

**ADVANCED GCE****BIOLOGY**

Unifying Concepts in Biology

2806/01

Candidates answer on the Question Paper

OCR Supplied Materials:

- Insert (inserted)

Other Materials Required:

- Electronic calculator
- Ruler (cm/mm)

**Thursday 28 January 2010
Morning****Duration:** 1 hour 15 minutes

Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **60**.
- 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.
- This document consists of **12** pages. Any blank pages are indicated.

Examiner's Use Only:			
1			
2			
3			
4			
Total			

Answer **all** the questions.

- 1** Insects, such as beetles, obtain oxygen by drawing air in through holes in their exoskeleton, called spiracles. Pairs of spiracles on each abdominal segment connect to air tubes that take the air deep into the tissues of the insect for gas exchange.

Diving beetles live in ponds. They carry a bubble of air under their wing cases when they swim underwater. The bubble supplies air to the spiracles. When the bubble has been used up, the beetle comes to the surface to collect a new bubble.

An investigation was carried out into the effect of temperature on diving beetles. Three beetles, **A**, **B** and **C**, of the same species were observed in thermostatically-controlled water baths. The number of times each beetle surfaced to renew its air bubble was counted at three different temperatures.

The results are shown in Table 1.1.

Table 1.1

temperature /°C	number of times air bubble was renewed per hour			
	beetle A	beetle B	beetle C	mean
10	10	12	8	
20	18	22	18	
30	44	48	38	

- (a) Plot a graph of the data on the graph paper provided in Fig. 1.1, to show the **mean number of times** air bubbles were renewed at each temperature. [4]

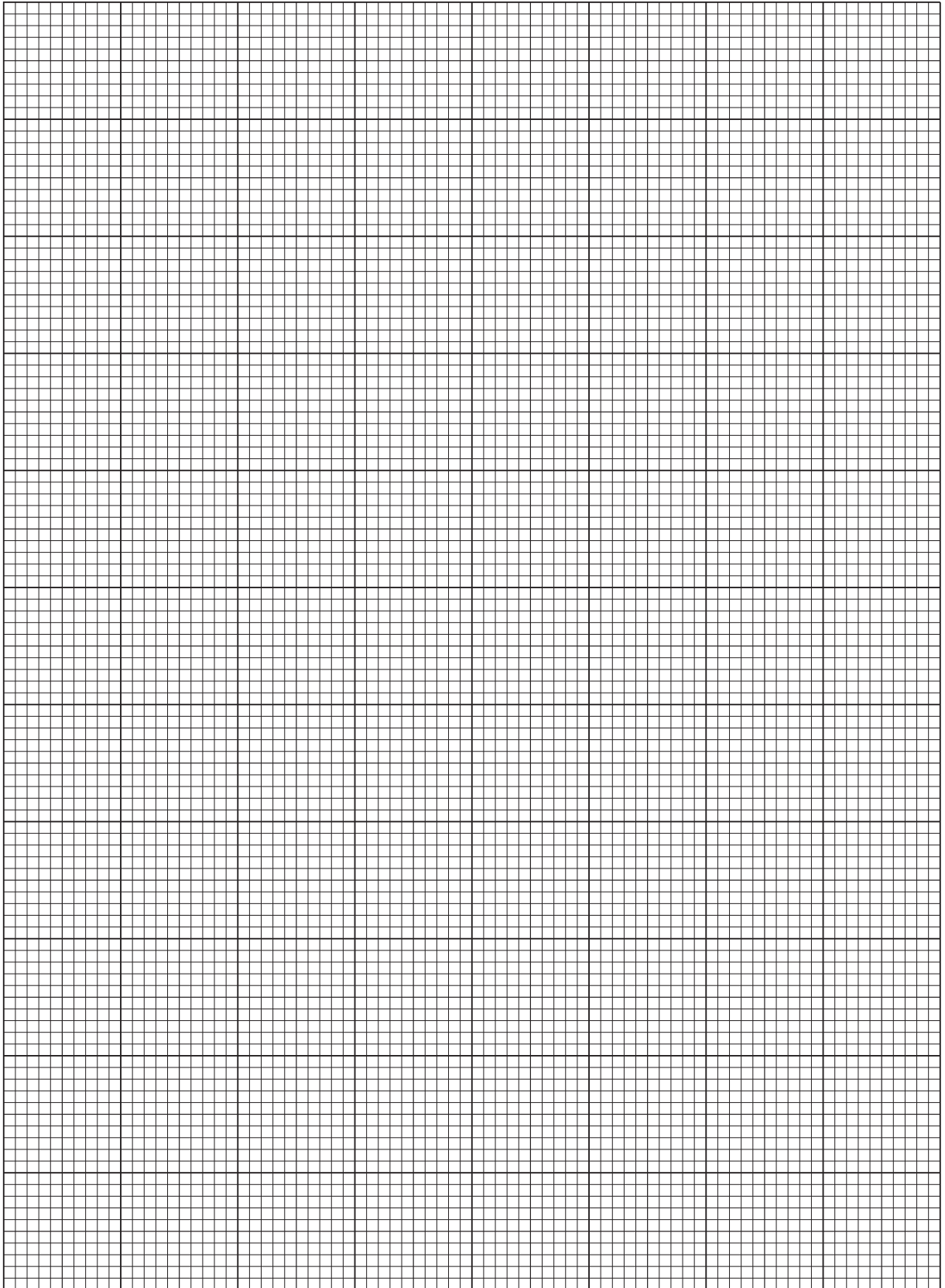


Fig. 1.1

- (b)** The number of times the air bubble is renewed per hour is related to a beetle's need for oxygen to carry out metabolic reactions in its cells.

Explain why the number of renewals per hour increases exponentially as the temperature rises from 10 °C to 20 °C to 30 °C.

[5]

- (c)** Human sub-aqua divers take a tank of oxygen-rich air underwater in order to breathe.

Explain why the consumption of oxygen by humans does not depend significantly on the external temperature of the water.

..... [2]

- (d)** List **three** factors that could increase a human diver's consumption of oxygen underwater.

1

2

3 [3]

[Total: 14]

- 2 Fig. 2.1, **on the insert**, shows energy flow through two ecosystems, a deciduous forest community and a marine (sea) community.

The numbers represent energy in $\text{kJ m}^{-2} \text{day}^{-1}$.

- (a) The producers in the marine community (the phytoplankton) are microscopic algae that carry out photosynthesis. The percentage of light energy available that is fixed in photosynthesis by the marine phytoplankton is 0.8%.
- (i) Calculate the percentage of light energy available that is fixed in photosynthesis by the forest plants. Show your working.

Answer = % [2]

- (ii) Explain why not all of the energy fixed in photosynthesis is passed on to the primary consumer trophic level in **both** ecosystems.

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..... [3]

- (iii) Primary consumers are animals. These have higher activity levels than plants as they move more. However, the figures for heat loss in metabolism of the primary consumers are smaller than the figures for the heat loss in metabolism of the producers in both flow charts.

Explain why.

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..... [2]

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

Use Fig. 2.1 to compare the efficiency of energy flow in the two ecosystems. Suggest reasons for the differences.

[7]

Quality of Written Communication [1]

[Total: 15]

- 3 Tobacco plants, *Nicotiana* species, synthesise nicotine in their roots and then transport this to the leaves and stem. The production of nicotine is a defence mechanism to prevent insects from eating the plants' leaves.

An experiment investigated the effect of insect damage on nicotine production and the number of seeds made in tobacco plants.

- Insect damage was simulated by making a number of small puncture holes in the leaves.
- As a control, plants were examined in which a single leaf had been removed.
- Both punctured and control plants had a similar surface area of leaf tissue removed.
- The plants were grown in two types of soil.

The results are shown in Table 3.1.

Table 3.1

	mean number of seeds per plant		mean nicotine content per plant as % of total dry mass	
	plants with single leaf removed	plants with leaves punctured	plants with single leaf removed	plants with leaves punctured
soil type 1	6 000	4 500	1.09	1.37
soil type 2	2 600	1 100	0.67	0.98

- (a) (i) Explain why the control plants were plants with a leaf removed rather than undamaged plants.

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..... [2]

- (ii) Use Table 3.1 to evaluate the hypothesis that tobacco plants respond to insect damage by increasing their defences against herbivores.

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..... [3]

- (b) Fig. 3.1 shows the structure of a nicotine molecule. Each molecule contains two nitrogen atoms.

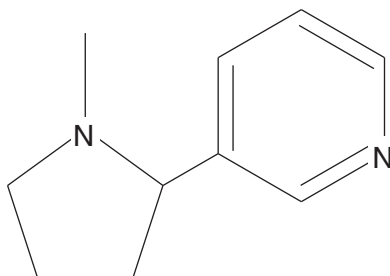


Fig. 3.1

With reference to other nitrogen-containing compounds in plants, suggest why an increase in nicotine production is associated with a decrease in the number of seeds made.

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..... [3]

- (c) Nicotine has a similar shape to the neurotransmitter acetylcholine. In the bodies of animals, including insects and mammals, nicotine binds to acetylcholine receptors on nerve and muscle cell membranes.

Nicotine is not hydrolysed by acetylcholinesterase.

- (i) Suggest how the action of nicotine could result in the death of insects.

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- (ii) Suggest why smoking tobacco rarely results in immediate death in humans.

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..... [1]

- (iii) Describe how regular **nicotine** intake by smoking tobacco may result in chronic disease in humans.

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..... [4]

[Total: 16]

QUESTION 4 STARTS ON PAGE 10

- 4 In Finland in 1988, a national campaign to reduce the use of the antibiotic erythromycin was started.

Fig. 4.1 shows the number of doses of erythromycin used per thousand people per month over the eleven year period from 1984 to 1994. The percentage of infections each year caused by erythromycin-resistant strains of the bacterium *Streptococcus pyogenes* is also shown.

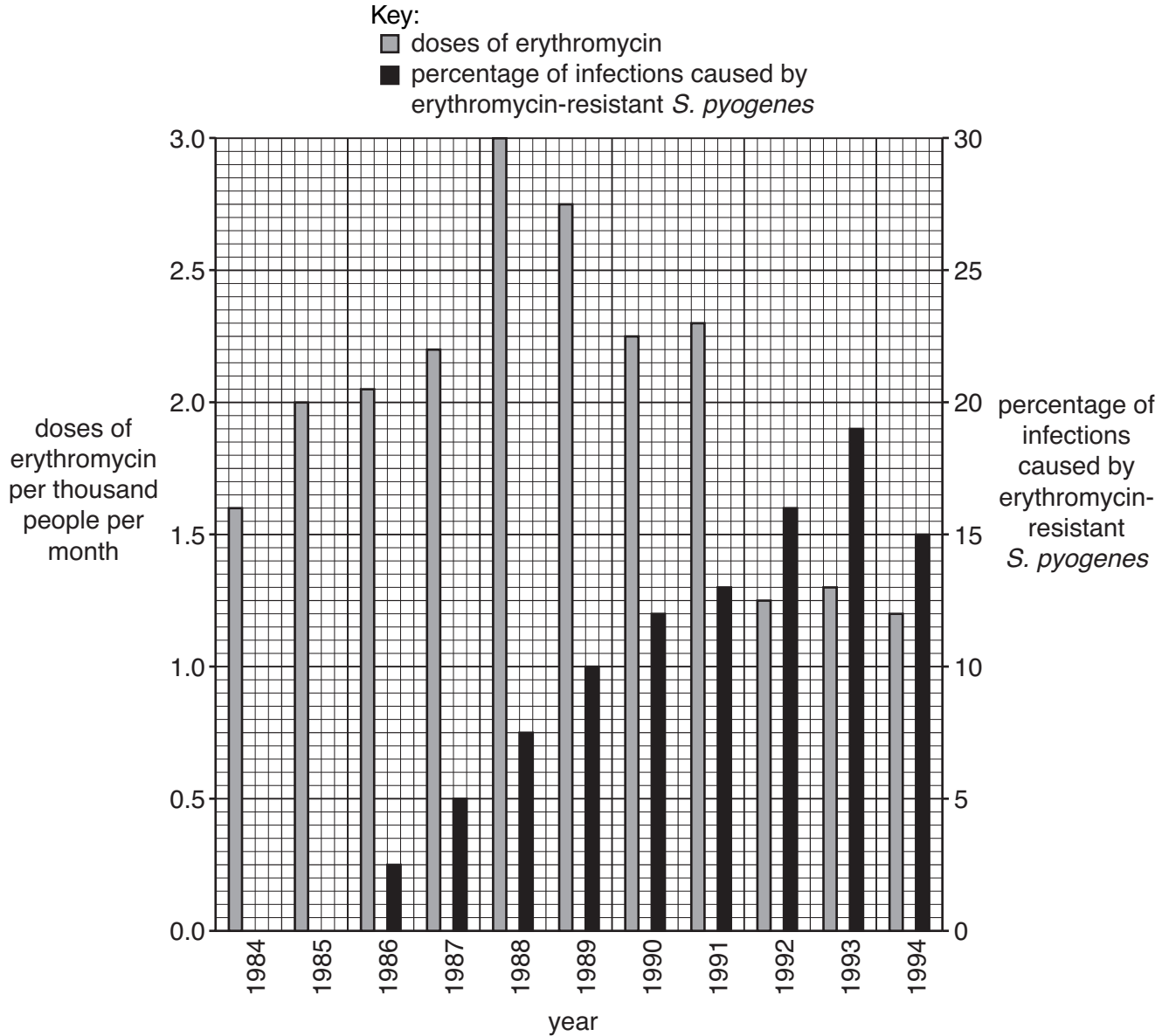


Fig. 4.1

- (a) (i) List **three** features that are characteristic of bacteria, including *S. pyogenes*.

- 1
- 2
- 3 [3]

- (ii) Explain the advantages to scientists of giving the bacterium *Streptococcus pyogenes* a two-part Latin name.

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- [2]

- (b) Use Fig. 4.1 to evaluate the success of the 1988 campaign to reduce the use of the antibiotic erythromycin.

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- [3]

QUESTION 4(c) STARTS ON PAGE 12

- (c) (i) Suggest how the erythromycin-resistant *S. pyogenes* may have originated in Finland in 1986.

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 [1]

- (ii) Explain why the percentage of erythromycin-resistant bacterial infections rose between 1986 and 1993.

.....

 [4]

- (iii) Suggest why the percentage of erythromycin-resistant bacterial infections fell between 1993 and 1994.

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 [2]

[Total: 15]

END OF QUESTION PAPER

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