



Rewarding Learning

ADVANCED  
General Certificate of Education  
January 2010

## Biology

### Assessment Unit A2 2

*assessing*

### Module 5: Reproduction, Genetics and Taxonomic Diversity

[A2B21]

MONDAY 25 JANUARY, AFTERNOON

#### TIME

1 hour 30 minutes.

#### INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.  
Write your answers in the spaces provided in this question paper.  
Answer **all seven** questions.

#### INFORMATION FOR CANDIDATES

The total mark for this paper is 75.  
Section A carries 60 marks.  
Section B carries 15 marks.  
You should spend approximately **20 minutes** on Section B.  
You are expected to answer Section B in continuous prose.  
Quality of written communication will be assessed in **Section B**.  
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	

<b>Total Marks</b>	
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71	
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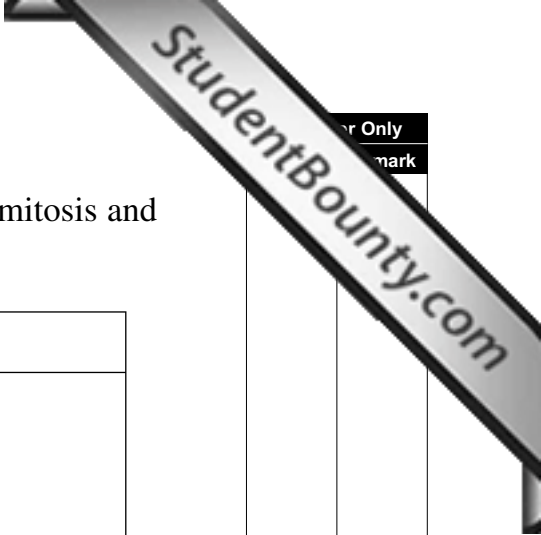
Candidate Number

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**Section A**



For Only  
mark

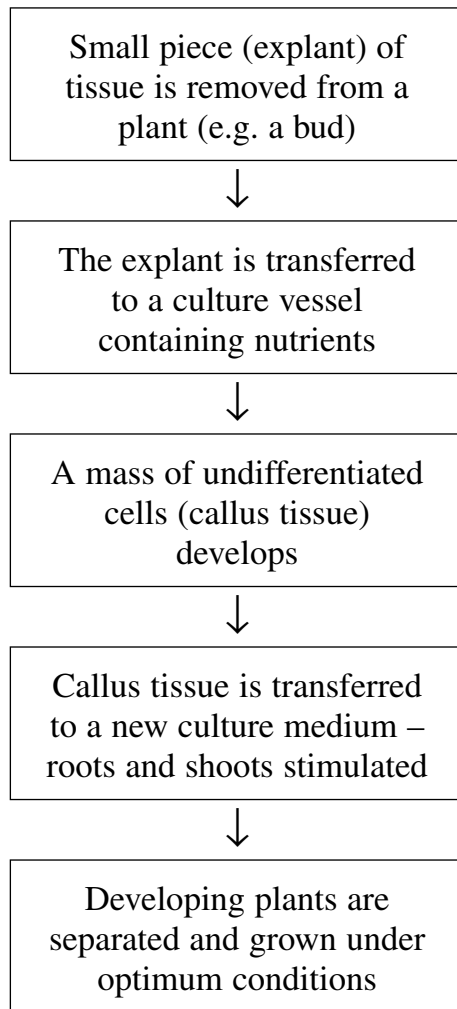
1 Complete the table below to identify **five** differences between mitosis and meiosis.

Mitosis	Meiosis

[5]

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2 The flow diagram below shows steps in the process of plant tissue culture (micropropagation).



(a) Outline the general purpose of plant tissue culture (micropropagation).

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[1]

(b) Sterile conditions are used throughout the process. Explain why sterile conditions are necessary.

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[1]

(c) Describe how callus tissue may be stimulated to initiate root and shoot development.

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[1]

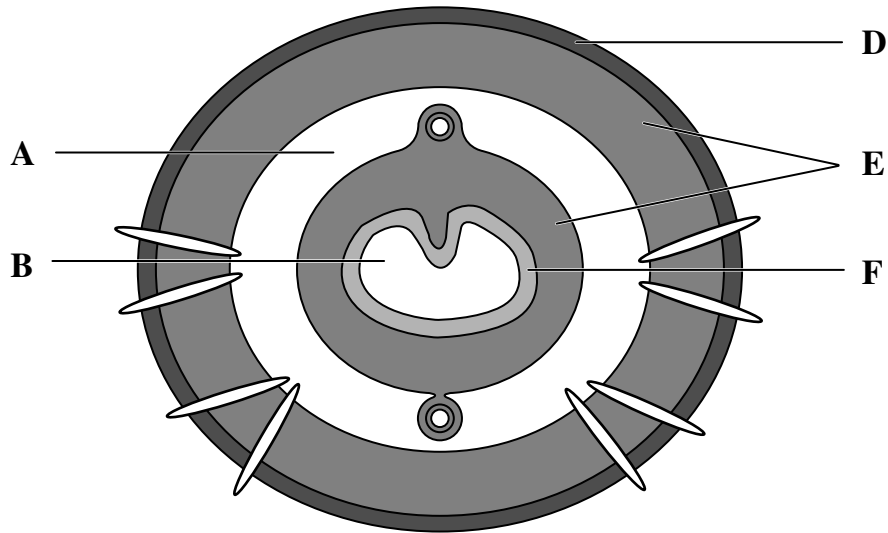
(d) State **two** advantages of producing plants by plant tissue culture (micropropagation) rather than by seeds.

1. \_\_\_\_\_  
\_\_\_\_\_
2. \_\_\_\_\_  
\_\_\_\_\_ [2]

(e) Plant tissue culture (micropropagation) is increasingly used in conjunction with genetic engineering to propagate transgenic plants. Outline **two** additional steps, further to the steps shown opposite, which would be required in the production of transgenic plants.

1. \_\_\_\_\_  
\_\_\_\_\_
2. \_\_\_\_\_  
\_\_\_\_\_ [2]

3 The diagram below represents a transverse section through an earthworm (*Lumbricus*), a member of the phylum Annelida.



(a) Identify the cavities **A** and **B**.

**A** \_\_\_\_\_

**B** \_\_\_\_\_ [2]

(b) Identify the tissue layers **D**, **E** and **F**.

**D** \_\_\_\_\_

**E** \_\_\_\_\_

**F** \_\_\_\_\_ [2]

(c) Annelids possess a blood system to distribute food and oxygen throughout the body. Into which of the above tissue layers are food and oxygen absorbed before passing into the blood system?

● Food \_\_\_\_\_

● Oxygen \_\_\_\_\_ [2]

(d) While annelids possess a blood system, platyhelminths do not. Explain this difference with respect to the body plan of each phylum.

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[2]

(e) Both annelids and platyhelminths have a digestive system. State **two** differences in the digestive systems in annelids and platyhelminths.

1. \_\_\_\_\_  
\_\_\_\_\_

2. \_\_\_\_\_  
\_\_\_\_\_

[2]

4 Huntington's disease is an hereditary disorder of the central nervous system in humans. It is caused by a faulty allele of a gene on chromosome 4. This allele produces an abnormal protein which leads to damage of nerve cells in areas of the brain. The loss of nerve cells is not fatal, but complications caused by symptoms reduce life expectancy. These symptoms generally only develop between the ages of 40 to 50 years, and persons possessing the faulty allele are frequently unaware of this until that age.

(a) The faulty allele (**H**) is dominant to its normal allele (**h**). The frequency of the **H** allele in the UK is  $2.5 \times 10^{-5}$ .

(i) Calculate the frequency of heterozygotes, assuming the population to be in Hardy–Weinberg equilibrium. (Show your working in the space below.)

[2]

(ii) Using the value calculated above, calculate the number of heterozygotes in a population of 62 million (the approximate population of the UK).

[1]

(iii) The number of diagnosed cases of Huntington's disease in the UK is approximately 2000. Suggest explanations for the discrepancy between this figure and the value calculated above.

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[2]



- (b) A population can only be regarded as being in Hardy–Weinberg equilibrium if a number of assumptions are met.

One assumption is that there is no selection operating on the gene. Discuss whether or not this is likely to be the case with the Huntington’s disease allele (**H**).

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[2]

- (c) A couple, one of whom has a parent with Huntington’s disease, are concerned about starting a family. Explain how genetic counsellors might advise the couple of the risk of them having a child who would develop the disease.

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[2]

- (d) Genetic testing for possession of the **H** allele is possible, either of cells from a foetus (pre-natal testing) or of cells from an adult (post-natal testing). While some people may emphasise the advantages of genetic testing, others will argue that such testing is not ethical. Discuss some of the issues involved.

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[2]

5 The budgerigar, *Melopsittacus undulatus*, is an Australian parakeet.

(a) Complete the table below to show the classification of the budgerigar.

Kingdom	
Phylum	Aves
	Psittaciformes
Order	Psittacidae
Family	Polytrichaceae
	<i>Melopsittacus</i>
Species	

[2]

Wild budgerigars display a predominantly light-green colour while the mantle (back) feathers are edged in black. Selective breeding in captivity has led to numerous colour forms with different inheritance patterns.

One gene, which is autosomal, has two alleles demonstrating codominance: **dd** is light-green, **Dd** is dark-green while **DD** is olive-green. Another gene, which is sex-linked, has a recessive form, opaline, which reduces the width of the black edging on the mantle feathers: the alleles are designated **X<sup>+</sup>** (non-opaline) and **X<sup>o</sup>** (opaline).

In budgerigars, the **female** is **XY** and the **male** is **XX**.

(b) Explain the terms “codominance” and “sex-linkage”, and explain how each phenomenon can be distinguished in genetic crosses.

● Codominance \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

● Sex-linkage \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

[4]

(c) Determine the genotype of the following phenotypes.

- Light-green, opaline male \_\_\_\_\_
- Dark-green, non-opaline female \_\_\_\_\_ [2]

(d) Two budgerigars of the following genotypes were crossed.

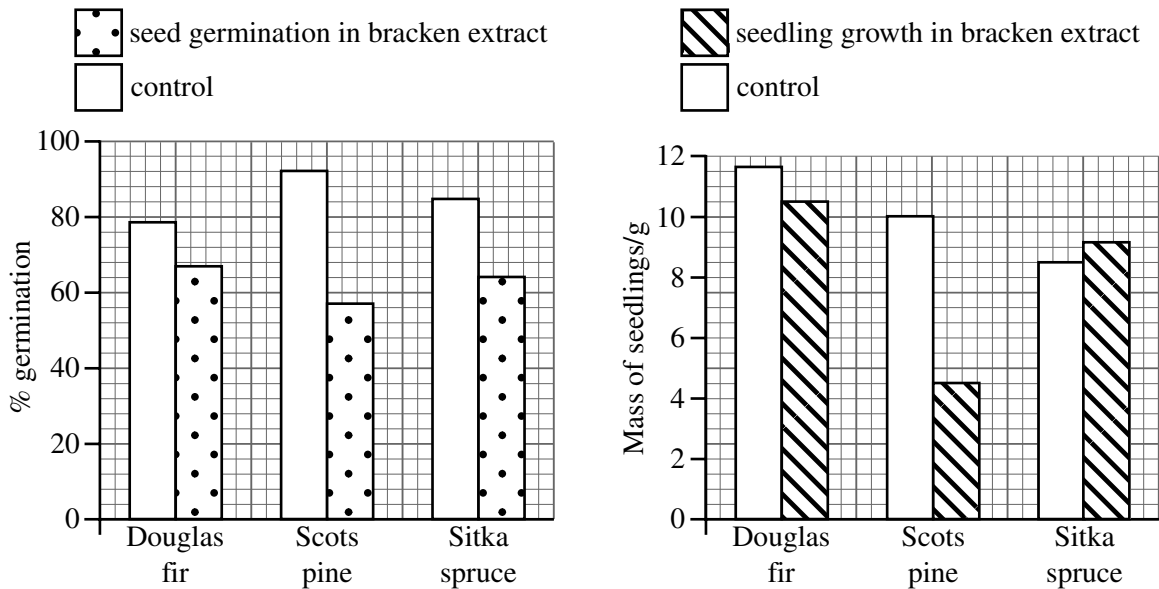
$$DDX^0Y \times DdX^+X^0$$

Determine the expected proportions of the offspring produced in terms of colour and gender. Show your working in a genetic diagram in the space below.

[6]

6 The bracken fern (*Pteridium aquilinum*) grows in dense stands rarely containing other plants. It is thought that phytotoxins leached by rain from the fern leaves are largely responsible for the absence of other plants.

(a) The effects of bracken on seed germination and seedling growth of three species of coniferous tree, Douglas fir (*Pseudotsuga menziensis*), Scots pine (*Pinus sylvestris*) and Sitka spruce (*Picea sitchensis*), were investigated. In field experiments, both seed germination and seedling growth were measured in plots irrigated with water-soluble extracts of bracken leaves, while control plots had no bracken extract added.



What conclusions can be made about the effect of bracken on the seed germination and seedling growth in the three species of coniferous tree?

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[4]

Examiner Only	
Marks	Remark

(b) Phytotoxins could be contained in any part of the bracken: the leaves, the stem and the roots. Design a laboratory experiment to test which of these parts, if any, exhibited the most inhibitory influence on seed germination using lettuce seeds as a test organism.

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[3]

A number of chemical compounds, including cyanide, have been implicated in the various toxic properties of bracken to animals. Nevertheless, there are insects that eat bracken. These include larvae of sawfly species which feed on bracken leaves.

(c) Wood ants have been shown to impose high rates of predation on larvae venturing onto the leaves. However, when sawfly larvae are attacked they respond by secreting a fluid which repels the ants. Suggest an explanation for the ability of sawfly larvae to repel foraging ants.

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[2]



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**(Questions continue overleaf)**











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