Diploma Programme
Programme du diplôme
Programa del Diploma

Biology
Higher level
Paper 3

8 November 2023

Zone A morning | **Zone B** morning | **Zone C** morning

Candidate session number

1 hour 15 minutes

Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[45 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 – 9
Option B — Biotechnology and bioinformatics	10 – 15
Option C — Ecology and conservation	16 – 20
Option D — Human physiology	21 – 26

8823 – 6009

47 pages

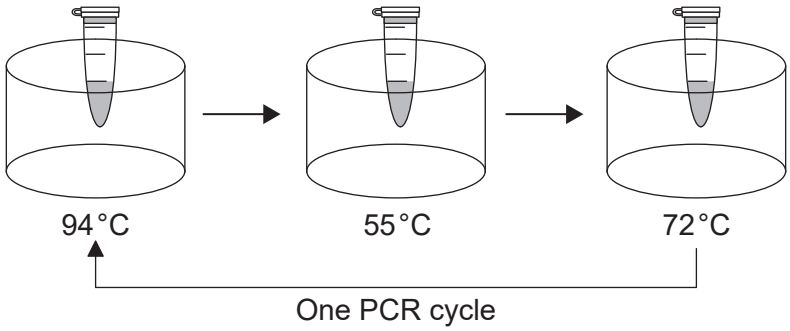
Section A

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

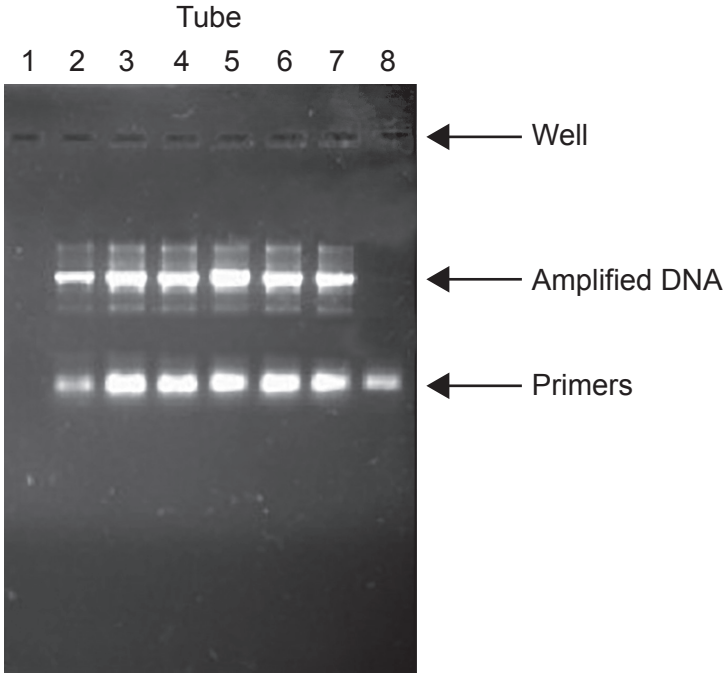
1. A polymerase chain reaction (PCR) was performed to amplify a small amount of DNA. Eight tubes were prepared as shown in the table.

	Mix of nucleotides, salts, buffer and polymerase	DNA	Primers
Control	✓	✓	✗
Control	✓	✗	✓
Six tubes	✓	✓	✓

The tubes were placed in a thermal cycler with the temperatures shown in the diagram and run for 25 cycles.



The image shows the result of gel electrophoresis on the eight samples.



(This question continues on the following page)

(Question 1 continued)

(a) State the number of the tube used as a control without DNA. [1]

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(b) Deduce, with a reason, whether the primers are smaller or larger than the amplified DNA. [1]

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(c) Explain the reason for changing the temperature during each cycle. [2]

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(d) Predict the result that would be obtained if fewer cycles were used in this PCR process. [1]

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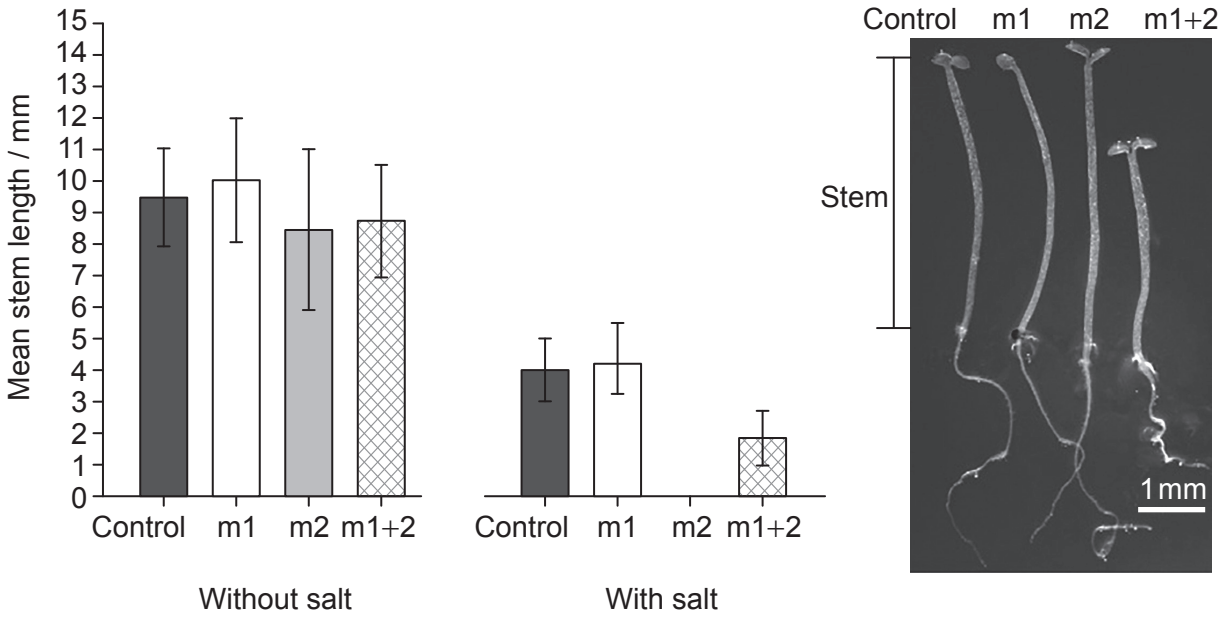
2. Scientists studied the effect of salt on the growth of seeds of normal and mutated thale cress *Arabidopsis thaliana*. Mutations occurred on genes coding for protein 1 (m1), protein 2 (m2) or both 1 and 2 (m1+2).

The bar chart shows the mean lengths of stems of seedlings grown without salt and with salt. The bar for m2 grown with salt is not represented. The photograph shows one set of seedlings grown with salt, all with the mean length for each group.



(This question continues on the following page)

(Question 2 continued)

(a) (i) Using the photograph and the scale bar, calculate the actual stem length of the m2 seedling grown with salt, showing your answer by drawing a bar in the space on the bar chart. [1]

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(ii) Explain the reason that you cannot draw an error bar for your answer to (a)(i). [2]

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(b) State **one** environmental factor that should be kept constant in this experiment. [1]

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(c) Using the results of this experiment, evaluate the influence of protein 1 and protein 2 in salt tolerance in thale cress plants. [2]

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Please **do not** write on this page.

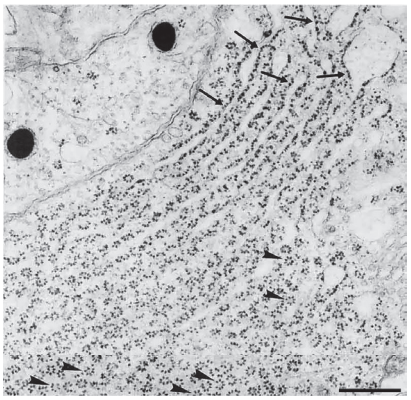
Answers written on this page
will not be marked.

3. The electron micrograph shows part of a cell in the pituitary gland of a rat. Ribosomes appear as dark granules. Some of the ribosomes are arranged in a linear array and some are in circles. The diagram shows how the ribosomes in a circular array are connected.

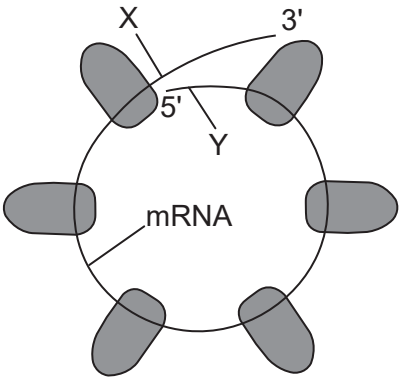
Key:

Linear

Circular



0.5 µm



(a) On the electron micrograph, label

(i) the rough endoplasmic reticulum [1]

(ii) a polysome. [1]

(b) Calculate the magnification of the electron micrograph. [1]

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(c) Using the diagram, identify, with a reason, whether X or Y is the start codon. [1]

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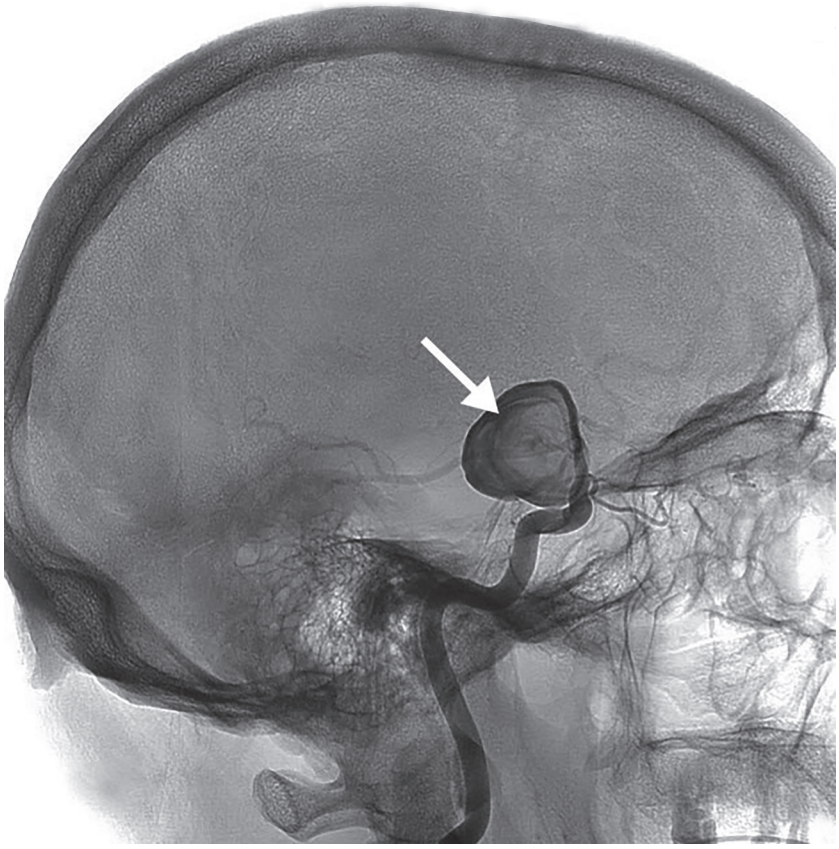
Section B

Answer **all** of the questions from **one** of the options. Answers must be written within the answer boxes provided.

Option A — Neurobiology and behaviour

4. The image shows an angiogram (X-ray with a dye) of blood vessels in the brain of a patient who has suffered a stroke in Broca's area. The arrow shows the exact location where the stroke has occurred.



(Option A continues on the following page)

(Option A, question 4 continued)

(a) Explain the likely consequences of a stroke in Broca's area. [2]

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(b) Explain the change in the brain which could lead to recovery from a stroke. [2]

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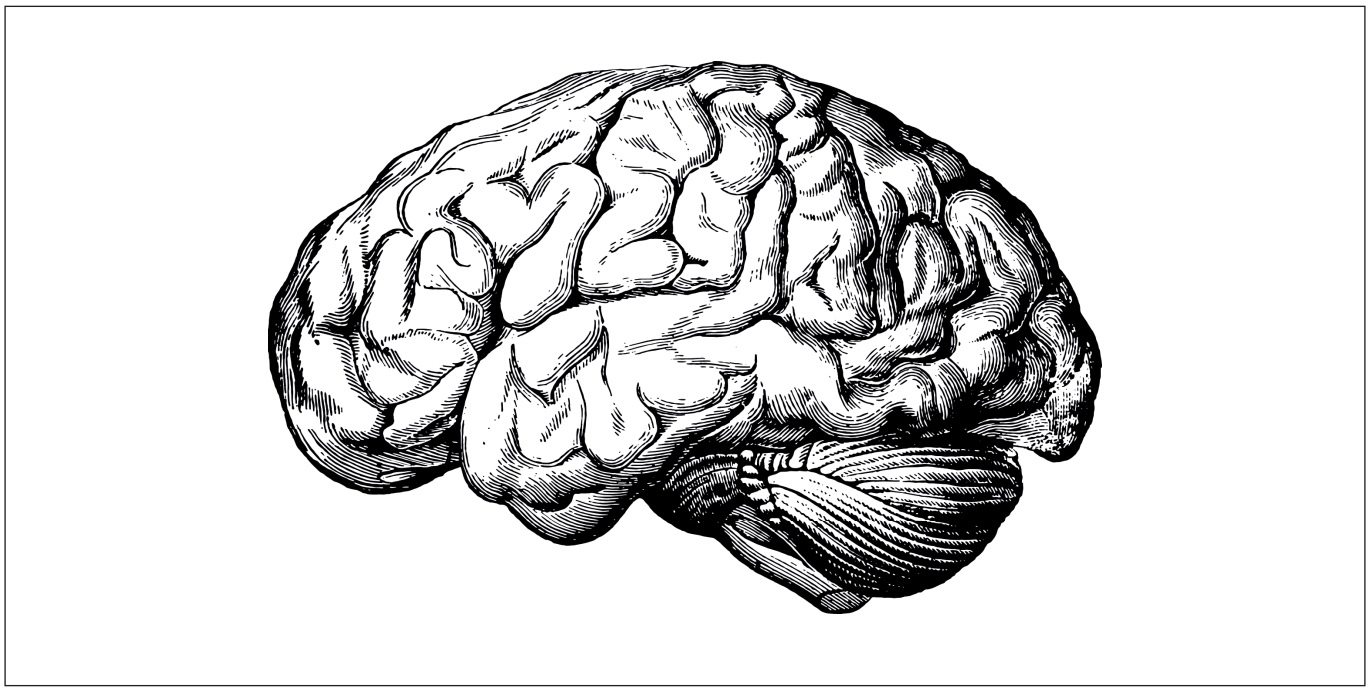
(Option A continues on the following page)

(Option A continued)

5. The diagram is a view of the human brain as seen from the left side.

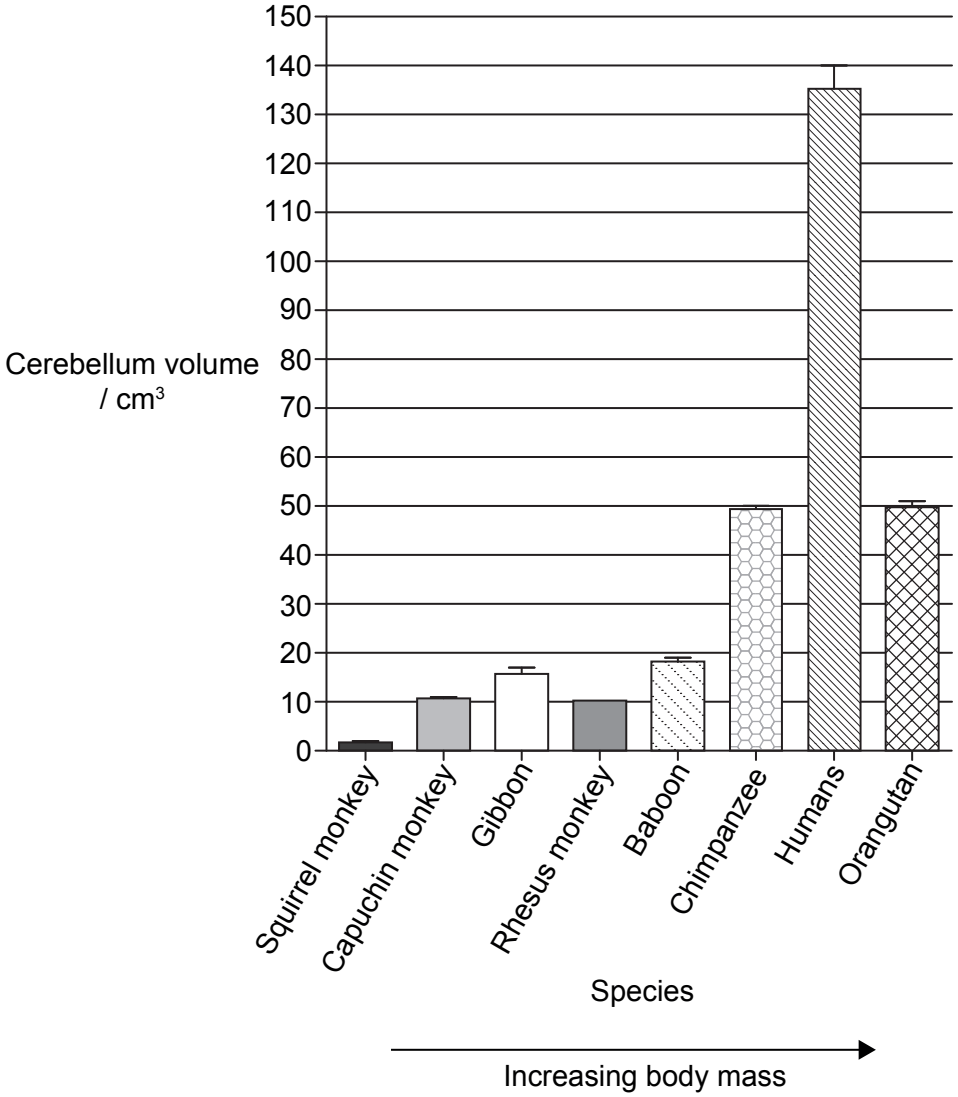


(a) On the diagram, label the cerebellum. [1]

(Option A continues on the following page)

(Option A, question 5 continued)

The graph shows the mean cerebellum volume from MRI scans in eight primate species arranged in order of increasing body mass.



(b) Analyse the relationship between body mass and cerebellum volume in these primate species. [2]

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(Option A continues on page 13)

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Answers written on this page
will not be marked.

(Option A, question 5 continued)

(c) Describe the use of fMRI to identify the role of the cerebellum. [2]

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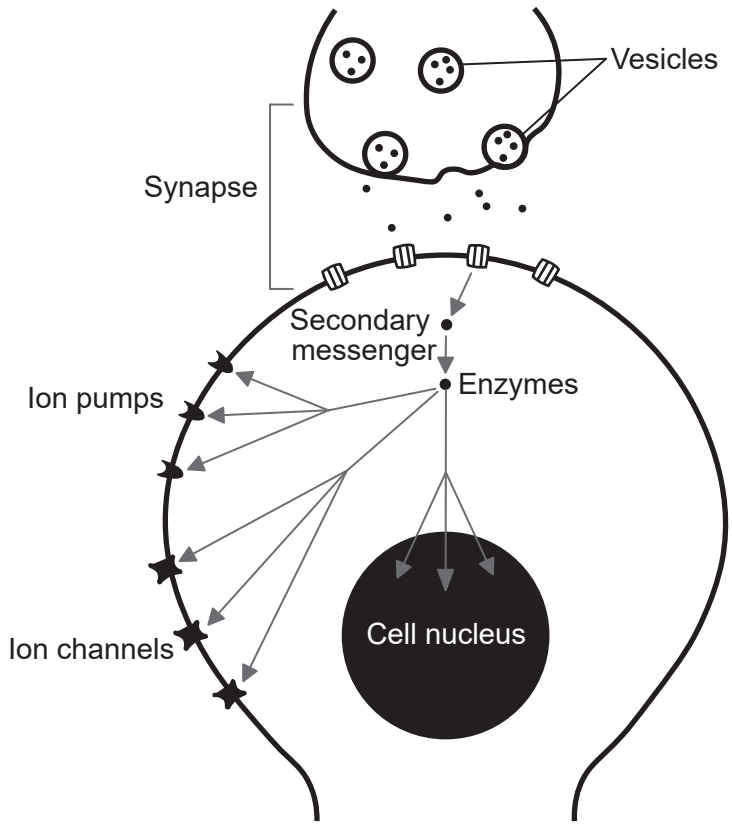
(Option A continues on the following page)

(Option A continued)

6. The diagram shows the signalling pathways involved in slow synaptic transmission.



(a) On the diagram, label a

(i) neurotransmitter receptor [1]

(ii) presynaptic membrane. [1]

(b) State **one** example of a slow-acting neurotransmitter. [1]

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(Option A continues on the following page)

(Option A, question 6 continued)

(c) Outline the role of slow-acting neurotransmitters in learning. [2]

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(d) Outline how MDMA (ecstasy) affects neurotransmitter metabolism in the brain. [2]

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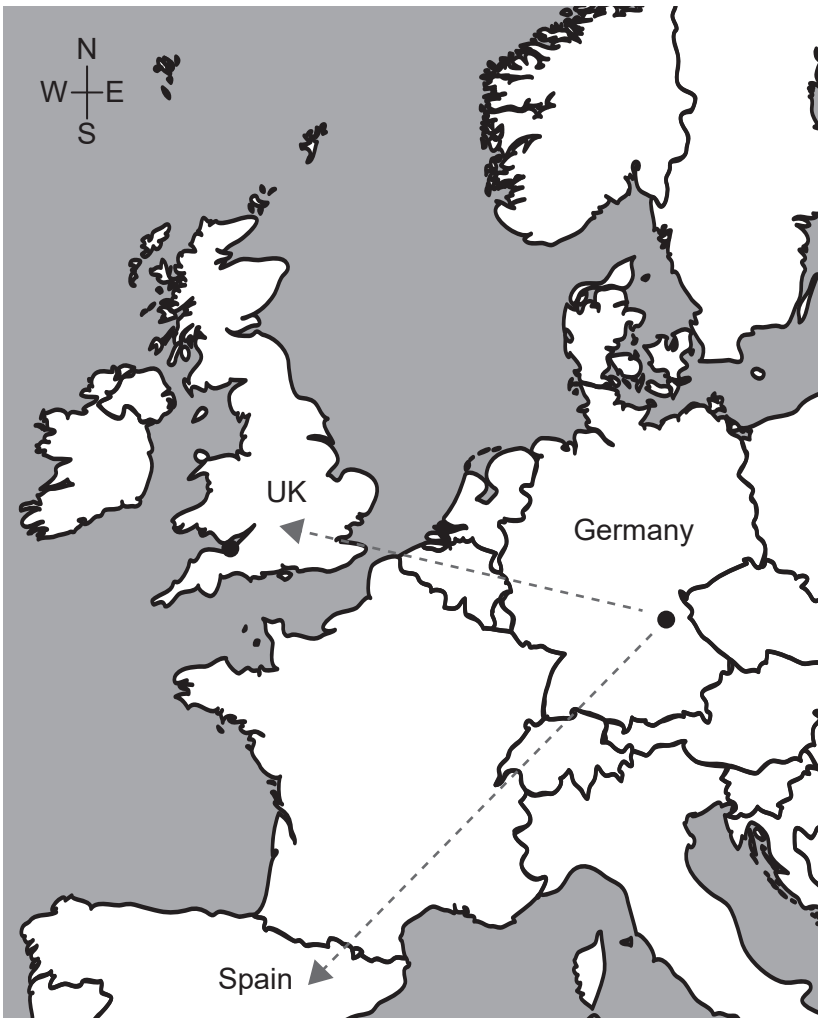
(Option A continues on the following page)

(Option A continued)

7. Blackcaps (*Sylvia atricapilla*) that live in Germany during the summer usually migrate to Spain or the UK in the winter. The map shows the direction of migration of adult birds.

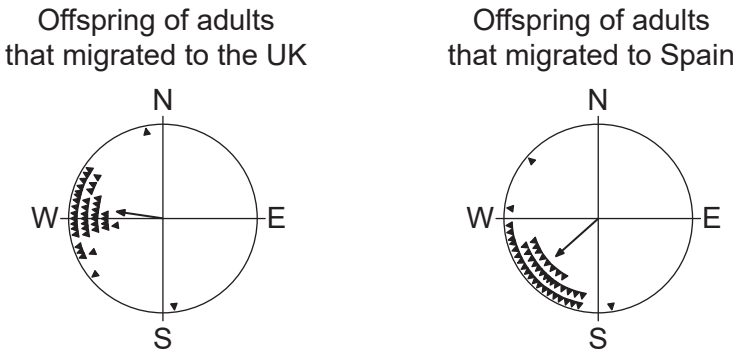


In an experiment, the offspring of blackcaps from adults that migrated to either the UK or Spain, were reared in isolation from their parents and released in Germany to see in which direction they migrated for the winter.

(Option A continues on the following page)

(Option A, question 7 continued)

Each symbol in the results diagram gives the direction of one bird and the arrows show the mean direction of all birds.



[Source: P. Berthold et al, Rapid microevolution of migratory behaviour in a wild bird species, *Nature*, 360, 668–670 (1992), Springer Nature. Reproduced with permission from Springer Nature. https://www.nature.com.]

Discuss whether the difference in migratory behaviour in blackcaps is caused by innate behaviour or learned behaviour. [3]

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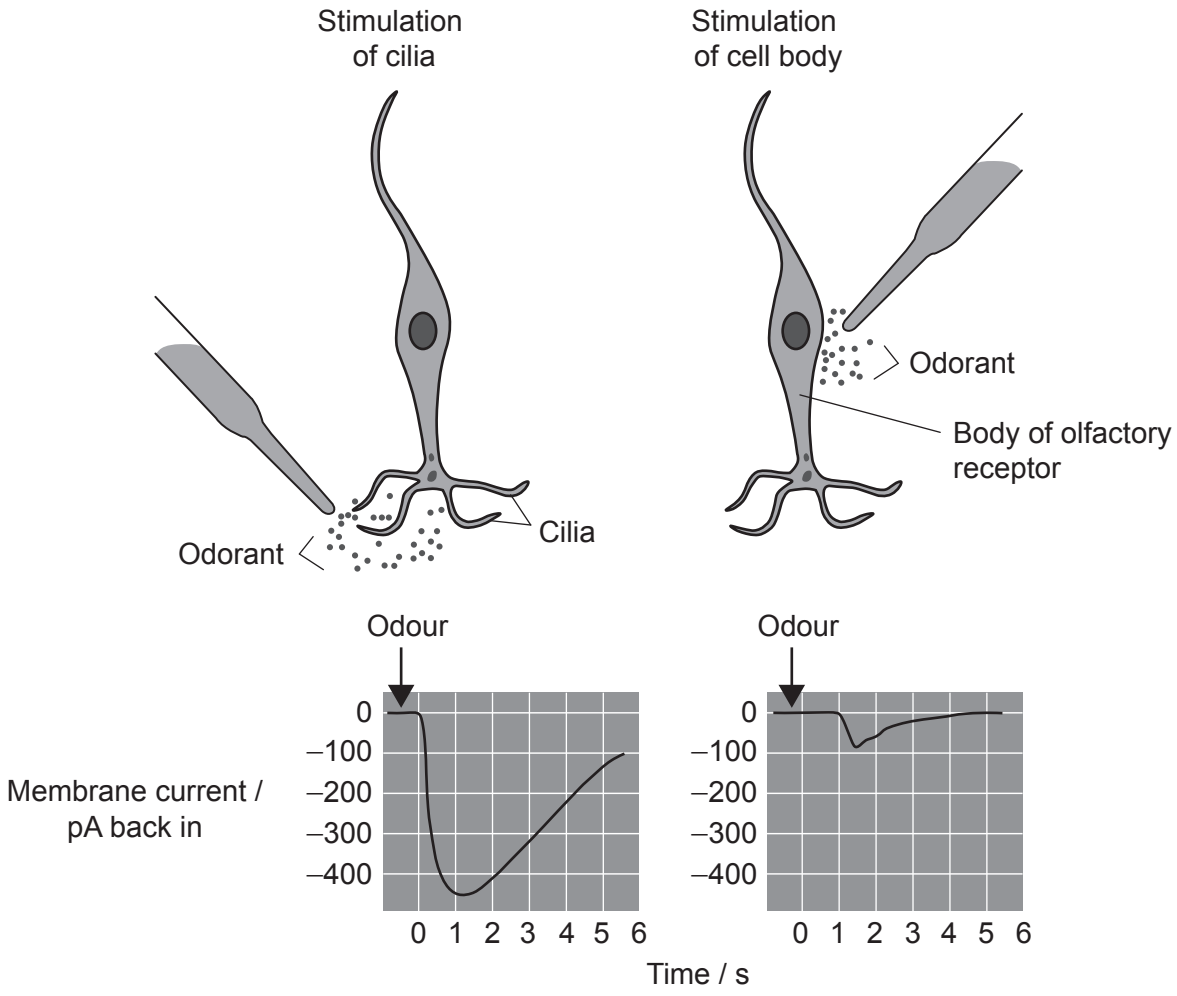
(Option A continues on the following page)

(Option A continued)

8. The diagram shows how chemoreceptor cells respond to a stimulus on their cilia or cell body. The impulse is detected with an oscilloscope and the change in membrane current is shown.



(a) Distinguish between the changes in the membrane current caused by stimulation of the cilia or the cell body. [2]

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(Option A continues on the following page)

(Option A, question 8 continued)

(b) Distinguish between olfactory receptor cells and rod cells. [2]

Feature of receptor cell	Olfactory receptor cells	Rod cells
Connection to nerve	no intermediate cell	
Type of stimulus perceived	chemicals	

(c) Hair cells play an important role in hearing. State where in the ear these hair cells are located. [1]

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(Option A continues on page 21)

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will not be marked.

(Option A continued)

9. Explain how the central nervous system of a fetus develops from ectoderm. [6]

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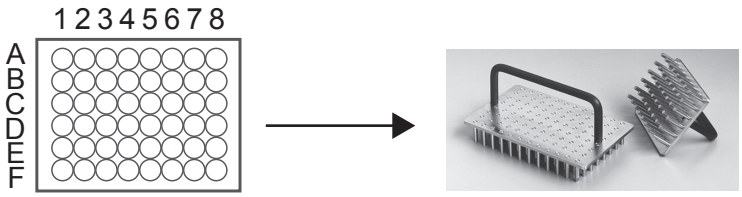
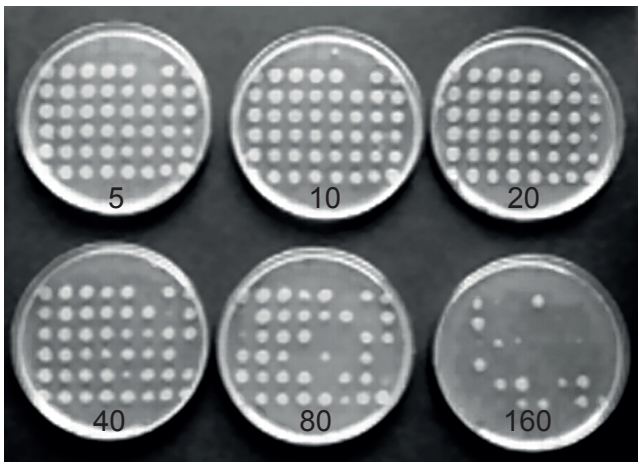
End of Option A

Option B — Biotechnology and bioinformatics

10. Different strains of the bacterium *Enterobacter cloacae* were grown on a plate and identified according to their place on the plate (for example, the first strain top left is A1). They were then transferred to Petri dishes containing agar with varying concentrations of antibiotic (5, 10, 20, 40, 80, 160 $\mu g\,ml^{-1}$).



The Petri dishes were left for 24 hours in an incubator at 25 °C and the resulting plates are shown.



(a) State the strain with the least resistance to antibiotic. [1]

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(b) Identify a reason that the plates were placed in an incubator at 25 °C before recording the results. [1]

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(Option B continues on the following page)

(Option B, question 10 continued)

(c) Suggest reasons for the presence of strains such as B2 in all of the plates. [2]

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(d) Distinguish between the method used in this experiment and methods using zones of inhibition. [2]

Feature	This experiment	Zones of inhibition
Location of antibiotic in the plate		
How the effect of antibiotic is evaluated		

(e) *Enterobacter cloacae* is Gram-negative. Describe the test that would show this. [4]

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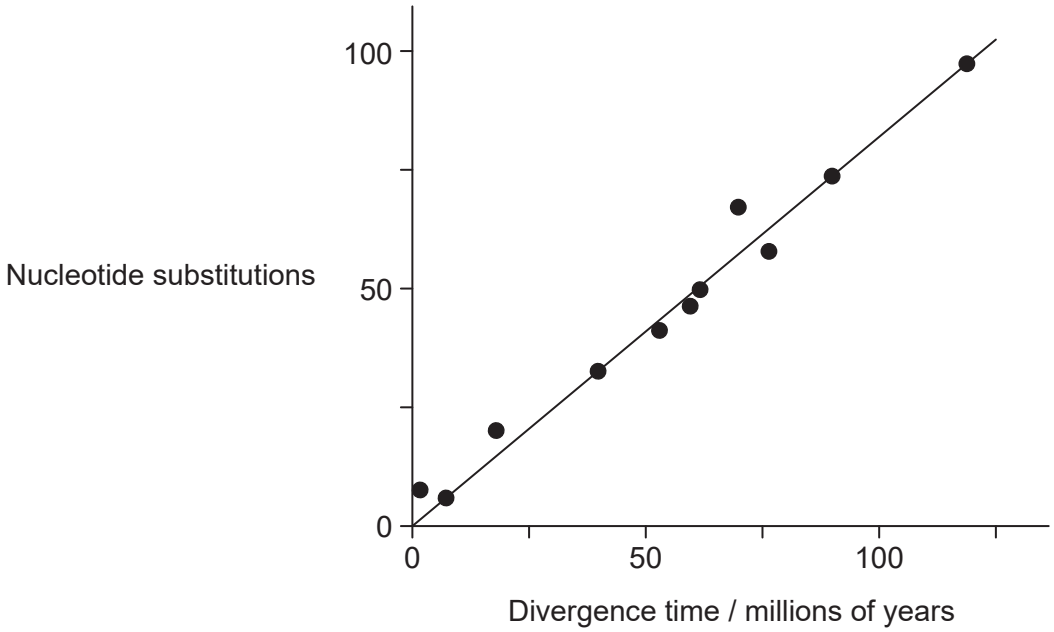
(Option B continues on the following page)

(Option B continued)

11. The evolutionary clock estimates the time elapsed since species separated from a common ancestor based on fossil evidence. The graph shows the number of differences in the DNA sequences (nucleotide substitutions) coding for certain polypeptides in 11 closely related mammals.



(a) State the relationship between divergence time and number of substitutions. [1]

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(b) Outline the bioinformatics method used to compare the nucleotide sequences coding for the polypeptides of different organisms. [2]

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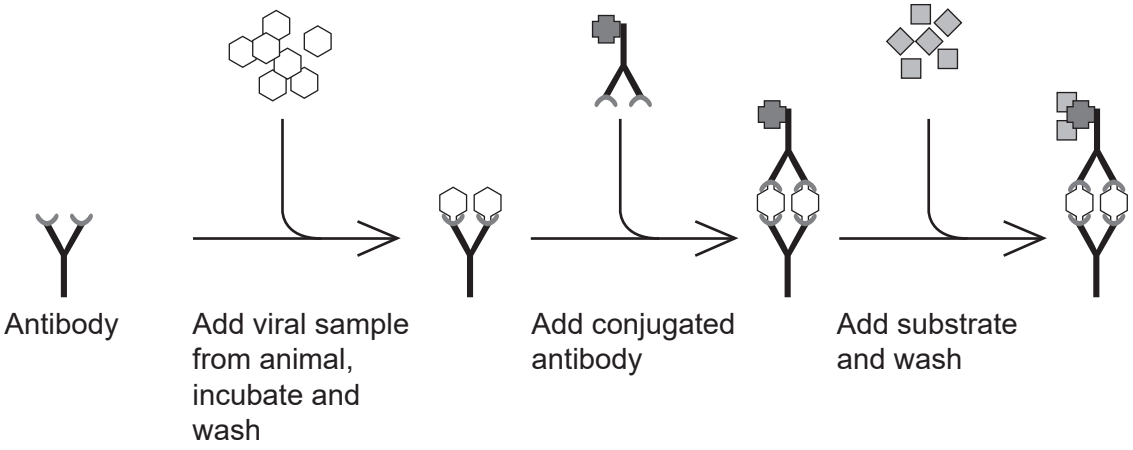
(Option B continues on the following page)

(Option B continued)

12. The diagram shows the steps performed in a well of an enzyme-linked immunosorbent assay (ELISA) test, using a sample from an animal with a viral infection.



(a) With reference to the ELISA test shown, state

(i) the part of the virus that binds to the antibody [1]

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(ii) the change that occurs in the well, after the substrate is added in the presence of the virus. [1]

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(b) State **one** technique that could be used for detecting the genetic material of viruses. [1]

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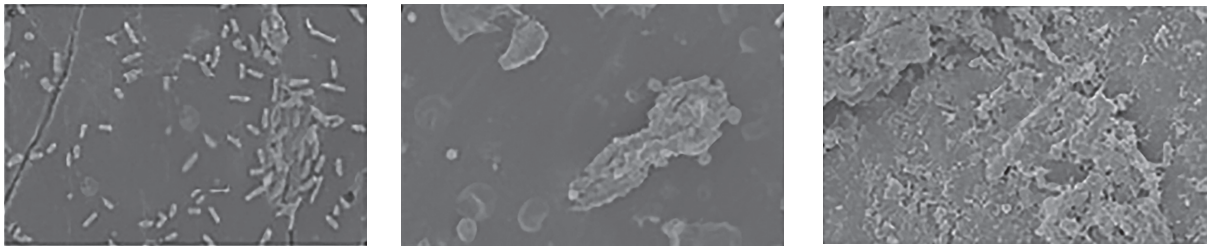
(Option B continues on the following page)

(Option B continued)

13. Microbial pathogens may grow during harvesting and processing of seafood, posing health risks to consumers. The bacterium *Vibrio parahaemolyticus* is one of the pathogens which forms biofilms on food and on food contact surfaces during processing. *V. parahaemolyticus* biofilm formation was investigated at different surface textures provided by stainless steel (smooth), shrimp shell (slightly rough) and crab shell (very rough).

Stainless steel | Shrimp shell | Crab shell



×10 000

(a) Discuss whether the results support the hypothesis that rough surfaces encourage biofilm adhesion and development. [2]

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(b) (i) State **one** emergent property of biofilms. [1]

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(ii) Outline **one** beneficial use of biofilms. [2]

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(Option B continues on the following page)

(Option B continued)

14. Antithrombin is a protein that naturally occurs in healthy individuals and helps to keep blood from clotting. Patients with antithrombin deficiency have been treated using supplies of this protein purified from human blood. The diagram shows how the biopharming of goats is now used to produce antithrombin.

Removed for copyright reasons

Discuss the benefits of antithrombin production by biopharming. [3]

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(Option B continues on page 29)

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will not be marked.

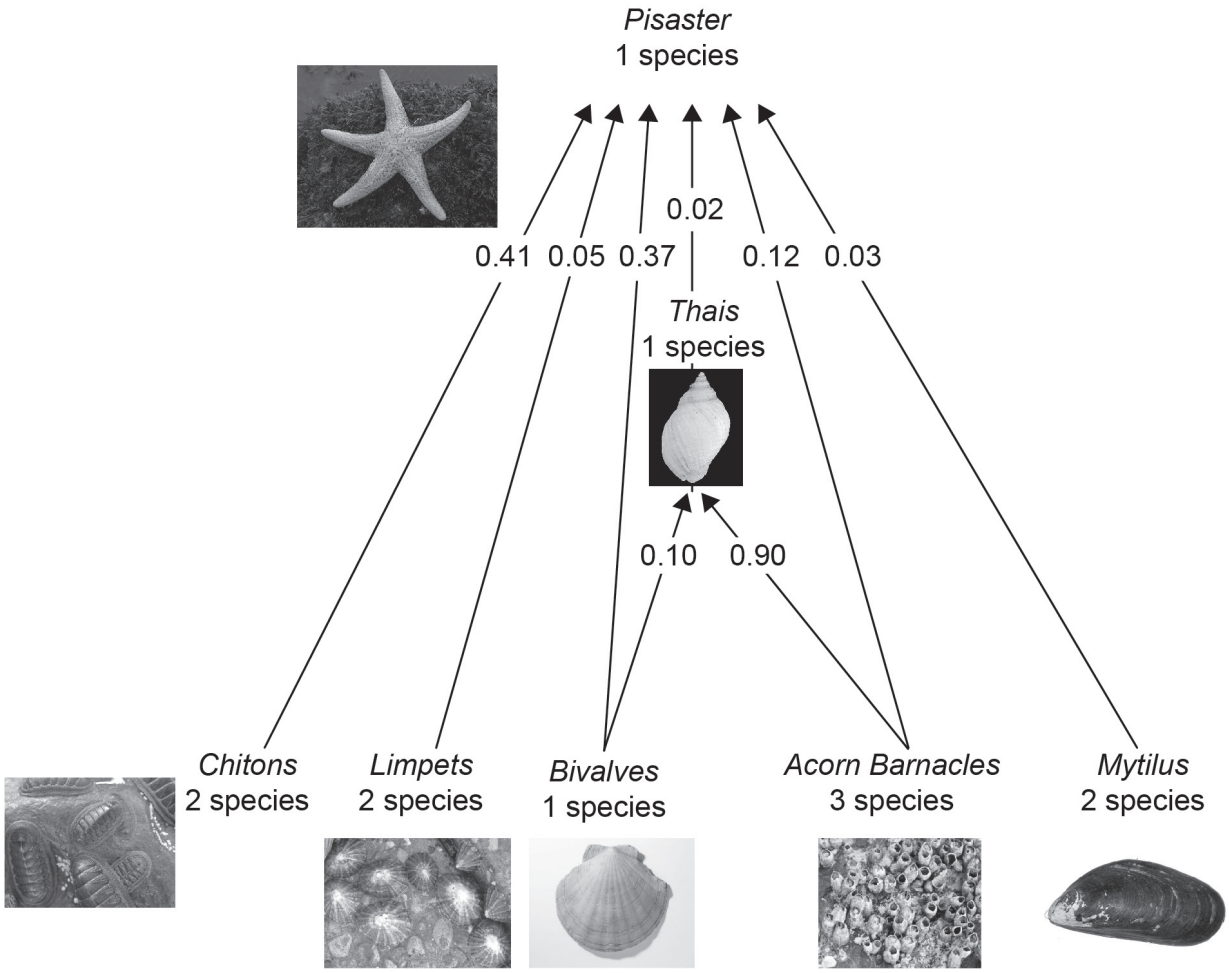
(Option B continued)

15. Explain how a plant can be genetically modified to increase crop yields. [6]

End of Option B

Option C — Ecology and conservation

16. Feeding relationships between organisms on rocky shores along the Pacific Coast of North America were studied. The food web shows the proportions of the total energy consumed by the two carnivorous species, a starfish (*Pisaster ochraceus*) and a small gastropod (*Thais emarginata*).



(Option C continues on the following page)

(Option C, question 16 continued)

(a) Identify the main source of energy of *Thais*. [1]

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(b) Limpets feed on photosynthetic algae. Identify the trophic level of limpets. [1]

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(c) Predict what would happen to this community if the following organisms were removed from the ecosystem.

(i) *Mytilus*: [1]

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(ii) Acorn barnacles: [2]

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(d) *Pisaster* is considered a keystone species. Explain the effects of *Pisaster* on this community. [2]

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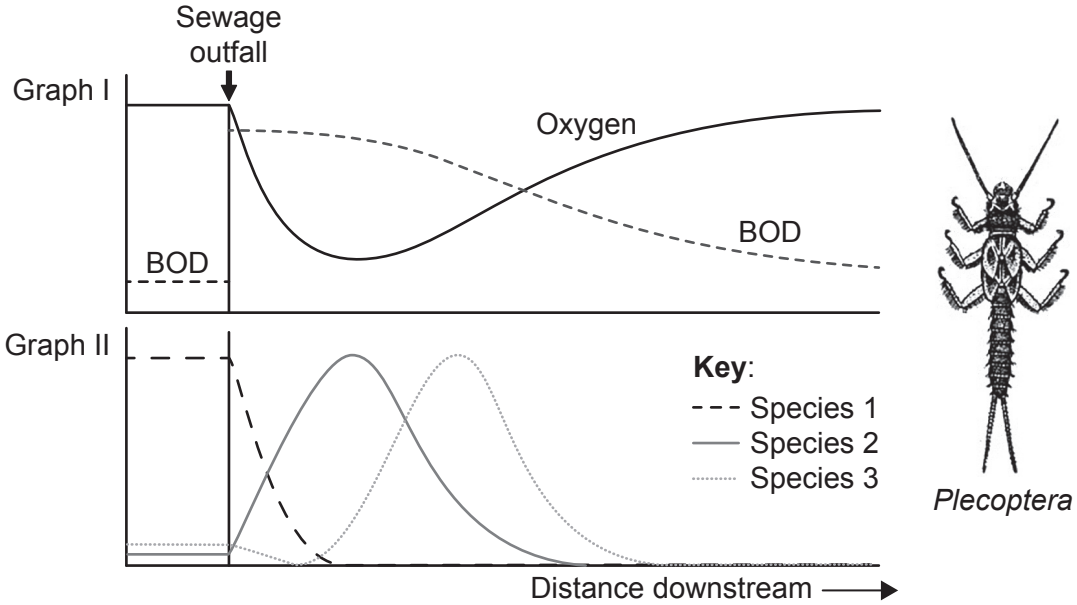
(Option C continues on the following page)

(Option C continued)

17. Stonefly nymphs (*Plecoptera*) are good indicators of unpolluted streams and rivers. Graph I shows the effect of a sewage outfall on oxygen concentration and biochemical oxygen demand (BOD) in a stream. Graph II shows the distribution curves of three different aquatic species living in the stream.



(a) Identify which curve in graph II shows the distribution of stonefly nymphs. [1]

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(b) Outline the use of indicator species such as stoneflies to assess the quality of aquatic environments. [3]

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(Option C continues on the following page)

(Option C, question 17 continued)

(c) Explain the effect of eutrophication on BOD. [3]

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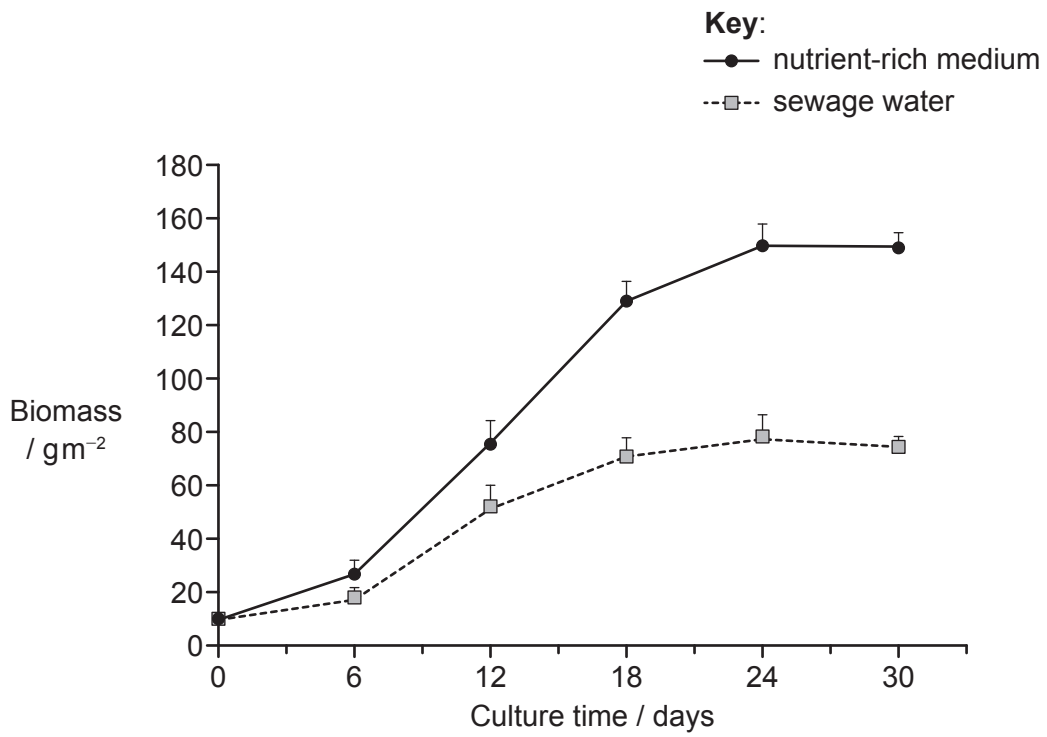
(Option C continues on the following page)

(Option C continued)

18. Duckweed (*Lemna aequinoctialis*) is a small floating plant that sometimes forms a continuous cover over the surface of ponds. In an experiment, it was grown either in nutrient-rich medium or in sewage water for four weeks. The biomass obtained per square metre at different times is shown in the population growth curves.



(a) Label **two** phases on the nutrient-rich medium population growth curve. [2]

(b) Compare the population growth curve in nutrient-rich medium and sewage water. [2]

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(Option C continues on the following page)

(Option C, question 18 continued)

(c) State **two** factors that limit the duckweed population size after 24 days. [2]

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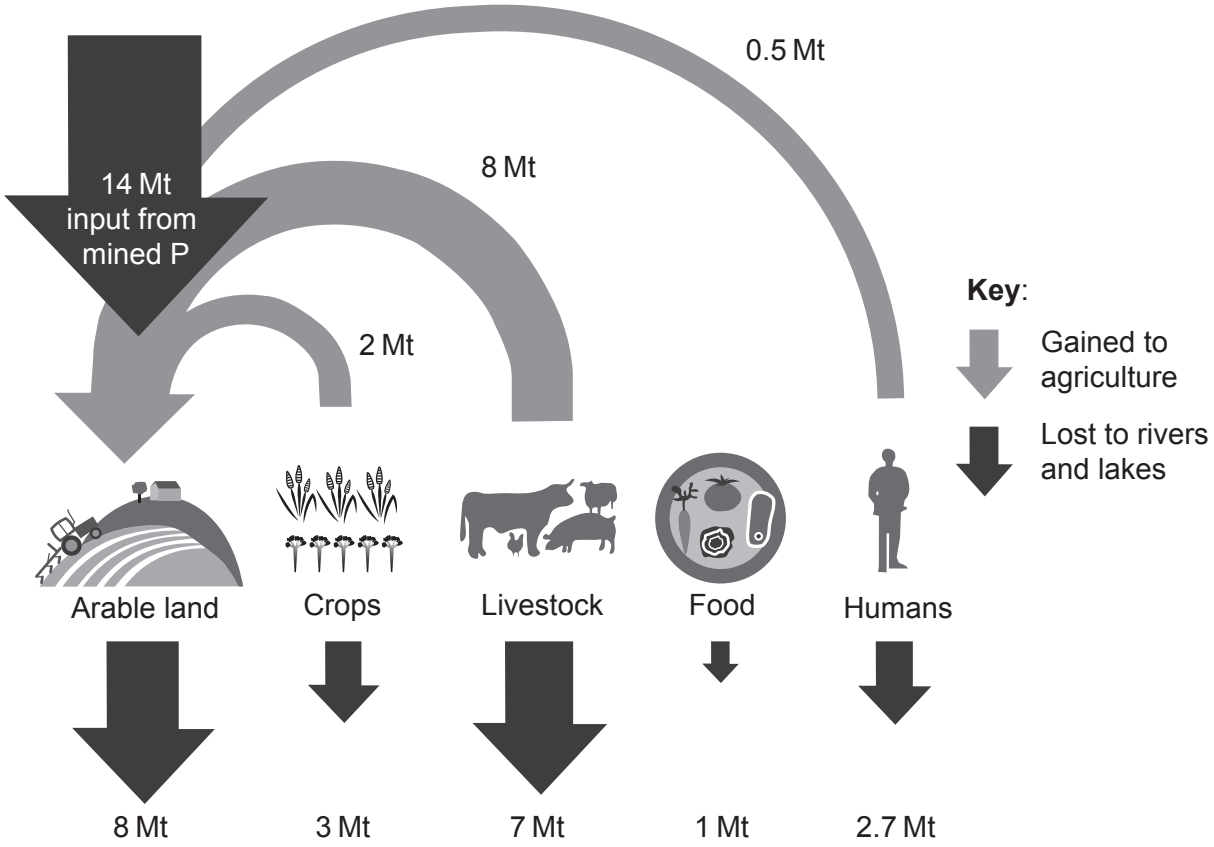
2. . . . . .

(Option C continues on the following page)

(Option C continued)

19. The flow chart shows transfers of phosphorus in million tonnes (Mt) due to human activity.



(a) State a process by which phosphate from arable land is lost to rivers. [1]

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(b) Outline reasons for the availability of phosphate becoming limiting to agriculture in the future. [3]

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(Option C continues on the following page)

(Option C continued)

20. Discuss, giving an example, the possible effects of the introduction of an alien species into an ecosystem. [6]

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End of Option C

Option D — Human physiology

21. Scurvy was a major problem for polar explorers. Scott and his companions reached the South Pole in January 1912 only to find that Amundsen's team had arrived there a month before. Amundsen's team came back safely but Scott's polar team all died on their return journey.

The basic source of nourishment for Scott's team was dried meat, while Amundsen's team ate raw meat and berries.

Scott's team

Amundsen's team

(a) Suggest why Amundsen's team did not suffer from scurvy. [1]

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(b) There are ethical objections to causing scurvy experimentally in humans, but few other species of mammal can be used as models for this deficiency disease. Outline the reasons for this. [2]

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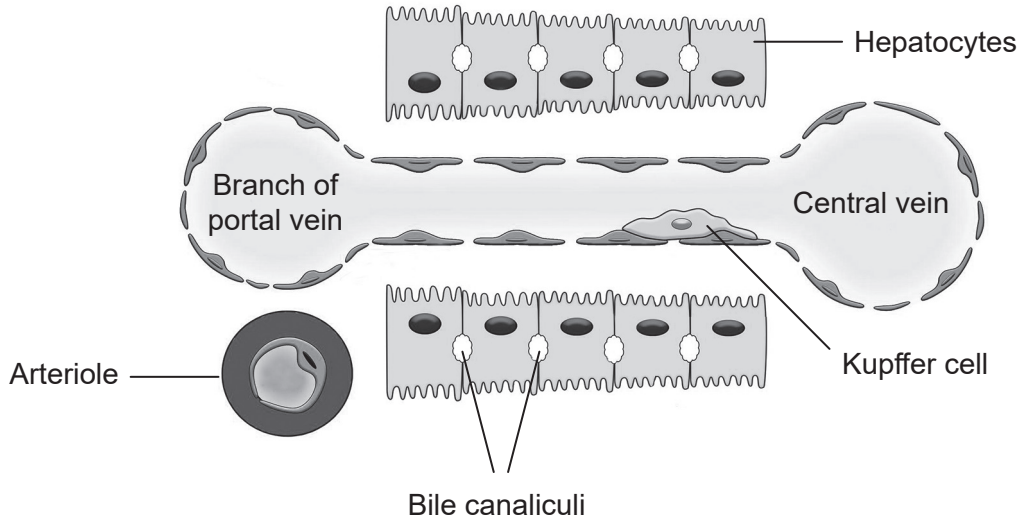
(Option D continues on the following page)

(Option D continued)

22. The diagram shows a detail of the internal structure of the sinusoid of the liver.



(a) On the diagram, draw arrows to show the direction of movement of

(i) oxygen supplied to hepatocytes [1]

(ii) toxins after detoxification. [1]

(b) Outline the function of hepatocytes in the regulation of nutrient levels. [2]

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(Option D continues on page 41)

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(Option D, question 22 continued)

(c) (i) State **one** chronic liver disease. [1]

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(ii) Kupffer cells are found in greater than normal amounts in patients with chronic liver disease. State **one** function of Kupffer cells. [1]

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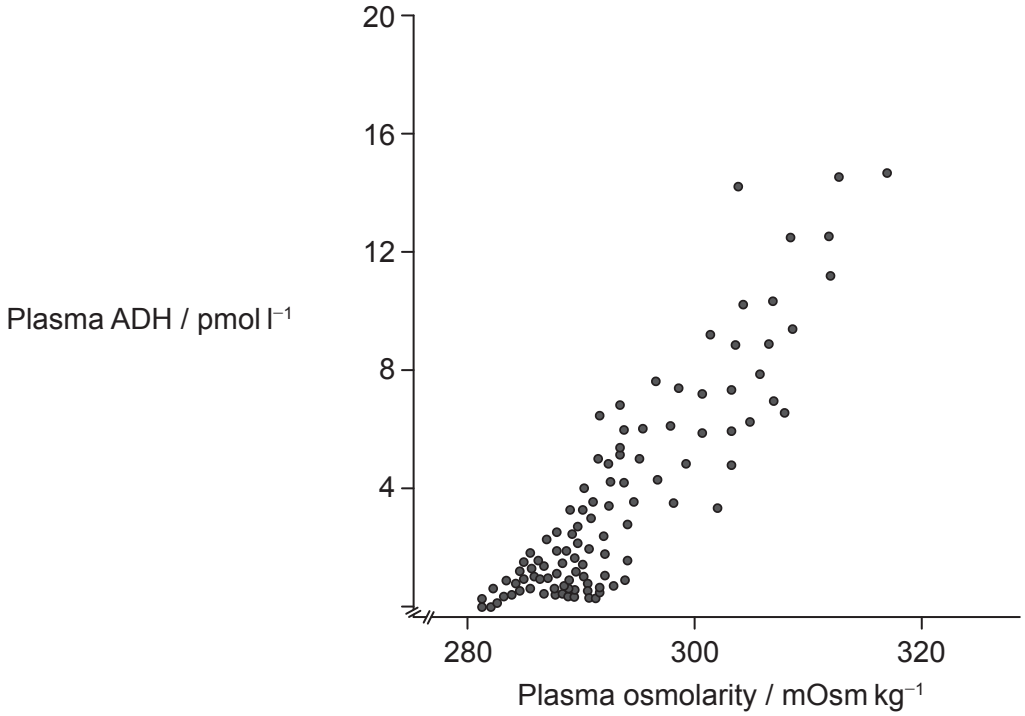
(Option D continues on the following page)

(Option D continued)

23. Antidiuretic hormone (ADH) is a peptide hormone that regulates the levels of water in the body. It is synthesized in the hypothalamus and stored in the posterior pituitary gland. The scattergraph shows the relationship between the osmolarity and ADH concentration in blood plasma.



(a) State the relationship between osmolarity and ADH concentration of blood plasma. [1]

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(b) Explain the action of peptide hormones. [3]

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(Option D continues on the following page)

(Option D, question 23 continued)

(c) State the reason that the posterior pituitary is considered an endocrine gland. [1]

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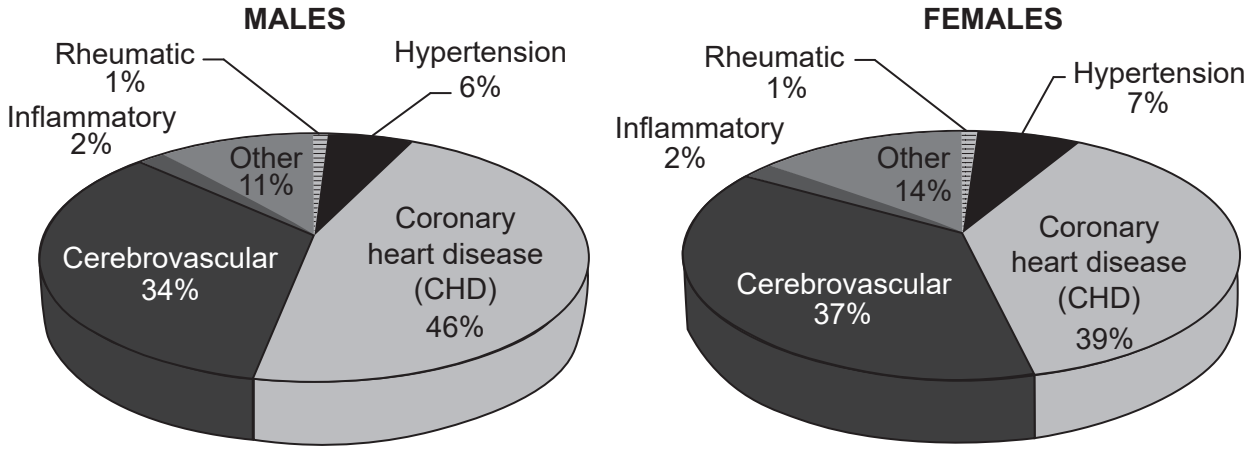
(Option D continues on the following page)

(Option D continued)

24. Cardiovascular diseases (CVDs) include diseases of the heart, vascular diseases of the brain and other diseases of blood vessels. CVDs are responsible for over 17 million deaths annually worldwide. The pie charts show the percentage incidences of CVDs in males and females.



(a) Suggest **one** reason for the difference in the percentage incidence of coronary heart disease (CHD) in males and females. [1]

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(b) Outline causes of hypertension. [2]

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(Option D continues on the following page)

(Option D, question 24 continued)

(c) Describe how an electrocardiogram (ECG) can be used to show that the heart is beating normally. [3]

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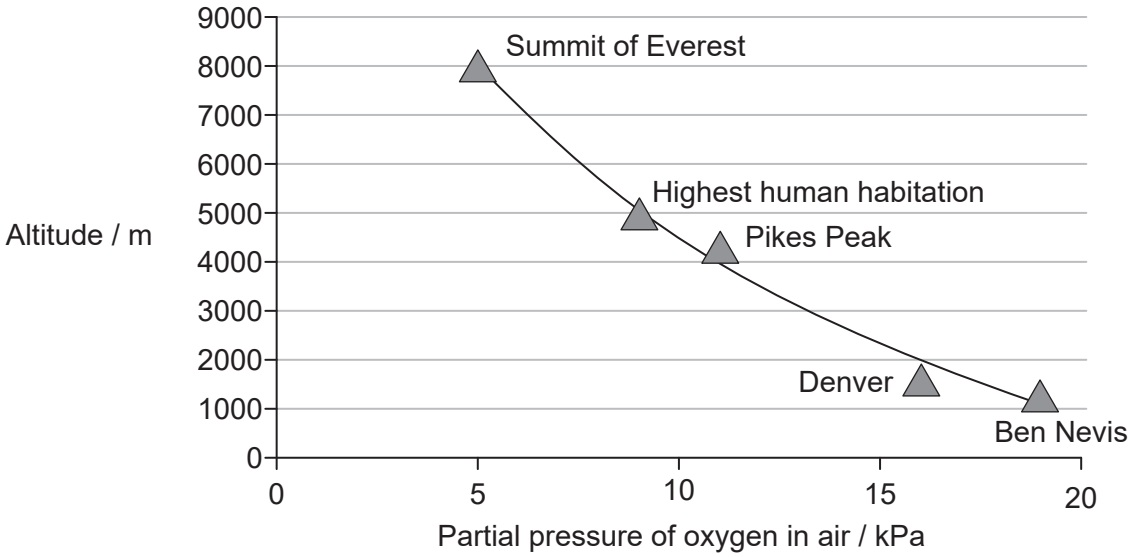
(Option D continues on the following page)

(Option D continued)

25. The graph shows the relationship between partial pressure of oxygen in air and altitude.



(a) State the effect of altitude on the partial pressure of oxygen in air. [1]

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(b) Explain the consequence of high altitude for gas exchange in humans. [3]

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(Option D continues on the following page)

(Option D continued)

26. Explain the secretion of acid into the stomach and how this can be controlled by using medication. [6]

End of Option D

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References:

2. Reprinted from *Cell*, Vol 162, Issue 6, Endler, A., Kesten, C., Schneider, R., Zhang, Y., Ivakov, A., Froehlich, A., Funke, N. and Persson, S., A Mechanism for Sustained Cellulose Synthesis during Salt Stress, Pages 1353–1364, Copyright 2015, with permission from Elsevier.

3. Christensen, A.K., Kahn, L.E. and Bourne, C.M., 1987. *The American Journal of Anatomy*, 178, pp. 1–10 © 1987 Wiley-Liss, Inc.

4. Used with permission of Mayo Foundation for Medical Education and Research, all rights reserved.

5.a Colleen from Pixabay. https://pixabay.com/vectors/brain-organ-cerebrum-cerebral-lobe-5605289/. Licensed under Pixabay Content license https://pixabay.com/service/license-summary/. Image adapted.

5.b Rilling, J.K., 2006. Human and NonHuman Primate Brains: Are They Allometrically Scaled Versions of the Same Design? *Evolutionary Anthropology*, 15, pp. 65–77 © 2006 Wiley Periodicals, Inc.

6. Used with permission of Portland Press, Ltd, from *Bioscience reports*, Biochemical Society (Great Britain), Vol 21, issue 3, 2001; permission conveyed through Copyright Clearance Center, Inc.

7. P. Berthold et al, Rapid microevolution of migratory behaviour in a wild bird species, *Nature*, 360, 668–670 (1992), Springer Nature. Reproduced with permission from Springer Nature. https://www.nature.com.

8. Purves D, Augustine GJ, Fitzpatrick D, et al, editors. *Neuroscience*. 2nd edition. Sunderland (MA): Sinauer Associates; 2001. The Olfactory Epithelium and Olfactory Receptor Neurons. Available from: https://www.ncbi.nlm.nih.gov/books/NBK10896/ Reproduced with permission of the Licensor through PLSclear.

10. Top image: *Replica plater for 96 well plate*, n.d. [image online] Available at: https://www.sigmaaldrich.com/catalog/product/sigma/r2383?lang=en&region=GB [Accessed 7 April 2020].

Petri dishes: Goldberg, S.D., Iannuccilli, W., Nguyen, T., Ju, J. and Cornish, V.W. (2003), Identification of residues critical for catalysis in a class C β-lactamase by combinatorial scanning mutagenesis. *Protein Science*, 12: 1633–1645 Copyright © 2003 The Protein Society.

11. Modified with permission from the *Annual Review of Biochemistry*, Volume 46 © 1977 by Annual Reviews, http://www.annualreviews.org.

13. Reprinted from *Food Control*, Vol 70, Noori Han, Md. Furkanur Rahaman Mizan, Iqbal Kabir Jahid, Sang-Do Ha, Biofilm formation by Vibrio parahaemolyticus on food and food contact surfaces increases with rise in temperature, Pages No. 161–166, Copyright (2016), with permission from Elsevier.

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17. Hynes, H.B.N., 1960. *The Biology of Polluted Waters*. Liverpool: Liverpool University Press.

18. Yu C, Sun C, Yu L, Zhu M, Xu H, Zhao J, et al. (2014) Comparative Analysis of Duckweed Cultivation with Sewage Water and SH Media for Production of Fuel Ethanol. *PLoS ONE* 9(12): e115023. Open Access. https://doi.org/10.1371/journal.pone.0115023.

19. Tirado, R. and Allsopp, M., 2012. *Phosphorus in agriculture. Problems and Solutions*. Greenpeace Research Laboratories Technical Report (Review). Amsterdam: Greenpeace International.

21. Scott's team: Copyright 1913 May 12, by Herbert G. Ponting.

Amundsen's team: Nasjonalbiblioteket/The National Library of Norway.

22. Xu J, Liu X, Koyama Y, Wang P, Lan T, Kim I-G, Kim IH, Ma H-Y and Kisseleva T (2014) The types of hepatic myofibroblasts contributing to liver fibrosis of different etiologies. *Front. Pharmacol*. 5:167. Open Access.

23. *Am J Physiol–Regulatory, Integrative and Comparative Physiology*, P. H. Baylis, Vol 253, Issue 5, 1987, pp. R671–R678.

24. Adapted from *Global Atlas on Cardiovascular Disease Prevention and Control* / Edited By: Shanthi Mendis ... [et al]. 2011. WHO is not responsible for the content or accuracy of this adaptation.

25. Reproduced from *The BMJ*, Andrew J Peacock, 317, pp. 1063–1066, 1998 with permission from BMJ Publishing Group Ltd.

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