

Biology
Higher level
Paper 2

Monday 1 May 2017 (afternoon)

Candidate session number

2 hours 15 minutes

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Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer two questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[72 marks]**.

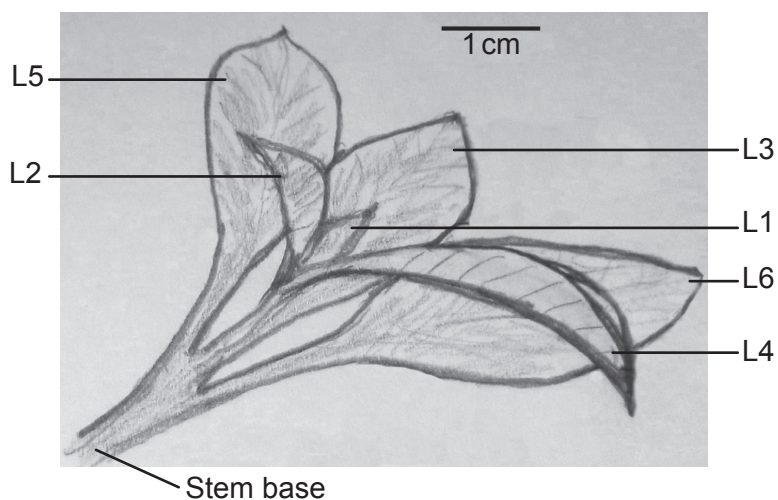


Section A

Answer **all** questions. Answers must be written within the answer boxes provided.

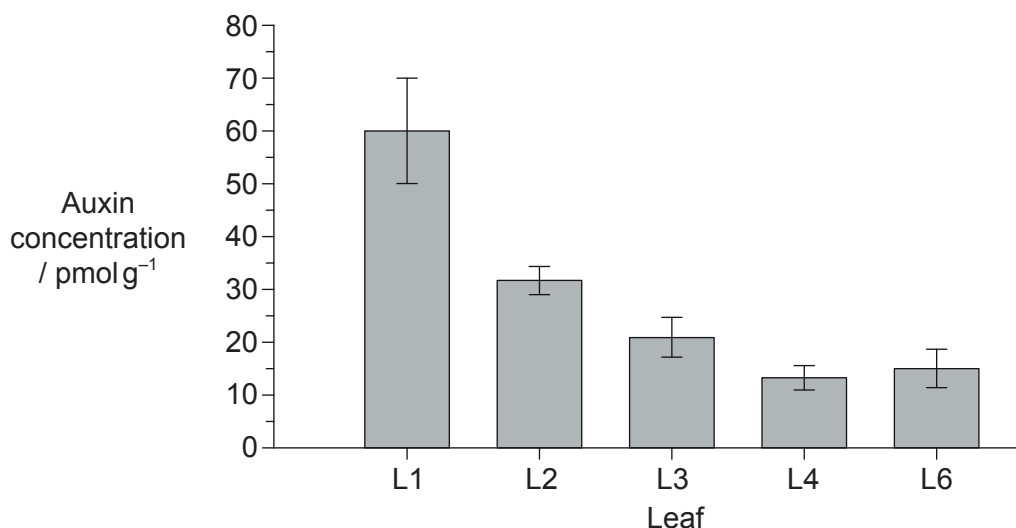
1. Auxin can be used to promote the development of roots from stem and leafy cuttings in some plants. In a study into the distribution of auxin in the development of these roots, scientists measured the amount of auxin in different leaves of a shoot tip of *Petunia hybrida*.

The figure indicates the numbering of leaves on the shoot, from L1 as the youngest and smallest to L6 as the largest and oldest leaf. The developmental stage of L5 and L6 was very similar, so L5 was not analysed. The stem base is the lowest part of the cutting where roots may form.



[Source: A. Ahkami *et al.* (2013) *Planta*, 238, pages 499–517]

The graph shows the auxin concentration in the different leaves.



[Source: A. Ahkami *et al.* (2013) *Planta*, 238, pages 499–517]

(This question continues on the following page)



(Question 1 continued)

- (a) Calculate the difference in the concentration of auxin found in L1 and L6. [1]

..... pmol g⁻¹

- (b) Identify the relationship between the concentration of auxin and the age of the different leaves. [2]

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N-1-naphthylphthalamic acid (NPA) is an inhibitor used to block auxin transport. NPA was sprayed onto the leaves of a set of cuttings for 14 days. Development of the roots in control (non-treated) and NPA-treated cuttings was measured 14 days after taking the cuttings. The table shows the influence of NPA on rooting.

	Mean number of roots per cutting	Mean root length / cm	Mean total root length per cutting / cm
Control	53.2	1.4	47.7
NPA-treated	8.0	0.6	1.0

[Source: adapted from A Ahkami, *et al.*, (2013), *Planta*, **238**, pages 499–517]

- (c) Analyse the effect of NPA on the formation of roots. [2]

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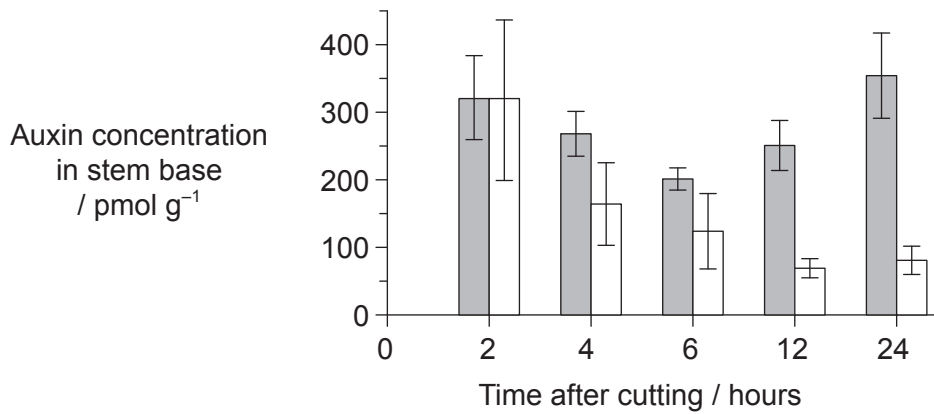
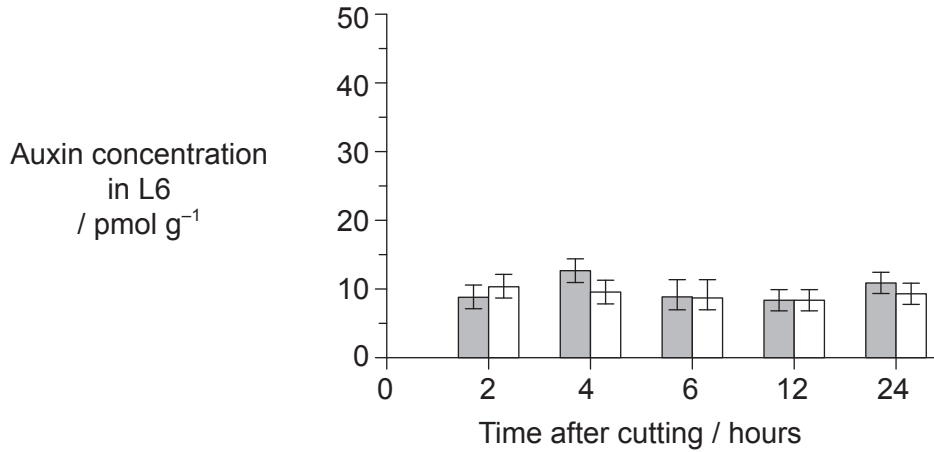
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(Question 1 continued)

The scientists also measured the changes in auxin concentration in L6 and the stem base during the early period of root formation. They recorded the concentration in the control and NPA-treated cuttings for 24 hours after taking the cuttings.



Key: ■ control □ NPA-treated

[Source: adapted from A Ahkami, *et al.*, (2013), *Planta*, **238**, pages 499–517]

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(Question 1 continued)

- (d) (i) Compare and contrast the changes in auxin concentration in the stem base over time for the control and NPA-treated cuttings.

[2]

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- (ii) Deduce the effect of NPA on auxin transport between L6 and the stem base.

[2]

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- (e) Based on all the data presented and your knowledge of auxin, discuss the pattern of auxin production and distribution in the leaves and the possible relationship to root formation in leafy cuttings of *Petunia hybrida*.

[3]

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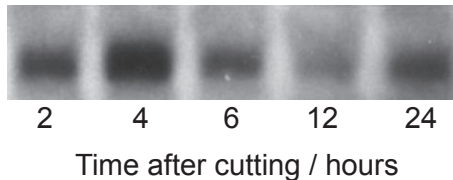
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(Question 1 continued)

The scientists wanted to know whether the accumulation of auxin over time in the stem base of the controls affected expression of the *GH3* gene, known to have a role in growth regulation in different plants. The technique that was used to quantify the level of transcription of the *GH3* gene was Northern blotting. In this procedure the darkness and thickness of the band is an indicator of the level of transcription of a particular gene. The image shows the result of the Northern blot from 2 hours to 24 hours after cutting.



[Source: adapted from A Ahkami, *et al.*, (2013), *Planta*, **238**, pages 499–517]

- (f) (i) State the name of the molecule which is produced by transcription. [1]

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- (ii) Compare the pattern of *GH3* transcription with the pattern of auxin concentration in the stem base control cuttings. You may use the table provided to help you to record the patterns before you compare them. (Please note: a simple comparison in the table will not gain marks) [2]

	2–4 hours	4–6 hours	6–12 hours	12–24 hours
Auxin concentration				
<i>GH3</i> bands				

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(Question 1 continued)

- (iii) The scientists concluded that auxin activates the transcription of the *GH3* gene. Using the information on the auxin concentration in the stem base in the graph on page 4 and the Northern blot, evaluate whether this conclusion is supported. [2]

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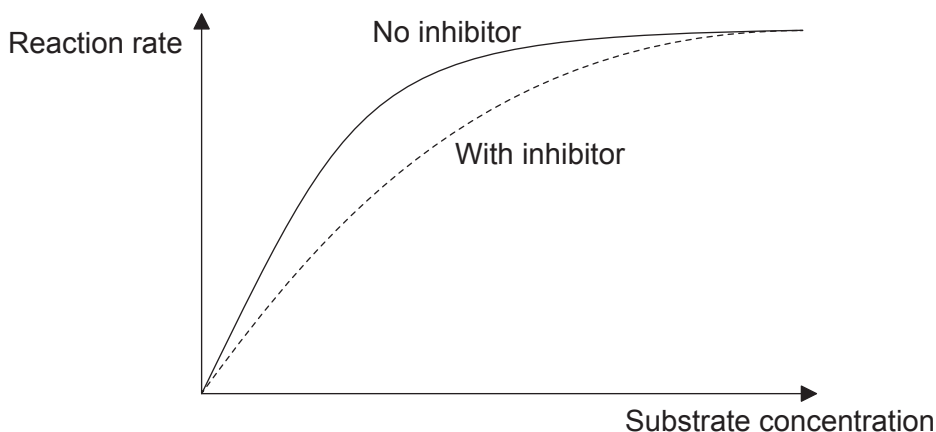
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2. (a) The sketch shows the relationship between the reaction rate and substrate concentration in the presence and the absence of a competitive inhibitor.



Explain the effect of the competitive inhibitor on the reaction rate. [2]

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(Question 2 continued)

(b) The enzyme ATP synthase has an essential role in aerobic cell respiration.
Describe its

(i) location.

[1]

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(ii) function.

[2]

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3. (a) Outline the properties of water molecules that permit them to move upwards in plants.

[2]

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(b) Define osmolarity.

[1]

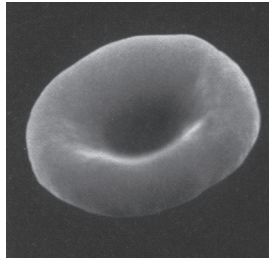
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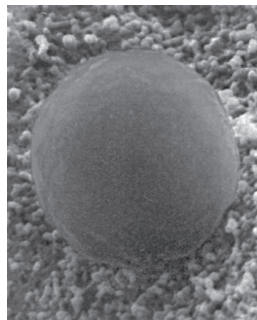
(Question 3 continued)

(c) This image shows a normal red blood cell.

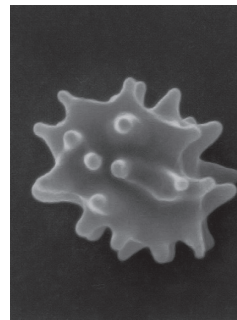


These images show two red blood cells that have been placed in solutions with different concentrations of solutes.

Red blood cell 1



Red blood cell 2



[Source: adapted from www.acbrown.com]

Deduce, with a reason, which red blood cell has been placed in a hypertonic solution. [1]

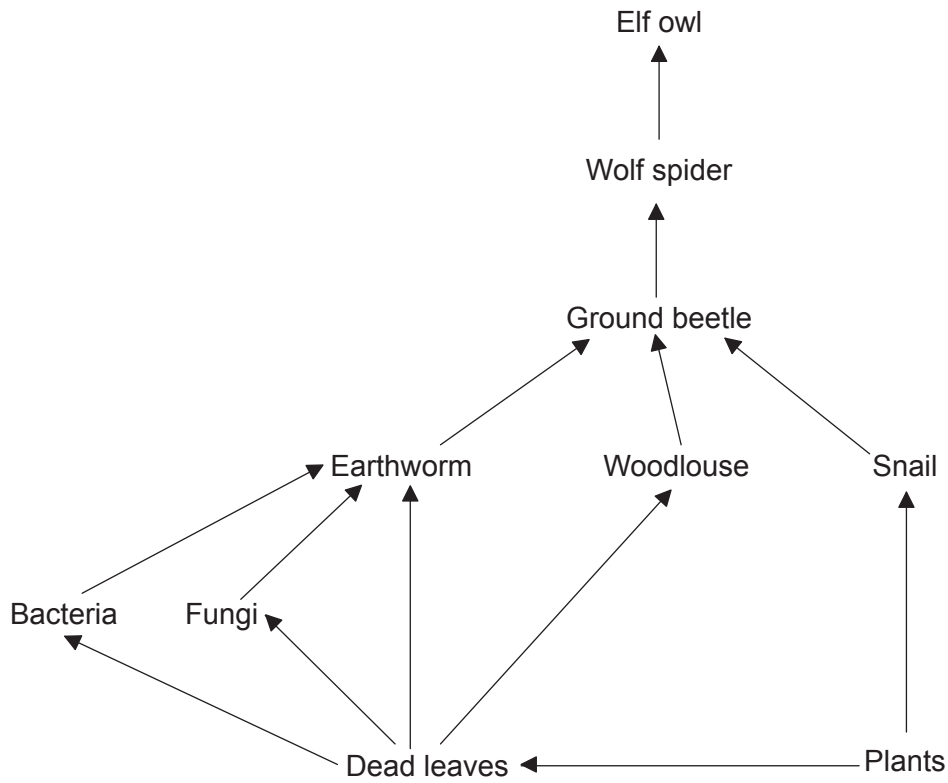
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(d) State what change there has been in the cell surface area to volume ratio in red blood cell 1. [1]

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4. The image shows a food web.



[Source: © International Baccalaureate Organization, 2017]

(a) Using the food web, identify a

(i) detritivore.

[1]

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(ii) saprotroph.

[1]

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(b) State the name of the domain to which birds, such as the Elf owl, belong.

[1]

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(Question 4 continued)

(c) Outline the energy flow through this food web.

[3]

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5. (a) Mutations are the ultimate source of genetic variation and are essential to evolution.

(i) State **one** type of environmental factor that may increase the mutation rate of a gene.

[1]

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(ii) Identify **one** type of gene mutation.

[1]

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(Question 5 continued)

(b) Lice are wingless insects that belong to the phylum arthropoda.

(i) State **two** characteristics that identify lice as members of the arthropoda. [2]

1.
2.

(ii) Some lice live in human hair and feed on blood. Shampoos that kill lice have been available for many years but some lice are now resistant to those shampoos. Two possible hypotheses are:

Hypothesis A	Hypothesis B
Resistant strains of lice were present in the population. Non-resistant lice died with increased use of anti-lice shampoo and resistant lice survived to reproduce.	Exposure to anti-lice shampoo caused mutations for resistance to the shampoo and this resistance is passed on to offspring.

Discuss which hypothesis is a better explanation of the theory of evolution by natural selection.

[3]

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Section B

Answer **two** questions. Up to one additional mark is available for the construction of your answers for each question. Answers must be written within the answer boxes provided.

6. (a) Draw molecular diagrams to show the condensation reaction between two amino acids to form a dipeptide. [4]
- (b) Outline the roles of the different binding sites for tRNA on ribosomes during translation. [4]
- (c) Explain the production of antibodies. [7]
7. (a) Outline how reproductive isolation can occur in an animal population. [3]
- (b) Describe the different cell types in the seminiferous tubules that are involved in the process of spermatogenesis. [4]
- (c) Explain the roles of specific hormones in the menstrual cycle, including positive and negative feedback mechanisms. [8]
8. (a) Cells go through a repeating cycle of events in growth regions such as plant root tips and animal embryos. Outline this cell cycle. [4]
- (b) Draw a labelled diagram of the formation of a chiasma by crossing over. [3]
- (c) Explain the control of gene expression in eukaryotes. [8]



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20EP15

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A large rectangular area with a dotted grid pattern, intended for writing answers.



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