

**ADVANCED GCE****BIOLOGY**

Unifying Concepts in Biology

2806/01

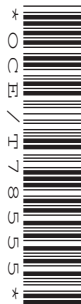
Candidates answer on the question paper

OCR Supplied Materials:

- Insert (inserted)

Other Materials Required:

- Electronic Calculator
- Ruler (cm/mm)

Friday 12 June 2009**Afternoon****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 **16** pages. Any blank pages are indicated.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	15	
2	15	
3	14	
4	16	
TOTAL	60	

Answer **all** the questions.

- 1** This question is about an experimental vaccine for multiple sclerosis.

Multiple sclerosis is an autoimmune disease where some of the body's own T lymphocytes attack and destroy the myelin sheath around nerve cells. Symptoms of multiple sclerosis include blurred vision, loss of balance, poor coordination and paralysis.

To make the vaccine, some of the T lymphocytes that attack myelin are taken from the patient's body. These are treated with radiation to make them inactive. They are then re-injected into the patient.

The body's immune system then recognizes these inactive T lymphocytes as damaged and attacks them. This primes the immune system to destroy all myelin-specific T lymphocytes in the same way as a conventional vaccine would lead to the destruction of a particular pathogen.

- (a)** Describe the structure of the myelin sheath.

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..... [2]

- (b)** Explain how damage to the myelin sheath accounts for the symptoms of poor coordination and paralysis.

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..... [4]

- (c)** Describe how a conventional vaccine leads to the destruction of a pathogen.

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..... [3]

- (d) Suggest a method by which T lymphocytes can be extracted from a patient.

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..... [2]

- (e) Suggest how radiation makes the T lymphocytes inactive.

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..... [2]

- (f) Explain why the experimental vaccine will **not** destroy **all** the body's T lymphocytes.

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..... [2]

[Total: 15]

2 Fig. 2.1, **on the insert**, shows some of the metabolic pathways that take place in a plant cell.

(a) State the names of the processes labelled **A**, **B** and **C**.

A

B

C [3]

(b) Select an example from Fig. 2.1 to explain what is meant by an anabolic reaction.

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..... [2]

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

Describe, using information from Fig. 2.1, how plants make the chemical components necessary to build cell walls, cell membranes and cytoplasm.

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[Total: 15]

- 3 (a) Fruits and vegetables that are red, blue or purple contain pigments called anthocyanins. The concentration of anthocyanin pigment in a large number of each type of fruit or vegetable was measured. Where results varied significantly, the measurements are given as a range. The results are shown in Table 3.1.

Table 3.1

fruit or vegetable	anthocyanin concentration / $\text{mg } 100\text{g}^{-1}$
bilberry	300–320
chokeberry	560
red radish	11–60
black raspberry	300–400

- (i) Suggest why there is **intraspecific** variation in the anthocyanin concentration of bilberry, red radish and black raspberry.

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..... [3]

- (ii) Calculate the median figure for the ranges shown for bilberry and red radish and use these figures to complete the bar chart in Fig. 3.1.

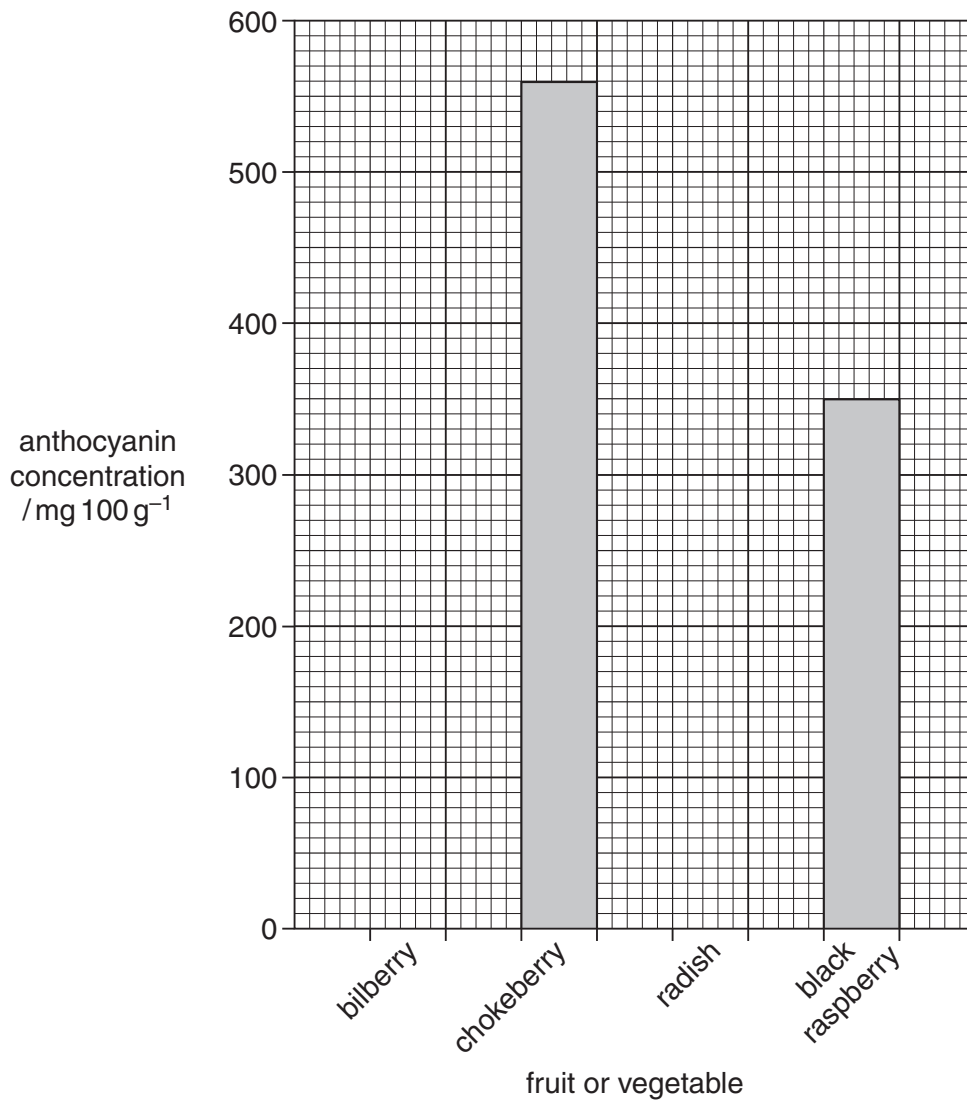


Fig. 3.1

[2]

- (b) Anthocyanins are believed to have health benefits. A study measured how well anthocyanins are absorbed from the mammalian gut. Rats were fed a diet high in anthocyanins from chokeberry for 14 weeks. The concentration of anthocyanin in their blood plasma and urine was then measured. The results are shown in Table 3.2.

Table 3.2

anthocyanin concentration in food / $\text{mg } 100 \text{ g}^{-1}$	anthocyanin concentration in blood plasma / $\mu\text{mol dm}^{-3}$	anthocyanin concentration in urine / nmol dm^{-3}
385	2	53

The concentration of anthocyanins in the blood plasma is low.

Explain whether the data support the suggestion that this is due to poor absorption from the gut, or the suggestion that this is due to efficient removal of anthocyanins from the blood by the kidneys.

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..... [3]

- (c) (i) Plant extracts from fruits and vegetables containing anthocyanin were tested to see if they slowed the rate of growth of colon cancer cells. The concentration of plant extract needed to reduce the rate of growth of cancer cells by 50% was measured. Concentrations of $14 \mu\text{g cm}^{-3}$ of chokeberry extract and $131 \mu\text{g cm}^{-3}$ of radish extract both halved the rate of growth of colon cancer cells.

Explain which plant extract is more effective in reducing the rate of growth of colon cancer cells.

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..... [2]

- (ii) Further investigation showed that the plant extracts blocked part of the cell cycle of the cancer cells by switching off two genes and switching on two others.

Explain how altering the activity of cell cycle genes can affect the multiplication of cancer cells.

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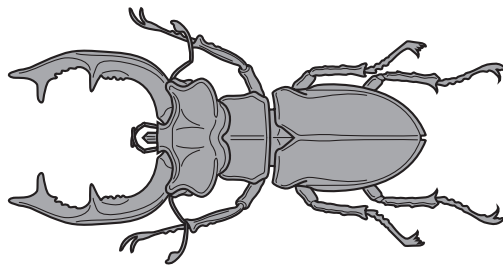
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..... [4]

[Total: 14]

- 4 The stag beetle, *Lucanus cervus*, is the largest beetle in the British Isles. Its population was surveyed in 1998 and again in 2002. People were encouraged to send in a report if they saw a stag beetle adult, shown in Fig. 4.1, or larva, shown in Fig. 4.2.



not drawn to scale

Fig. 4.1

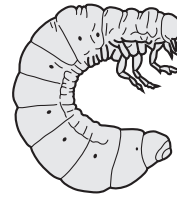


Fig. 4.2

Stag beetle larvae live underground feeding on decaying wood. After three years, each larva forms a pupa. The adult beetle emerges from this in late summer and stays underground during winter, before digging its way to the surface the following year.

Table 4.1 shows the number of sightings of stag beetles in some British counties in 1998 and in 2002.

Table 4.1

county	1998		2002	
	number of sightings	% of total sightings	number of sightings	% of total sightings
Berkshire	662	7.06	228	8.06
Dorset	636	6.78	193	6.82
Hampshire	950	10.13	338	11.94
Kent	464	4.95	271	9.58
Greater London	2936	31.30	817	28.87

- (a) (i) The number of sightings in 2002 was much lower than in 1998. Less publicity in 2002 meant that fewer people knew the survey was taking place.

Explain the importance of calculating the percentage of total sightings.

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..... [2]

- (ii) It was suggested that the stag beetle population is increasing in Kent.

Discuss whether or not the data in Table 4.1 support this suggestion.

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..... [3]

- (iii) Adult stag beetles that bred in 1998 produced offspring that emerged as adults in 2002.

State **one** advantage and **one** disadvantage of conducting the surveys at four-yearly intervals.

advantage

.....

disadvantage

..... [2]

QUESTION 4(b) CONTINUES ON PAGE 12

- (b) Table 4.2 shows sightings of stag beetle larvae and sightings of adult female stag beetles laying eggs, at the bases of different species of tree.

Table 4.2

tree species	common name	number of sightings of larvae	number of sightings of egg laying
<i>Crataegus monogyna</i>	hawthorn	2	1
<i>Fraxinus excelsior</i>	ash	1	3
<i>Malus domestica</i>	apple	4	11
<i>Prunus sp.</i>	cherry / plum	3	7

Table 4.3 shows records of predation of stag beetles by some other animal species.

Table 4.3

animal species	common name	number of sightings of predation
<i>Corvus corone</i>	carrion crow	3
<i>Passer domesticus</i>	house sparrow	3
<i>Pica pica</i>	magpie	18
<i>Vulpes vulpes</i>	fox	5

- (i) Give the **genus** name of an organism at a lower trophic level than the stag beetle.

..... [1]

- (ii) Give the **species** name of an organism at a higher trophic level than the stag beetle.

..... [1]

- (iii) *Crataegus*, *Malus* and *Prunus* are all members of the family Rosaceae. Of the 68 sightings in total of larvae or egg laying, 31 sightings involved trees belonging to this one family.

Calculate the percentage of sightings of larvae and egg laying behaviour that occurred on trees of the Rosaceae family.

Show your working and give your answer to the nearest whole number.

Answer = % [2]

- (iv) Suggest reasons why the beetles specialise in tree species that are closely related.

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..... [2]

QUESTION 4(c) CONTINUES ON PAGE 14

- (c) Male stag beetles have large horns formed from enlarged mouthparts. Other species of beetle have horns formed from other regions of the body.

Fig. 4.3 shows a possible evolutionary pathway for the development of horns in some other beetles. The figure is based on comparisons of DNA sequences from 48 beetle species.

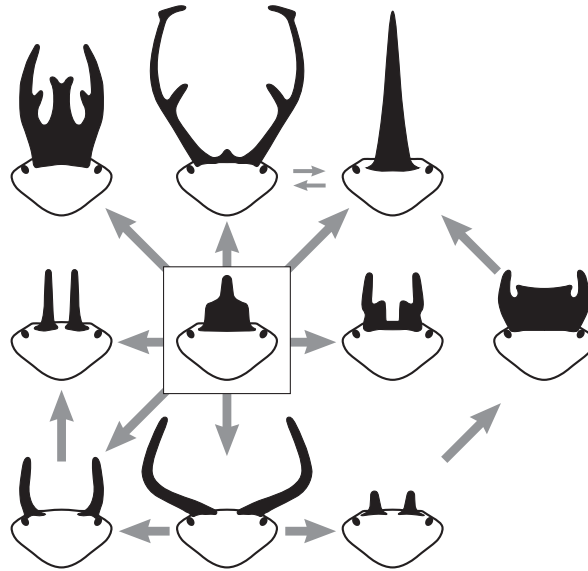


Fig. 4.3

- (i) Suggest why it might be advantageous for a male beetle to have horns.

.....
 [1]

- (ii) Explain why DNA sequences were used to work out the pattern of evolution of horns in beetles.

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 [2]

[Total: 16]

END OF QUESTION PAPER

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