

Biology
Standard level
Paper 3

Monday 7 November 2016 (morning)

Candidate session number

1 hour

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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.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[35 marks]**.

Section A	Questions
Answer all questions.	1 – 3

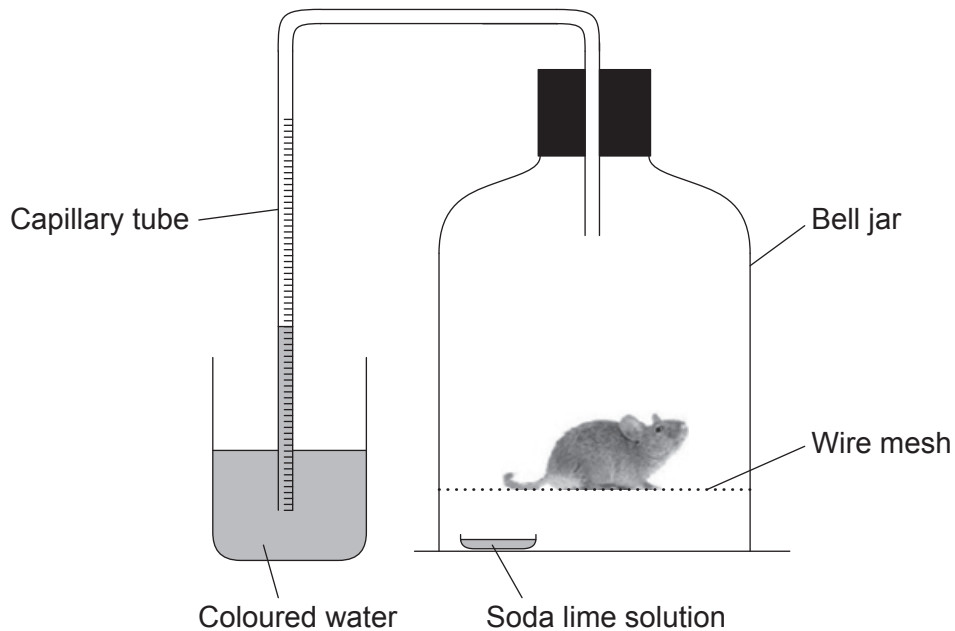
Section B	Questions
Answer all of the questions from one of the options.	
Option A — Neurobiology and behaviour	4 – 7
Option B — Biotechnology and bioinformatics	8 – 10
Option C — Ecology and conservation	11 – 14
Option D — Human physiology	15 – 18



Section A

Answer **all** questions. Write your answers in the boxes provided.

1. In an experiment measuring oxygen consumption, a laboratory mouse was placed in a respirometer for a short time. Soda lime solution absorbed any carbon dioxide produced during the experiment.



[Source: © International Baccalaureate Organization 2016]

- (a) Suggest the purpose of the wire mesh.

[1]

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- (b) Describe how the apparatus measures the oxygen consumption of the mouse.

[3]

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(This question continues on the following page)



(Question 1 continued)

- (c) Discuss whether the apparatus would be suitable for measuring the oxygen consumption of a small green plant during respiration.

[3]

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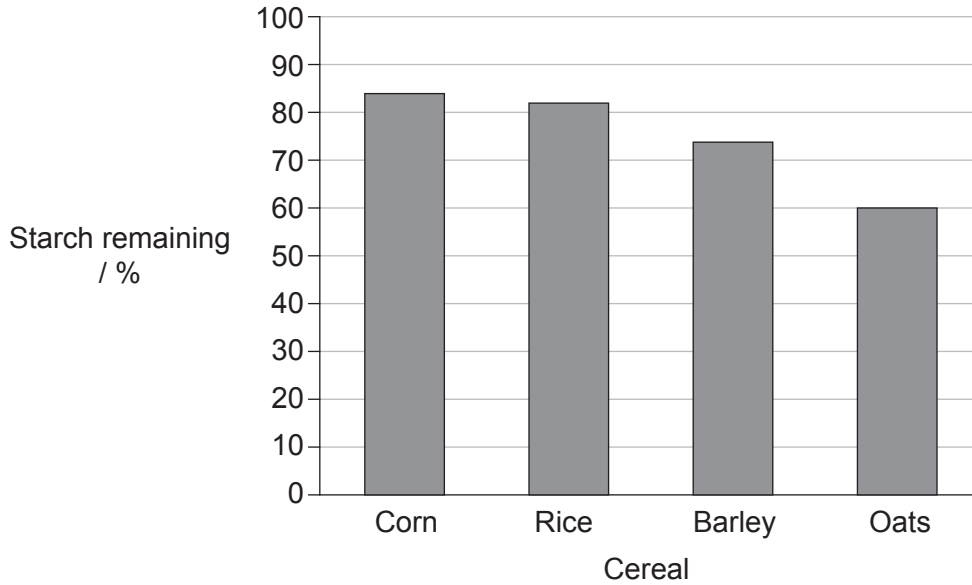
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32EP03

Turn over

2. The enzyme amylase was extracted from the digestive system of horses and added to whole cereal grains (seeds) in test tubes at 39 °C to determine which grain was digested quickest. Each test tube received equal quantities of the enzyme. The quantity of starch remaining in the grains after 15 minutes was measured.



[Source: adapted from N Richards, *Enhancing Starch Digestion in the Equine Small Intestine*. Doctoral thesis, University of New England, <http://e-publications.unen.edu.au/1959.11/15182>. Copyright 2003 - Nerida Richards]

- (a) Suggest **one** reason for differences between the cereal grains, in the percentage of starch remaining after 15 minutes. [1]

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- (b) Suggest **one** method that could have been used to keep the tubes at a constant temperature. [1]

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(This question continues on the following page)



(Question 2 continued)

- (c) Explain the importance of having equal quantities of the enzyme at the start of the experiment.

[2]

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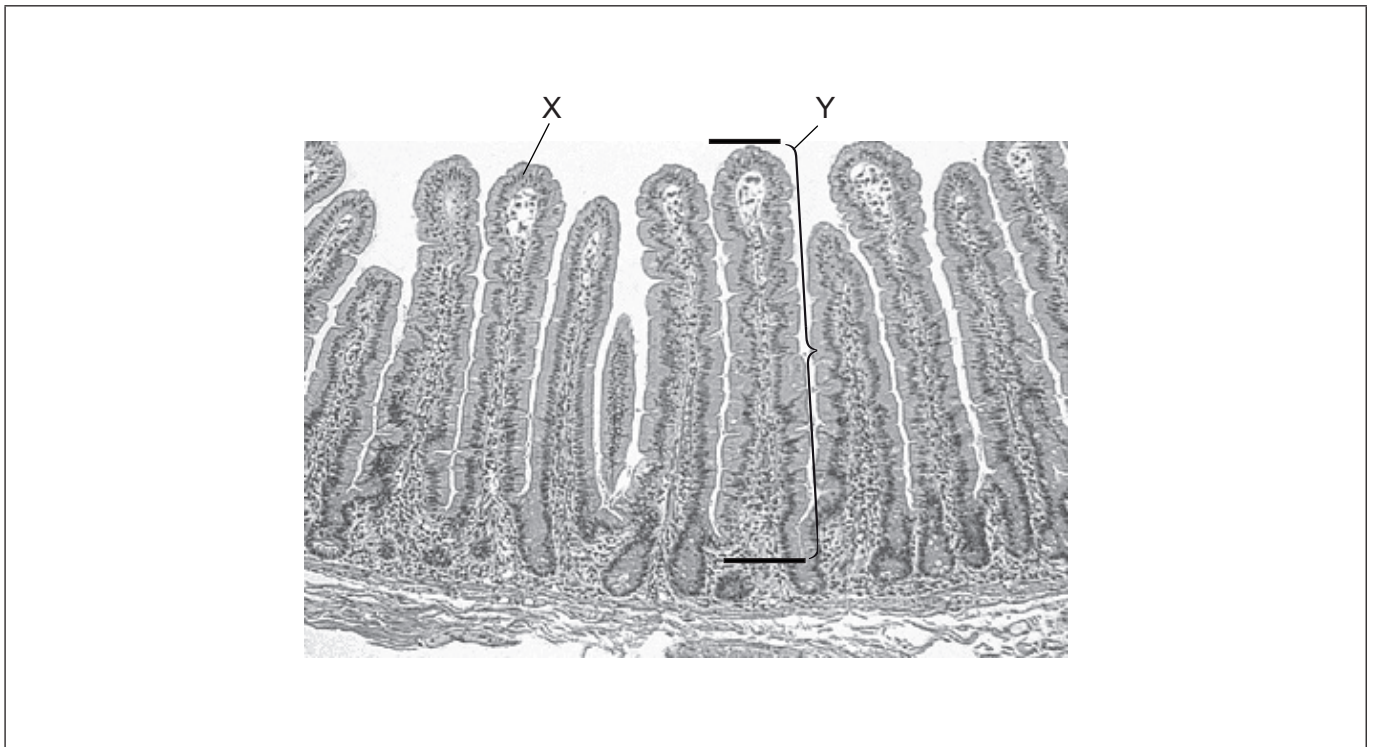
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32EP05

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3. The micrograph shows a section of an organ in the human body.



[Source: adapted from Stacey E. Mills (ed.), *Histology for Pathologists*, 3rd Edition, Copyright ©2007, Lippincott Williams & Wilkins.]

(a) State from which organ the section was taken. [1]

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(b) Identify the layer of tissue found at X. [1]

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(This question continues on the following page)



(Question 3 continued)

- (c) The actual length of the structure labelled Y is 0.8 mm between the two black lines. Calculate the magnification of the micrograph. Working should be shown. [2]

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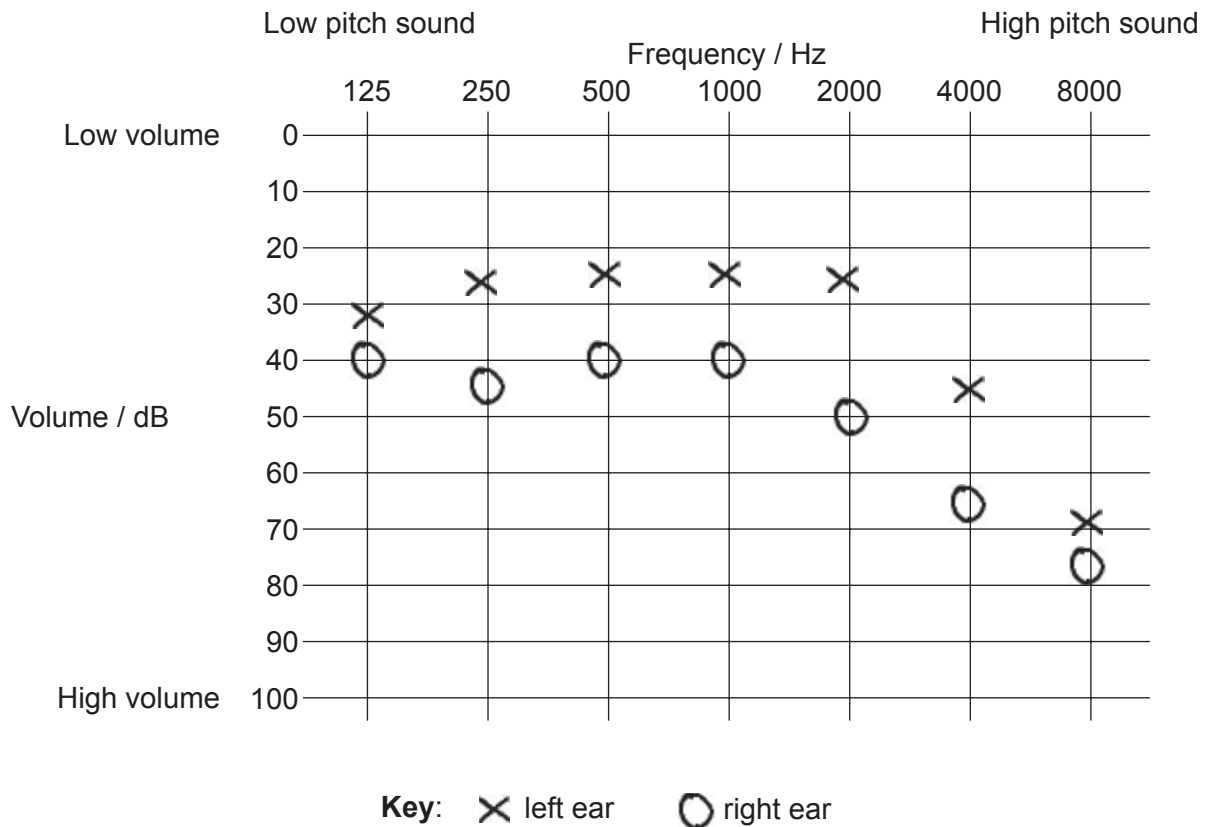


Section B

Answer **all** of the questions from **one** of the options. Write your answers in the boxes provided.

Option A — Neurobiology and behaviour

4. To test hearing, sounds are played at very low volume levels and gradually increased until the patient can hear the sound. This is repeated with different frequencies which correspond to low or high pitch sounds. The results are marked on an audiogram. This audiogram is from a 60-year-old woman.



[Source: © International Baccalaureate Organization 2016]

- (a) Human speech occurs at a volume of approximately 60 dB and at frequencies between 125 Hz and 4000 Hz. Outline whether the woman would hear all conversations with both ears.

[1]

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(Option A continues on the following page)



(Option A, question 4 continued)

- (b) The woman suffers from otosclerosis in the right ear, a condition where the bones of the middle ear do not function properly. Describe how this is consistent with the hearing test result shown in the audiogram. [2]

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- (c) Explain the role of the hair cells in the cochlea. [3]

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(Option A continues on the following page)



(Option A continued)

5. The diagram shows the early development of the nervous system in embryonic chordates.



[Source: adapted from www.geol.umd.edu]

(a) Outline the process taking place in the diagram.

[2]

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(b) State what occurs to structure X immediately following its formation.

[1]

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(c) Outline how spina bifida could occur during embryonic development.

[1]

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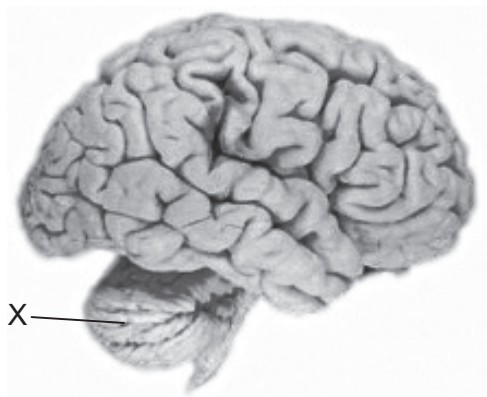
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(Option A continues on the following page)



(Option A continued)

6. The images show the brains of human (*Homo sapiens*) and baboon (*Papio hamadryas*). The images are not drawn to scale.



Human brain



Baboon brain

[Source: adapted from <http://serendip.brynmawr.edu>]

- (a) (i) Identify the structure labelled X. [1]

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- (ii) Outline the function of X in the human brain. [2]

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- (b) With reference to structures visible in the diagrams, explain how the human brain is more evolved for higher order functions than the baboon brain. [2]

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(Option A continues on the following page)



(Option A continued)

7. The image shows a human eye.



[Source: adapted from https://en.wikipedia.org/wiki/Human_eye#/media/File:Human_eye_with_blood_vessels.jpg, by ROTFLOLEB]

(a) Identify the structures labelled I and II. [1]

I.	
II.	

(b) Explain how the pupil of the eye can be used to assess brain damage. [4]

End of Option A



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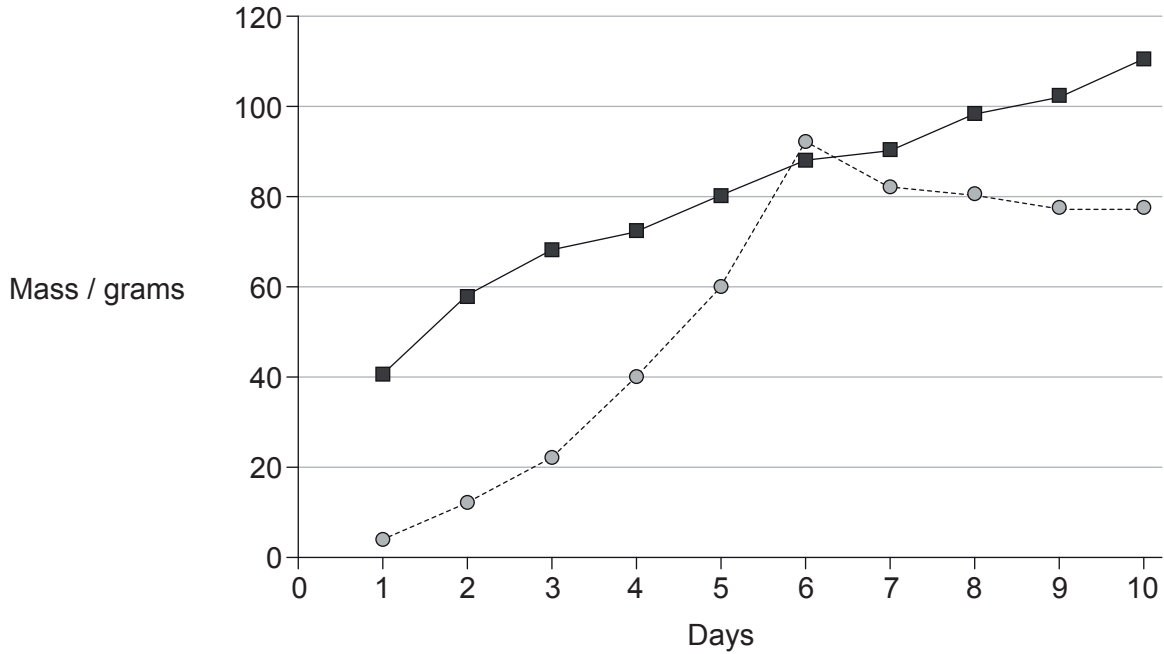


32EP13

Turn over

Option B — Biotechnology and bioinformatics

8. Sugar solution in a fermenter was inoculated with a culture of fungus, incubated at 30°C and left for 10 days to produce citric acid. The mass of sugar consumed and the mass of citric acid produced was measured daily.



Key: ■ sugar consumed ● citric acid produced

[Source: adapted from Ali, S.; ul-Haq, I.; Qadeer, M.; Iqbal, J. (2002), Production of citric acid by *Aspergillus niger* using cane molasses in a stirred fermentor. *Electronic Journal of Biotechnology*, Vol. 5, No. 3]

- (a) State a suitable fungus for the production of citric acid in the fermenter. [1]

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- (b) Suggest a reason that fermentation is most successful at 30°C. [1]

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(Option B continues on the following page)



(Option B, question 8 continued)

(c) Suggest reasons for the changes in mass of sugar and citric acid after day 6. [2]

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(d) State **two** uses of the citric acid produced. [2]

1.

2.

(Option B continues on the following page)



(Option B continued)

9. One method of inserting new genes into plants is by gene gun.



[Source: adapted from www.genomicon.com]

(a) Outline how a gene gun inserts genes into plants.

[2]

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(b) Marker genes are often inserted together with the new gene. State the function of the marker genes.

[1]

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(c) Outline the characteristics of an open reading frame.

[2]

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(Option B continues on the following page)



(Option B, question 9 continued)

(d) Explain, using an example, how gene transfer to a plant could help increase crop yield. [3]

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(Option B continues on the following page)

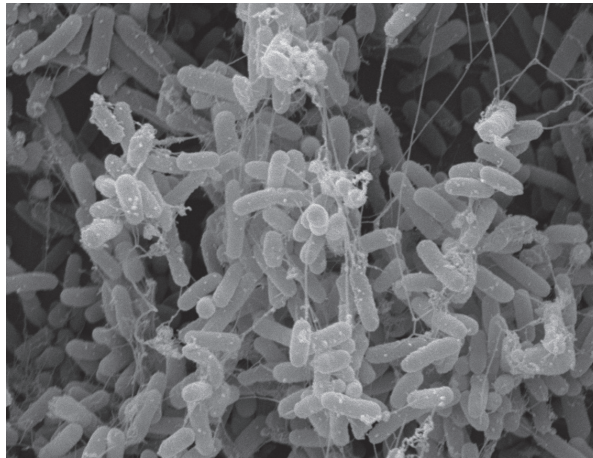


32EP17

Turn over

(Option B continued)

10. Cooperative aggregates of microorganisms can form biofilms. The micrograph shows a biofilm of *Escherichia coli*.



[Source: Brigit Pruess for North Dakota State University]

- (a) Outline the emergent properties of biofilms.

[2]

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- (b) Explain **two** ways in which bacteria of the genus *Pseudomonas* can be used for bioremediation.

[4]

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End of Option B



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32EP19

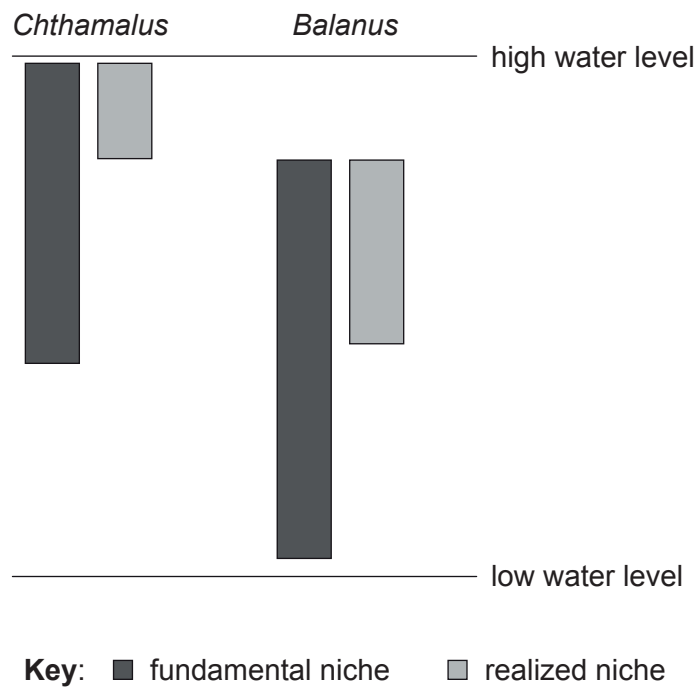
Turn over

Option C — Ecology and conservation

- 11. *Chthamalus* and *Balanus* are two species of barnacles that live attached to rocks between the low and high tide level of the sea. The distribution of each species is influenced by the presence of their own species and different species.

Balanus barnacles attached to the rock

Removed for copyright reasons



[Source: adapted from <http://bio.classes.ucsc.edu>]

- (a) Distinguish between a fundamental niche and realized niche.

[1]

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(Option C continues on the following page)



(Option C, question 11 continued)

(b) Suggest reasons that *Chthamalus* cannot live higher up the shore. [2]

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(c) Describe how the distribution of *Chthamalus* and *Balanus* is affected when both are present. [3]

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(Option C continues on the following page)

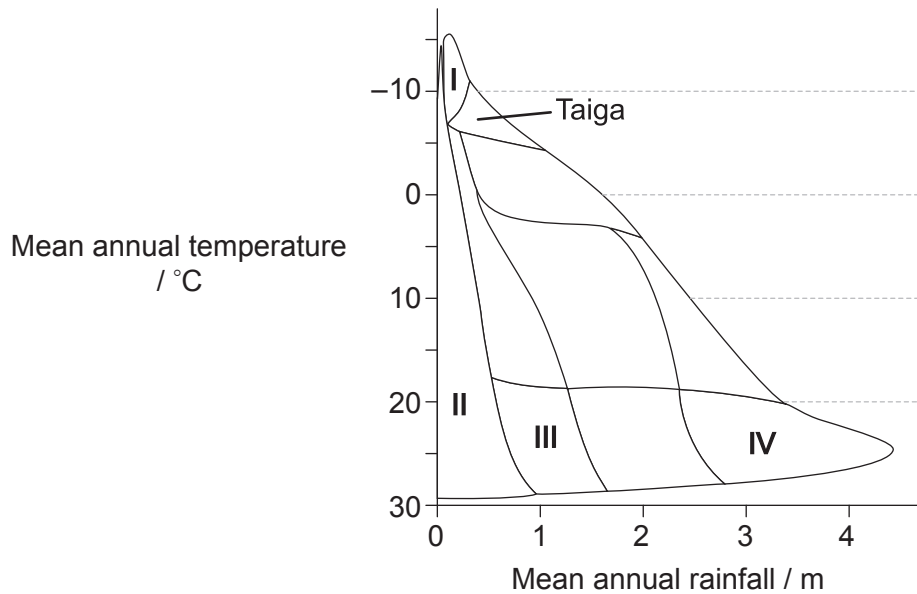


32EP21

Turn over

(Option C continued)

12. The climograph shows the distribution of biomes according to the temperature and rainfall of land areas on Earth.



[Source: © International Baccalaureate Organization 2016]

(a) Identify the ecosystem with the appropriate numeral from the climograph. [2]

Ecosystem	Numeral
Tropical rainforest	
Desert	
Tundra	

(b) Referring to the climograph, explain reasons that the nutrient store in the litter layer of the taiga is greater than in the tropical rainforest. [3]

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(Option C continues on the following page)



(Option C continued)

13. The number of plants in two fields of approximately the same size was counted.

Type of plant	Field 1	Field 2
Daisy (<i>Bellis perennis</i>)	307	18
Dandelion (<i>Taraxacum officinale</i>)	332	48
Buttercup (<i>Ranunculus repens</i>)	361	934
Total	1000	1000

(a) Compare and contrast the richness and the evenness of the two fields. [2]

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(b) A calculation of Simpson's reciprocal index was undertaken on each field with the following results.

Field 1	3.0
Field 2	1.1

Evaluate these results. [2]

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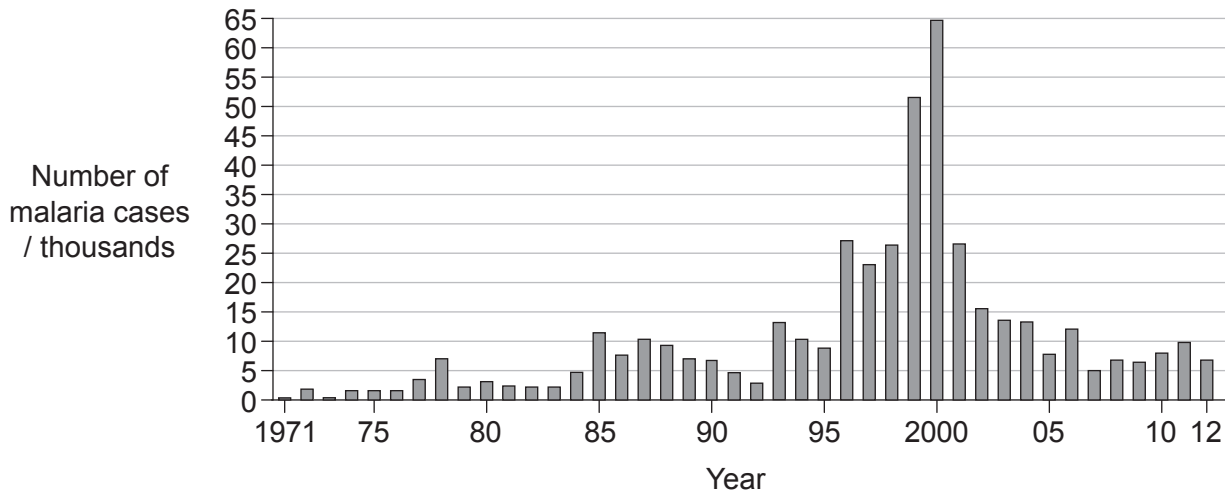
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(Option C continues on the following page)



(Option C continued)

14. In 1997 in South Africa, a decision was made to decrease the use of mosquito-killing pesticides due to their negative effect on the environment. Mosquitoes are known to be responsible for the spread of malaria. In 2001 the decision was reversed and the use of pesticides was increased. The graph shows the estimated numbers of people with malaria in each year.



[Source: adapted from www.healthlink.org.za]

(a) Outline the trend in the number of people with malaria during the period when the use of pesticides was decreased in South Africa.

[1]

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(b) One pesticide used in killing mosquitoes was DDT. Considering its harmful effects, discuss whether the decision to reintroduce it was justified.

[4]

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End of Option C



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32EP25

Turn over

Option D — Human physiology

15. The QT interval corresponds to the time it takes for the ventricles of the heart to contract and then start to refill with blood before beginning the next contraction. Measures of QT interval were taken from 15-year-old female patients with anorexia nervosa and compared to healthy females of the same age. The body mass, heart rate and the mass of the left ventricle were also measured and the mean values are shown in the table.

	Anorexia nervosa	Healthy
Sample size	30	30
Body mass / kg	39	53
Heart rate / beats per minute	57	83
QT / ms	438	360
Mass of left ventricle / g	76	98

[Source: Published with permission of the Publisher. Original source: Vázquez M, Olivares JL, Fleta J, Lacambra I, González M. Cardiac Disorders in Young Women With Anorexia Nervosa. *Rev Esp Cardiol* 2003;56:669-73. Copyright © 2003 Sociedad Española de Cardiología. Published by Elsevier España, S.L. All rights reserved.]

(a) Outline the reasons that the female patients with anorexia nervosa have a lower mean ventricle mass than healthy females. [2]

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(b) Suggest a reason for the difference in QT interval between females with anorexia nervosa and healthy females. [1]

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(c) State the **two** causes of normal heart sounds. [1]

1.

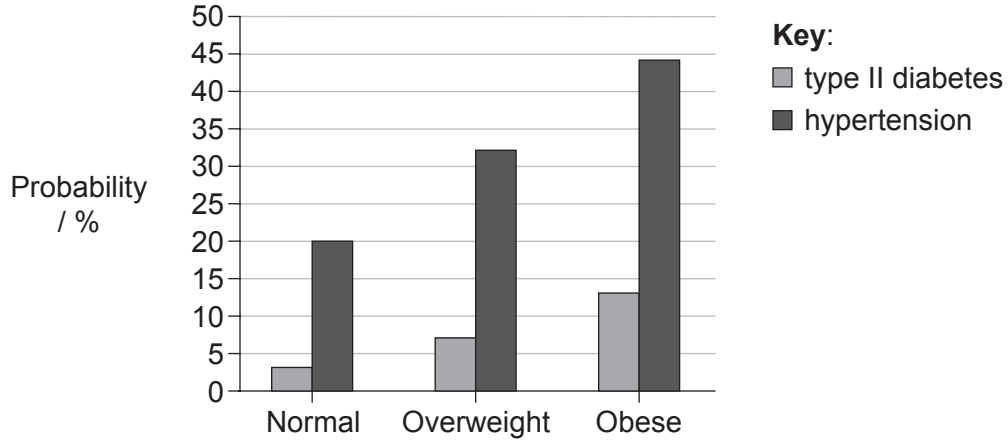
2.

(Option D continues on the following page)



(Option D continued)

16. A study undertaken in West Virginia, USA, shows the relationship between body mass and the probability of having hypertension or type II diabetes. The test subjects in the study were classified as normal, overweight or obese according to their body mass index (BMI).



[Source: adapted from E Thoenen, (2002), *Obesity: Facts, Figures, Guidelines*. Department of Health and Human Resources, West Virginia Health Statistic Center.]

(a) Identify the increased probability of an obese person having hypertension relative to someone who has normal weight. [1]

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(b) Explain how the administration of a drug that stimulates the leptin receptors in the hypothalamus could help treat obesity. [3]

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(Option D continues on the following page)



32EP27

Turn over

(Option D continued)

17. The table shows the nutritional information for two different types of milk as it is displayed on the carton. The information in both tables is based on a 250 g serving and shows the recommended daily allowance (RDA) for each nutrient.

Whole Milk			
	Mass	RDA / %	
Total fat	8 g	13	
Saturated fat	5 g	24	
Cholesterol	26 mg	9	
Total carbohydrates	12 g	4	
Protein	8 g	16	
Sodium	102 mg	4	
		RDA / %	RDA / %
Vitamin A	5	Vitamin D	26
Vitamin B12	29	Calcium	29
Vitamin B6	5	Magnesium	6

Skimmed Milk			
	Mass	RDA / %	
Total fat	480 mg	1	
Saturated fat	322 mg	2	
Cholesterol	5 mg	2	
Total carbohydrates	12 g	4	
Protein	5 g	10	
Sodium	132 mg	6	
		RDA / %	RDA / %
Vitamin A	11	Vitamin D	26
Vitamin B12	18	Calcium	37
Vitamin B6	5	Magnesium	8

[Source: © International Baccalaureate Organization 2016]

(a) Calculate how many grams of protein should be consumed each day. Working is not required.

[1]

..... g

(b) State **one** function of sodium in the diet.

[1]

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(Option D continues on the following page)



(Option D, question 17 continued)

- (c) Identify, with a reason, which milk provides more energy in a 250g serving. [1]

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- (d) Suggest, with reasons, which milk would be recommended for someone with osteomalacia. [2]

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(Option D continues on the following page)

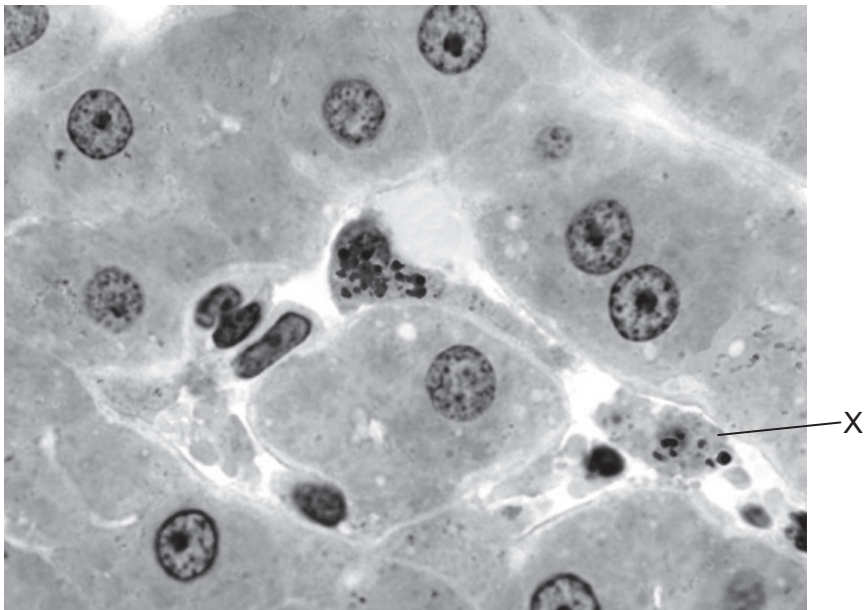


32EP29

Turn over

(Option D continued)

18. The micrograph shows a section through the human liver.



[Source: Dr Thomas Caceci, Virginia Tech/Carilion School of Medicine.]

(a) The cell labelled X is only found in the liver and is associated with the wall of a sinusoid.

(i) Identify cell X.

[1]

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(ii) Outline the function of cell X.

[2]

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(Option D continues on the following page)



(Option D, question 18 continued)

(b) Explain the importance of bilirubin in the onset of jaundice.

[4]

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End of Option D



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32EP32