



ADVANCED GCE
BIOLOGY
 Central Concepts

2804

Candidates answer on the question paper

OCR Supplied Materials:
 None

Other Materials Required:

- Electronic calculator
- Ruler (cm/mm)

Friday 12 June 2009
Afternoon

Duration: 1 hour 30 minutes



Candidate Forename		Candidate Surname	
-----------------------	--	----------------------	--

Centre Number						Candidate Number				
---------------	--	--	--	--	--	------------------	--	--	--	--

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 **90**.
- 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.

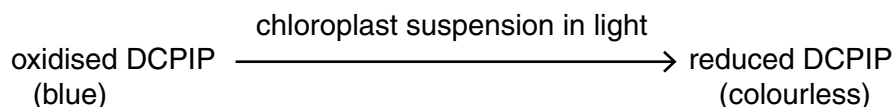
FOR EXAMINER'S USE

Qu.	Max	Mark
1	15	
2	15	
3	15	
4	16	
5	19	
6	10	
TOTAL	90	

Answer **all** the questions.

- 1 Absorption of light and the generation of hydrogen atoms in the light dependent stage of photosynthesis can be demonstrated by using isolated chloroplasts. A chloroplast suspension is prepared by grinding up leaves in an ice cold buffer solution that has the same water potential as the stroma of the chloroplasts. The mixture is filtered, centrifuged and the supernatant decanted and discarded. The chloroplasts are resuspended in fresh, cold buffer solution. A sample of this suspension rapidly reduces a dilute solution of DCPIP (dichloro-phenolindophenol).

The DCPIP is blue when oxidised and colourless when reduced.



- (a) (i) Name **two** pigments found in a chloroplast that are involved in light absorption.

1

2 [2]

- (ii) Outline how hydrogen atoms are generated in the light dependent stage of photosynthesis.

.....

.....

.....

..... [2]

- (iii) State the name of the hydrogen acceptor found in chloroplasts that is replaced by DCPIP in the experiment described above.

..... [1]

- (iv) Explain why the chloroplasts are suspended in an ice cold buffer solution that has the same water potential as the stroma.

.....

.....

.....

.....

.....

.....

..... [4]

(b) An investigation was performed on the chloroplast suspension by setting up the following mixture in a colorimeter tube:

- 0.5 cm³ chloroplast suspension
- 4 cm³ buffer solution
- 1 cm³ DCPIP solution.

This tube was placed in a colorimeter and the disappearance of the blue colour of the oxidised DCPIP was determined by taking readings at two-minute intervals. The results of this and of a similar tube in which the chloroplast suspension had previously been boiled and cooled are shown in Fig. 1.1.

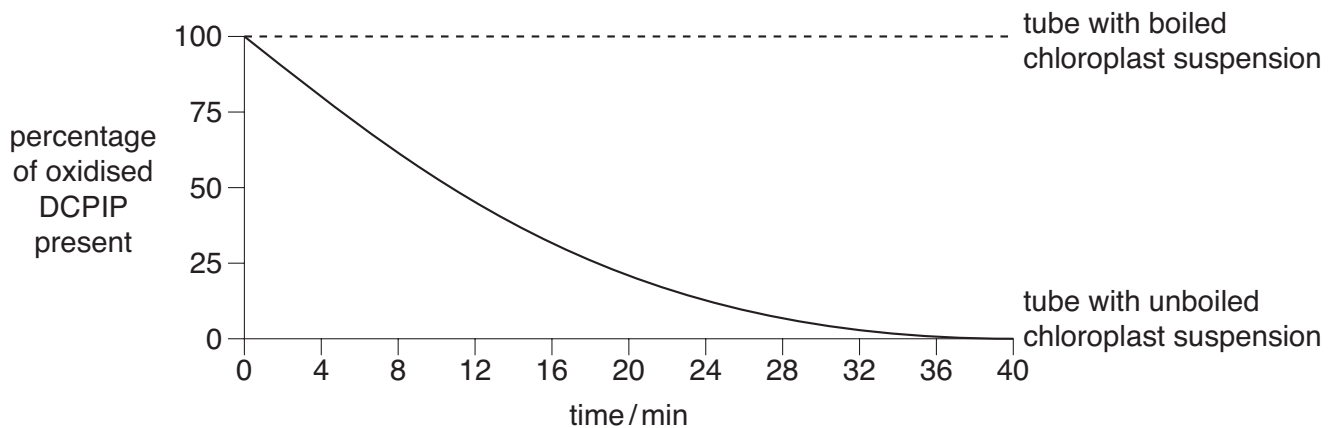


Fig. 1.1

(i) State the colour of the chloroplast suspension in the two tubes after 40 minutes.

boiled

unboiled [2]

(ii) Explain the difference in the results obtained for the boiled and unboiled chloroplast suspensions.

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 15]

2 Table 2.1 shows the rate of nerve impulse transmission in neurones from different animals.

Table 2.1

animal	myelinated	diameter of neurone / μm	rate of nerve impulse transmission / ms^{-1}
crab	no	30	5
squid	no	500	25
frog	yes	16	32
cat	no	15	2
cat	yes	20	100

(a) (i) State **two** structural features of neurones that affect the rate of nerve impulse transmission.

1

2 [2]

(ii) Explain the differences in the rate of nerve impulse transmission for the two different types of neurone from the cat.

.....

.....

.....

.....

..... [3]

(b) The rate of nerve impulse transmission in a human arm was investigated as follows:

- an electrical stimulus was applied to the ulnar nerve at the elbow
- this produced a twitch in the muscles of the thumb after a time interval of t_0 seconds
- the electrical stimulus was then applied to the same nerve at the shoulder, a distance of 0.3 metres from the elbow
- the thumb twitch this time followed after a slightly longer time t_1
- $t_1 - t_0$ was found to be 6×10^{-3} seconds.

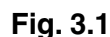
Calculate the rate of transmission of the nerve impulse along the ulnar nerve in metres per second.

Answer = m s^{-1} [2]

[Total: 15]

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE



The results are shown in Table 3.1.

Table 3.1

time / min	1	2	3	4	5
distance, d , moved by meniscus each minute / mm	2	3	2	2	3

- Show your working.

Answer = $\text{mm}^3 \text{min}^{-1}$ [2]

- (ii) Explain how you would adapt the apparatus to measure the volume of carbon dioxide produced per minute **and** to calculate the respiratory quotient (RQ) of the germinating mung beans.

..... [5]

- (iii) A student calculated the RQ value of germinating mung beans to be 0.8.

Explain what this value indicates about the type of substrate being respired.

.....

.....

.....

.....

..... [2]

- (b) The role of oxygen in respiration is to act as the final acceptor of hydrogen atoms. These hydrogen atoms will have been involved in oxidative phosphorylation.

- (i) Explain where the hydrogen atoms that are involved in oxidative phosphorylation come from.

.....

.....

.....

.....

..... [3]

- (ii) State where in the mitochondrion oxidative phosphorylation occurs.

..... [1]

- (iii) Explain what is meant by the term *chemiosmosis*.

.....

.....

..... [2]

[Total: 15]

- 4 Fig. 4.1 shows diagrams of two different stages of meiosis in cells taken from the testis of a grasshopper, *Chorthippus brunneus*. The stages are labelled **P** and **Q**.

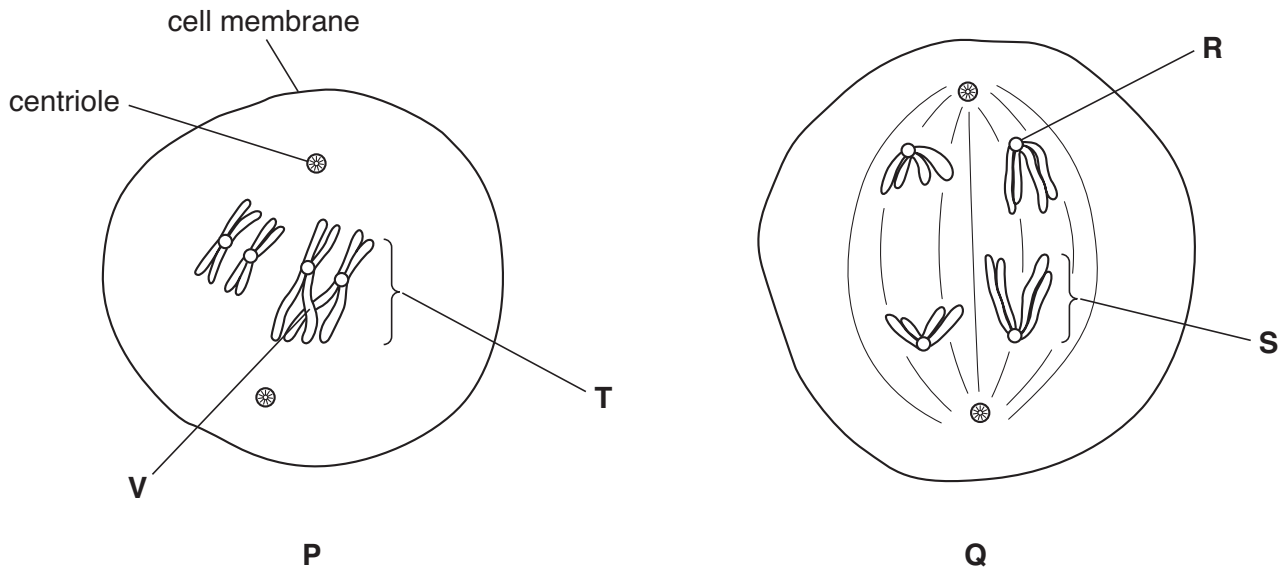


Fig. 4.1

- (a) (i) Name the two stages.

P

Q

[2]

- (ii) Name the structures labelled on the two diagrams.

R

S

T

V

[4]

- (b) State the ways in which meiosis can lead to genetic variation.

.....

.....

.....

.....

.....

.....

..... [3]

- (c) In one of his experiments, Gregor Mendel investigated the inheritance, at the same time, of two traits in peas, seed shape and seed colour.

The allele for round seeds, **R**, is dominant to the allele for wrinkled seeds, **r**.

The allele for yellow seeds, **Y**, is dominant to the allele for green seeds, **y**.

- (i) List all the possible genotypes of seeds that are round **and** yellow.

..... [1]

- (ii) Name the cross that would be carried out to determine the genotype of a plant grown from a seed that is round **and** yellow.

..... [1]

- (iii) Draw a genetic diagram to show the results of a cross between a plant heterozygous for both seed shape and seed colour and a plant grown from a wrinkled, green seed.

parental genotypes

gametes

offspring genotypes

offspring phenotypes

phenotypic ratio [5]

[Total: 16]

- 5 The spoil heaps of old copper mines are sparsely populated by plants because of the toxic levels of copper in the soil. However, copper-tolerant varieties of grasses such as Common Bent Grass, *Agrostis tenuis*, can become established in such habitats. The distribution of copper-tolerant varieties of *A. tenuis* was investigated on the spoil heap of an old copper mine, as shown in Fig. 5.1.

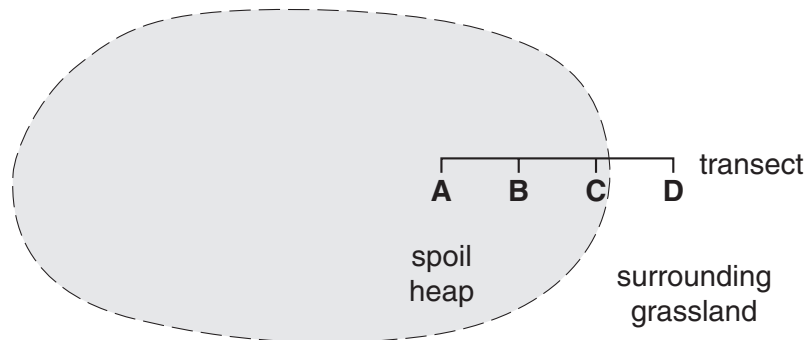


Fig. 5.1

The copper content of the soil and the copper-tolerance of the plants was measured at sites **A**, **B**, **C** and **D** along the transect.

Plants were taken from each of these sites and their copper-tolerance was determined by growing half the plants from each site in a culture solution without copper ions and the other half in a culture solution with a known concentration of copper ions.

The mean root growth of the plants in each solution was measured. The percentage reduction in mean root growth due to the presence of copper ions was calculated. The results are shown in Table 5.1.

The more copper-tolerant the plants, the smaller the percentage reduction in mean root growth.

Table 5.1

site along transect	copper content of soil / ppm	% reduction in mean root growth
A	750	45
B	350	52
C	125	67
D	35	80

- (a) (i) Suggest how copper ions reduce root growth in *A. tenuis*.

.....

 [2]

- (ii) Name **two** experimental conditions that needed to be controlled in the investigation into root growth.

1
 2 [2]

..... [7]

Turn over

(c) For the copper-tolerant varieties of *A. tenuis* to develop into separate species, the population must split into two separate gene pools.

(i) Name the **two** types of isolating mechanism that can lead to speciation.

1

2

[2]

(ii) The apple maggot fly, *Rhagoletis pomonella*, lives on hawthorn berries in North America.

- The larvae develop in the berries and, when adult, the females emerge and mate with males attracted from other hawthorn berries.
- The mated females then seek out a new hawthorn berry in which to lay their eggs.
- When apple trees were introduced to North America in the nineteenth century some female flies switched from hawthorn to apple.
- Female flies always lay their eggs on the same type of plant from which they emerged.
- Flies emerge from apples one month before flies emerge from hawthorn berries.

Explain how the switch in host plant by some female flies could lead to speciation occurring.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

[Total: 19]

- 6 Species of the floating water plant, *Lemna*, grow well in culture under laboratory conditions. They undergo asexual reproduction by budding and the buds soon become detached from the parent plant so that an increase in numbers occurs. Full-sized plants of *L. gibba* and *L. polyrrhiza* were grown in pure and mixed cultures. A large number of replicates was used so that every week the dry mass of the plants could be determined. The results are shown in Fig. 6.1.

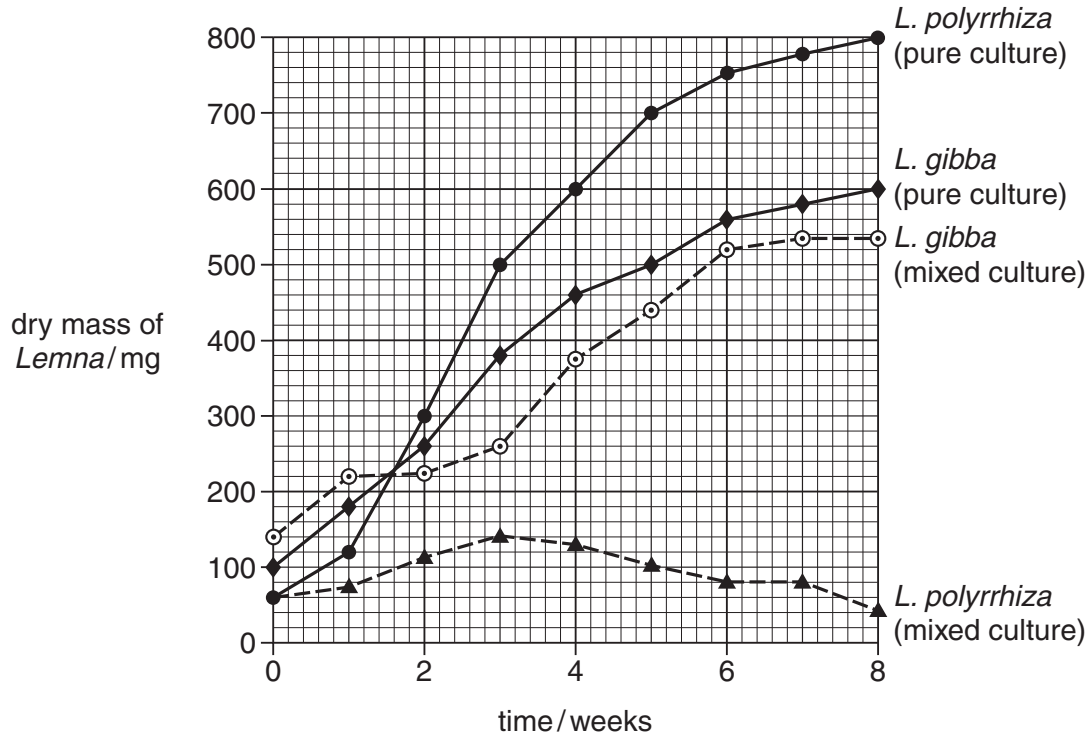


Fig. 6.1

- (a) (i) Describe the difference in growth of the two species in **pure** culture.

.....

.....

.....

..... [2]

- (ii) Explain the results for both species when grown in a **mixed** culture.

.....

.....

.....

.....

..... [3]

- (iii) Name **two** factors that may limit the size of a population of *L. gibba* growing in a natural freshwater habitat.

1

2

[2]

- (b) Plants such as *Lemna* are often the first to colonise a newly formed pond.

- (i) State the name given to organisms that are the first to colonise a newly formed environment.

..... [1]

- (ii) Suggest how plants such as *Lemna* start the process of succession in a pond.

.....

.....

.....

..... [2]

[Total: 10]

END OF QUESTION PAPER

Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations, is given to all schools that receive assessment material and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1PB.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.