OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced GCE

BIOLOGY

2806/01

Unifying Concepts in Biology

Monday **24 JANUARY 2005** Morning 1 hour 15 minutes

Candidates answer on the question paper.
Additional Materials:
Electronic calculator
Ruler (cm/mm)

Candidate Name	Centre Number	Candidate Number

TIME 1 hour 15 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 provided 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	11	
2	10	
3	15	
4	12	
5	12	
TOTAL	60	

This question paper consists of 16 printed pages and 4 blank pages.

Registered Charity Number: 1066969
[Turn over

Answer **all** the questions.

1 Coronary heart disease (CHD) is one of the most common causes of death. Many factors have been shown to affect the risk of a person dying from CHD.

The Swedish Twin Registry was used to identify all pairs of twins born in Sweden between 1925 and 1986. Only those pairs that were **same-sex** (either girl/girl or boy/boy) and living in Sweden in 1961, were studied.

Each of these pairs of twins was classified as **monozygotic** or **dizygotic**.

Monozygotic or 'identical' twins develop from the same fertilised egg cell. Dizygotic or 'non-identical' twins develop from two different egg cells that have been fertilised by two different sperm cells.

(a) Explain why

(i) monozygotic twins are **genetically** identical while dizygotic twins are not;

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(ii) monozygotic twins are not **phenotypically** identical.

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[4]

The cause of death for any of the people in the sample of same sex Swedish twins has been recorded since 1961.

Some of the data from these records were published in 2002 and are shown in Table 1.1.

Table 1.1

	male twin pairs		female twin pairs	
	monozygotic ('identical')	dizygotic ('non-identical')	monozygotic ('identical')	dizygotic ('non-identical')
number of pairs of twins studied	1640	2978	2004	3861
number of pairs where **both** have died of CHD	153	248	97	155
percentage of pairs where **both** have died of CHD	9.33	8.33	4.84	4.01

The differences between the percentages shown in Table 1.1, for example between 4.84% and 4.01%, are small but are statistically significant.

(b) Explain what is meant by **statistical significance**.

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(c) State **four** conclusions that may be drawn from the data shown in Table 1.1.

Conclusion 1 .....

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Conclusion 2 .....

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Conclusion 3 .....

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Conclusion 4 .....

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(d) Suggest why twins of different sex (girl/boy pairs) were **not** included in the sample of twin pairs studied.

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[Total: 11]

2 Palisade cells have both chloroplasts and mitochondria. Exchanges between a mitochondrion, a chloroplast and the cytoplasm surrounding them are shown in Fig. 2.1.

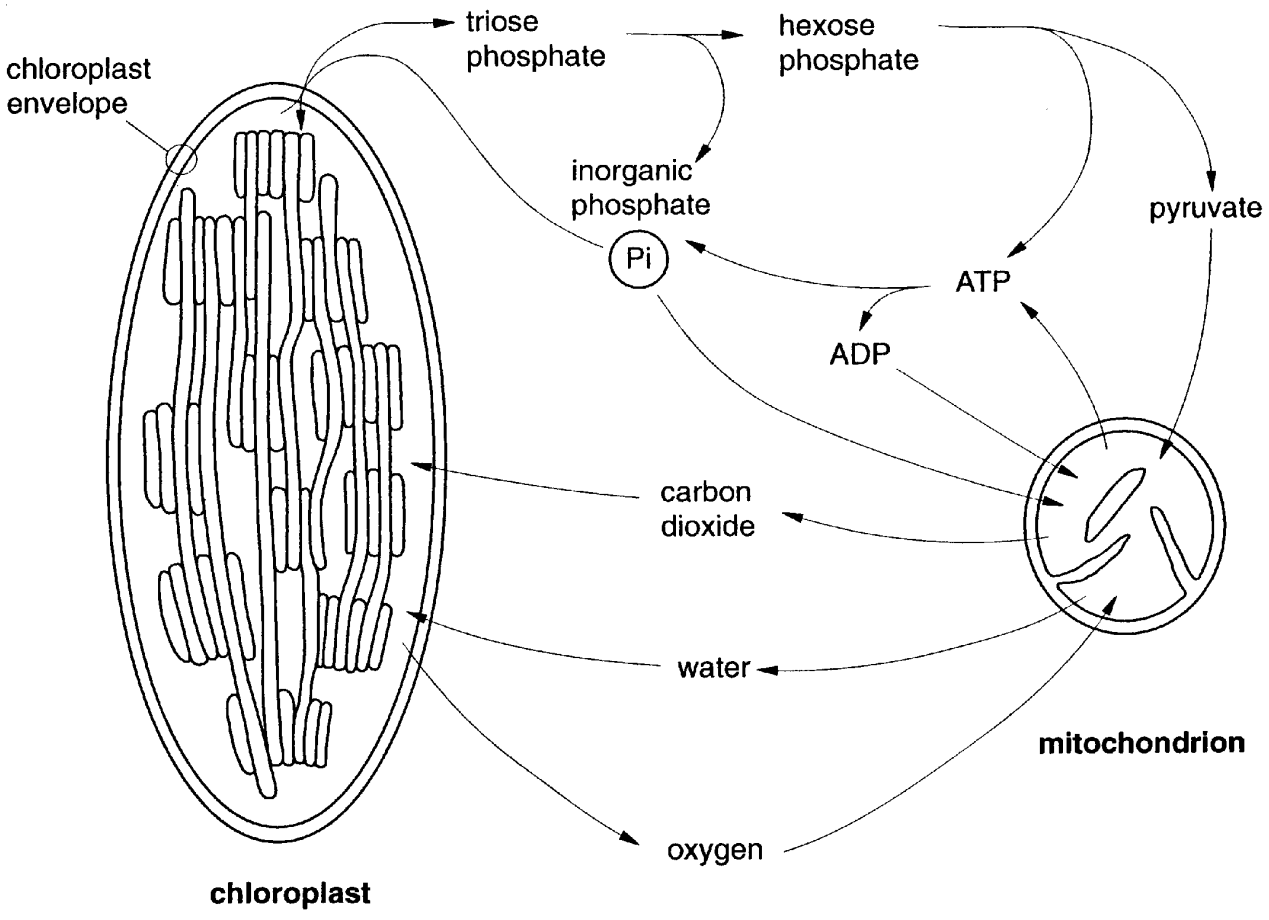

Fig. 2.1

(a) A leafy shoot can be sealed inside a transparent container. The concentration of oxygen in the atmosphere within this container can be measured. In the dark, the oxygen concentration falls. At high light intensities, the oxygen concentration increases. At a particular light intensity, the oxygen concentration in the container remains constant.

Use Fig. 2.1 to explain how it is possible for the oxygen concentration to remain constant.

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(b) Explain why there is no build up in the concentration of phosphate ions inside mitochondria as a result of the inward passage of phosphate ions.

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(c) Triose phosphate moves out of chloroplasts by passing through carrier proteins that are part of the chloroplast envelope. These proteins allow an inorganic phosphate ion to pass inwards at the same time as triose phosphate moves outwards.

Suggest why the movement of triose phosphate out of chloroplasts is an example of facilitated diffusion rather than active transport.

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(d) Many biologists believe that both mitochondria and chloroplasts evolved, at an early stage in the history of the earth, from prokaryotic organisms that inhabited the cytoplasm of eukaryotic host cells.

State **two** structural features of mitochondria and chloroplasts that are also present in prokaryotic cells.

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[Total: 10]

3 Forced pulmonary ventilation is voluntary rapid and deep breathing. It occurs when a person has not recently taken exercise and would not normally breathe in this way.

A class of students decided to investigate the effect of forced pulmonary ventilation on the time for which each of them was able to hold his/her breath.

Care was taken to exclude all class members who had any respiratory infection, or who had any history of asthma, from the investigation.

The class adopted the following procedure:

- Six students (**group A**) carried out forced pulmonary ventilation for one minute.
- These students exhaled and held their breath for as long as they could. They timed the period for which they held their breath.
- A different group of six students (**group B**) held their breath **without** any prior forced ventilation. They timed the period for which they held their breath.

The whole class continued with their lesson for 30 minutes. Then:

- **Group A** timed how long they were able to hold their breath, this time **without** prior forced ventilation.
- **Group B** timed how long they were able to hold their breath, this time **after** they had carried out forced ventilation.

All the students were sitting at desks before and during the investigation.

The results are shown in Table 3.1.

Table 3.1

	male/female	time for which breath was held / s	
		without prior forced ventilation	**after** prior forced ventilation
group **A**	M	29	78
	M	62	80
	F	38	60
	F	30	57
	F	32	55
	F	30	54
mean for group **A**		**37**	**64**
group **B**	M	32	78
	F	33	74
	M	56	115
	F	43	76
	M	43	95
	M	32	82
mean for group **B**		**40**	**87**

(a) The students were allocated to groups by putting those sitting to the left in group **A** and those sitting to the right in group **B**.

State **two** variables that **should** have been taken into account when selecting the groups to give a more valid investigation.

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2 ..... [1]

(b) The students in each group held their breath twice, but the groups made their attempts in a different sequence. One of the students concluded that, 'the sequence in which the two attempts were made was not an important variable in this investigation'.

Explain whether the data shown in Table 3.1 support this conclusion or not.

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(c) **(i)** State the likely effects of forced pulmonary ventilation on the blood in the alveolar capillaries.

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(ii) Explain how these effects are produced.

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For Examiner's Use

(d) In this question, one mark is available for the quality of spelling, punctuation and grammar.

During exercise, pulmonary ventilation increases so that the changes in the composition of the blood produced by exercise are **reversed** by the increased ventilation. This is an example of homeostasis.

Outline **other** homeostatic mechanisms which act on the blood and circulation during prolonged exercise.

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Quality of Written Communication [1]

[Total: 15]

4 The leaves of tomato plants are usually dark green. A variety known as 'Sunny' has yellow-green leaves when grown under the same conditions as dark green varieties.

A 'Sunny' plant was allowed to self-pollinate and many seeds were collected from its fruit. A class of students germinated some of these seeds in pots, each containing 80 g of compost and 50 cm^3 of water. Six seeds were planted in each pot. The pots were placed in an incubator at 26 °C for four days and then on a bench near a window in bright daylight for a further four days, after which the seedlings were examined and the colour of their leaves recorded.

Some of the students' results are shown in Table 4.1.

Table 4.1

pot	numbers of seedlings developed after 8 days		
	dark green	yellow-green	yellow
A	3	2	0
B	0	6	0
C	1	4	1
D	1	0	2
E	2	3	1
F	1	4	1

After all the data had been recorded, totals were calculated and are shown in Table 4.2.

Table 4.2

	numbers of seedlings developed after 8 days		
	dark green	yellow-green	yellow
totals	28	56	33
ratio			

(a) Calculate the ratio of dark green : yellow-green : yellow seedlings to the nearest whole number and enter this ratio in the spaces provided in Table 4.2. [1]

(b) Explain the results shown in Table 4.2.

You may include a genetic diagram as part of your explanation. Explain any symbols that you use.

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[5]

(c) The student who had been responsible for pot **B** was concerned that there must have been some error because all six of the seedlings were the same.

Another student said that the totals of the results, shown in Table 4.2, seemed so 'good' that they must have been 'fiddled', i.e. must have been a scientific fraud.

Comment on the views of these two students.

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(d) The seedlings were left to grow in the pots for a further 14 days. The pots remained in bright light and were watered regularly.

- All the yellow seedlings died.
- The dark green seedlings grew larger than the yellow-green seedlings.

Explain these observations.

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[Total: 12]

5 Read the passage below and answer the questions that follow.

Snake Venoms

Some types of snake kill their prey and defend themselves by means of a poisonous bite. Fangs (hollow teeth) inject venom from specialised glands into the victim. The venom contains a protein, which is a toxin.

Different species of snake have toxins that act in different ways. Haemolytic toxins are enzymes that hydrolyse phospholipids. They damage tissues, including heart muscle.

Neurotoxins, such as the one produced by green mamba snakes, bind to acetylcholine receptors on the surface membranes of nerve cells or muscle fibres. This leads to muscle paralysis and heart failure.

Fig. 5.1 shows the way in which the polypeptide chain of a neurotoxin, produced by the green mamba snake, is folded.

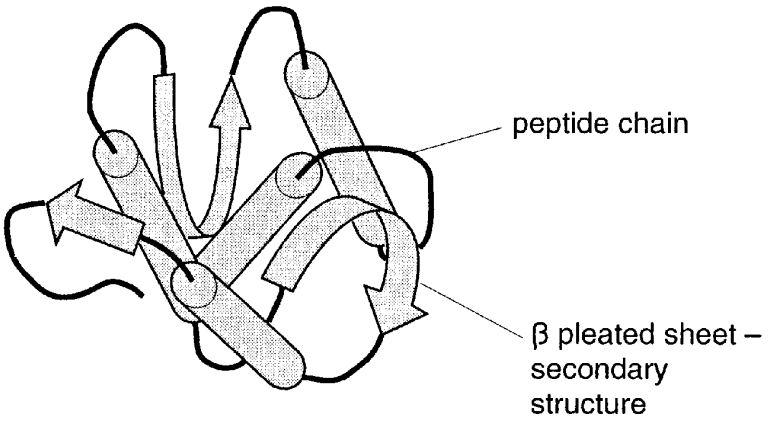

Fig. 5.1

Some antibodies bind to toxins and inactivate them. These antibodies are known as antitoxins.

The human immune response is far too slow to be effective in making antitoxins against snake venom.

Injecting a very small, non-lethal quantity of venom into a horse produces antitoxin. The horse produces antitoxins that can be extracted from horse blood and used as an emergency treatment for those bitten by the same species of snake.

Each time the horse is injected with venom, it is able to tolerate larger doses and the concentration of the specific antitoxin in its blood is greater.

(a) State how enzymes which hydrolyse phospholipids damage tissues.

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(b) Suggest how a neurotoxin which binds to acetylcholine receptors on muscle fibres would produce paralysis.

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(c) Explain why the **human** immune response is too slow to protect a person from a snake bite.

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(d) Explain why a horse is injected more than once with a small amount of venom when it is being prepared for use as a source of antitoxin.

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(e) With the help of Fig. 5.1, explain why snake venom which has been heated to 100 °C for several minutes, would be unlikely to be toxic.

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(f) Why would treatment with horse antitoxin produce no long-term protection against snake bites?

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[Total: 12]

END OF QUESTION PAPER