how the species *D. pseudoobscura* could have evolved from a population of *D. miranda.*

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..... [4]

[Total: 8]

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6 In humans a rare, sex-linked, recessive allele results in a change in the shape of the iris in the eye. This condition is know as cleft iris (CI).

(a) Explain what is meant by the term *sex linkage*.

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..... [2]

(b) Using suitable symbols complete the genetic diagram below.

Key to symbols

recessive allele .....

dominant allele .....

parental phenotypes	male with CI	X	normal female
parental phenotypes	.....		.....
gametes	.....		.....

offspring genotypes .....

offspring phenotypes ..... [5]

(c) A woman who is heterozygous for CI becomes pregnant by a man with a normal iris.

State the probability that their child will have CI.

..... [1]

[Total: 8]

7 Fig. 7.1 is an outline diagram of the Krebs cycle. A two carbon acetyl group enters the cycle by combining with a molecule of oxaloacetate. A molecule of citrate is formed which is decarboxylated and dehydrogenated to regenerate the oxaloacetate.
The letters **P** to **V** are steps in the cycle.

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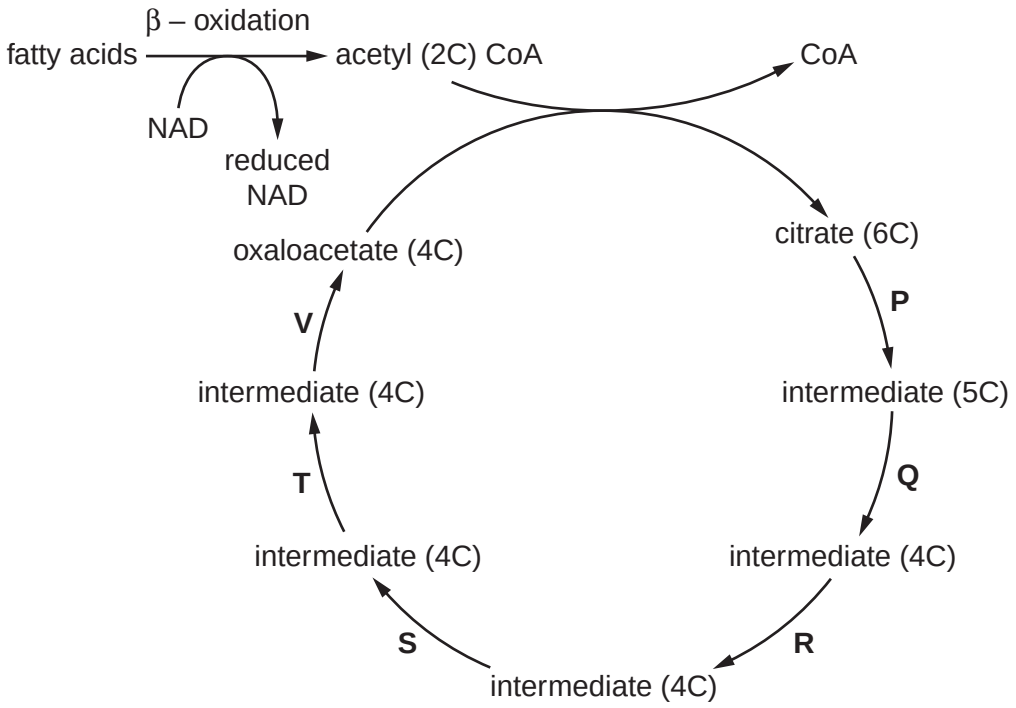


Fig. 7.1

(a) **(i)** Explain what is meant by the following terms:

decarboxylation .....

dehydrogenation ..... [2]

(ii) Using the letters in the cycle, state where decarboxylation is taking place.

..... [1]

(b) Fig. 7.1 shows that fatty acids can be converted into acetyl coenzyme A (acetyl CoA) by a process known as oxidation. Both this process and the Krebs cycle require NAD. The hydrogen atoms released reduce the NAD molecules.

(i) State the number of reduced NAD molecules that are formed in the Krebs cycle from one acetyl group that enters the cycle from acetyl CoA.

..... [1]

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(ii) State where the reduced NAD molecules are re-oxidised **and** describe what happens to the hydrogen atoms.

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(c) Describe the role of reduced NAD in respiring yeast cells in the absence of oxygen.

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(d) Describe how the production of lactate in muscle tissue **differs** from anaerobic respiration in yeast.

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[Total: 16]

8 Gene technology has many uses including the production of substances such as insulin.

For Examiner's Use

(a) (i) Outline what is meant by *gene technology*.

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..... [2]

(ii) Explain why genes for enzymes that produce fluorescent substances are used as makers in gene technology.

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..... [2]

(b) There is much controversy throughout the world regarding the use of genetically modified (GM) crops.

(i) Suggest **two** advantages of growing GM rice with an enhanced vitamin A content.

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(ii) Suggest **two** disadvantages of growing GM crops.

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..... [2]

[Total: 8]

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Section B

For Examiner's Use

Answer **one** question.

9 **(a)** Describe the structure of photosystems and explain how a photosystem functions in cyclic photophosphorylation. [8]

(b) Explain briefly how reduced NADP is formed in the light-dependent stage and how it is used in the light-independent stage. [7]

[Total: 15]

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

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

[Total: 15]

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