

© International Baccalaureate Organization 2021

All rights reserved. No part of this product may be reproduced in any form or by any electronic or mechanical means, including information storage and retrieval systems, without the prior written permission from the IB. Additionally, the license tied with this product prohibits use of any selected files or extracts from this product. Use by third parties, including but not limited to publishers, private teachers, tutoring or study services, preparatory schools, vendors operating curriculum mapping services or teacher resource digital platforms and app developers, whether fee-covered or not, is prohibited and is a criminal offense.

More information on how to request written permission in the form of a license can be obtained from <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

© Organisation du Baccalauréat International 2021

Tous droits réservés. Aucune partie de ce produit ne peut être reproduite sous quelque forme ni par quelque moyen que ce soit, électronique ou mécanique, y compris des systèmes de stockage et de récupération d'informations, sans l'autorisation écrite préalable de l'IB. De plus, la licence associée à ce produit interdit toute utilisation de tout fichier ou extrait sélectionné dans ce produit. L'utilisation par des tiers, y compris, sans toutefois s'y limiter, des éditeurs, des professeurs particuliers, des services de tutorat ou d'aide aux études, des établissements de préparation à l'enseignement supérieur, des fournisseurs de services de planification des programmes d'études, des gestionnaires de plateformes pédagogiques en ligne, et des développeurs d'applications, moyennant paiement ou non, est interdite et constitue une infraction pénale.

Pour plus d'informations sur la procédure à suivre pour obtenir une autorisation écrite sous la forme d'une licence, rendez-vous à l'adresse <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

© Organización del Bachillerato Internacional, 2021

Todos los derechos reservados. No se podrá reproducir ninguna parte de este producto de ninguna forma ni por ningún medio electrónico o mecánico, incluidos los sistemas de almacenamiento y recuperación de información, sin la previa autorización por escrito del IB. Además, la licencia vinculada a este producto prohíbe el uso de todo archivo o fragmento seleccionado de este producto. El uso por parte de terceros —lo que incluye, a título enunciativo, editoriales, profesores particulares, servicios de apoyo académico o ayuda para el estudio, colegios preparatorios, desarrolladores de aplicaciones y entidades que presten servicios de planificación curricular u ofrezcan recursos para docentes mediante plataformas digitales—, ya sea incluido en tasas o no, está prohibido y constituye un delito.

En este enlace encontrará más información sobre cómo solicitar una autorización por escrito en forma de licencia: <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

Biology
Standard level
Paper 2

Wednesday 19 May 2021 (morning)

Candidate session number

--	--	--	--	--	--	--	--	--	--

1 hour 15 minutes

Instructions to candidates

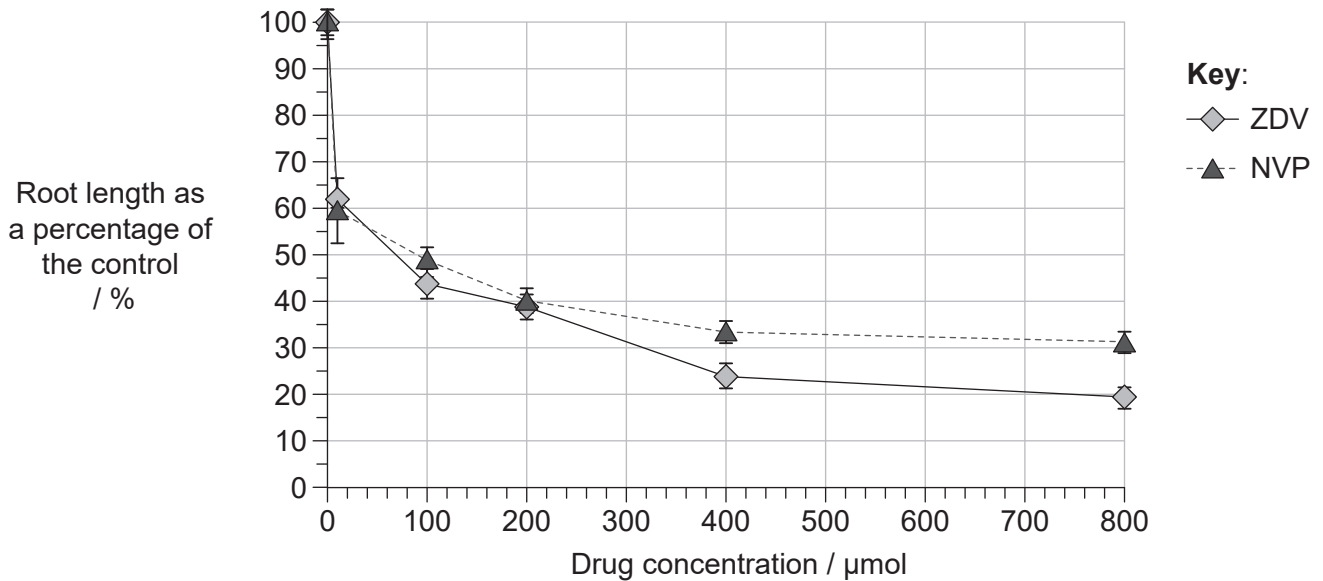
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer one question.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[50 marks]**.



Section A

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

1. Antiretroviral drugs are used to treat Human Immunodeficiency Virus (HIV) infections. Zidovudine (ZDV) and nevirapine (NVP) are examples of antiretroviral drugs. There are concerns that these drugs may be toxic to body cells in mitosis. In a study using *Allium cepa*, root tips were exposed to the drugs for 96 hours at a range of concentrations. The control treatment was a drug concentration of 0 μmol . In the graph, root lengths after the 96-hour treatment period are expressed as a percentage of the length of the control.



- (a) (i) Deduce the concentration of ZDV that would cause a 50% reduction in root growth compared to the control. [1]

.....

- (ii) Identify the root length, as a percentage of the control, resulting from a ZDV concentration of 400 μmol . [1]

.....

(This question continues on the following page)



(Question 1 continued)

(b) Compare and contrast the effect of ZDV and NVP on the growth of *Allium* roots. [2]

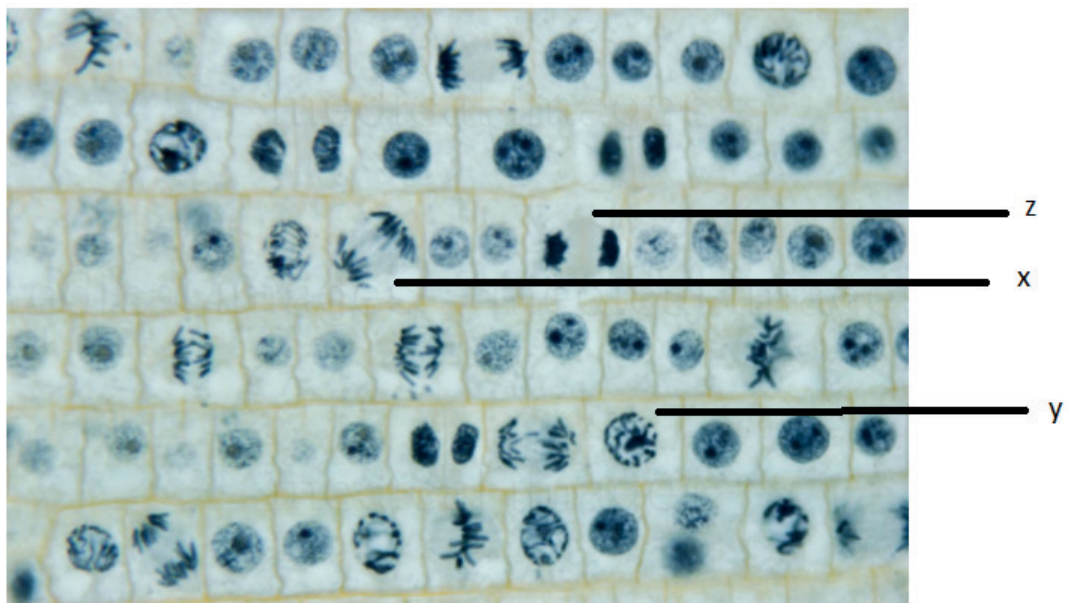
.....

.....

.....

.....

Both ZDV and NVP are believed to have a damaging effect on the process of mitosis but ZDV in particular is believed to block the formation of the spindle.



(c) Based on this information, suggest with a reason which of the labelled cell types will become more common in *Allium* root tips treated with ZDV. [2]

.....

.....

.....

.....

(This question continues on the following page)

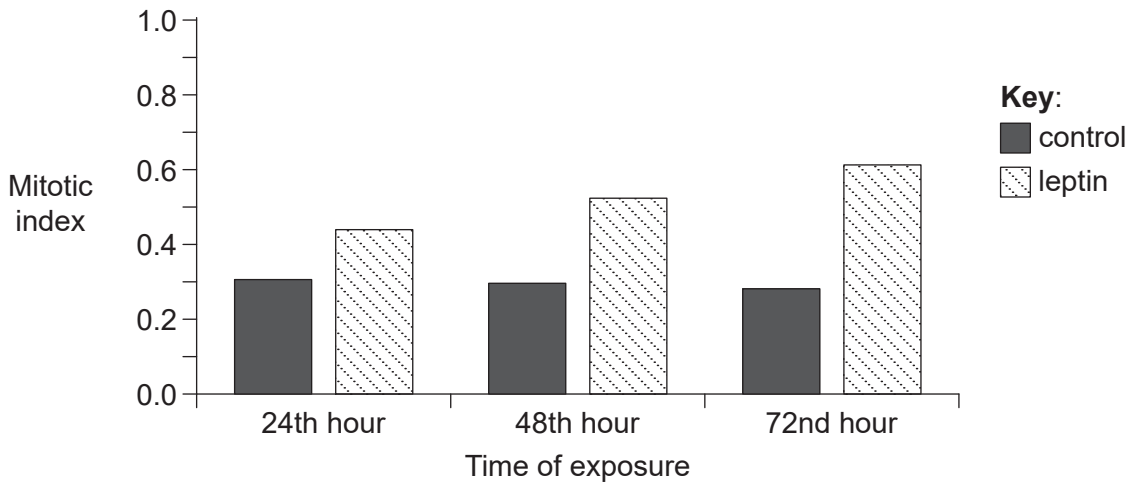


(Question 1 continued)

- (d) *Allium* root tips continue to show some growth even at high concentrations of NVP. Suggest a possible reason for the growth seen in root tips with 800 μmol NVP. [1]

.....
.....

Mitosis plays an important role in tissue regeneration and can be an important factor in recovery from surgery. The hormone leptin has been shown to promote mitosis in certain circumstances. The bar chart shows the mitotic indices of liver tissue exposed to leptin and control tissue during 72 hours after surgery.



- (e) Deduce the change in mitotic index after 72 hours compared to the control. [1]

.....
.....

(This question continues on the following page)



(Question 1 continued)

(f) Based on the data, evaluate the evidence for leptin promoting regeneration of liver tissue.

[3]

.....

.....

.....

.....

.....

.....

(g) Outline the role of leptin in appetite control.

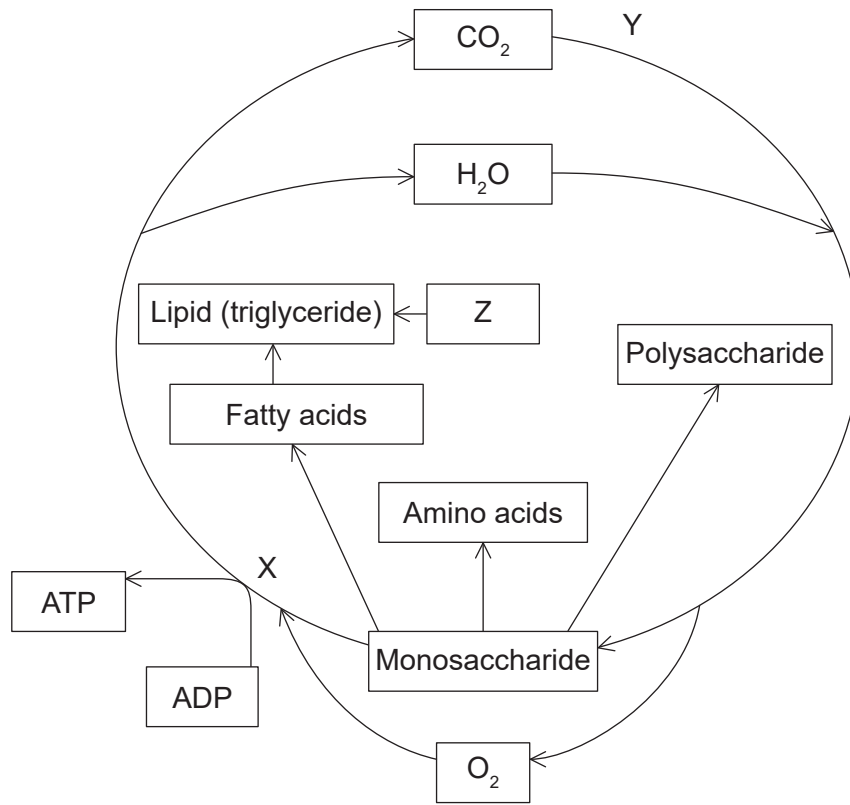
[1]

.....

.....



2. The diagram shows some of the metabolic processes taking place in a plant cell.



(a) (i) Identify the process Y and state the name of the organelle where it takes place in a plant cell. [1]

Process Y:

Name of the organelle:

(ii) Identify the molecule Z. [1]

.....

(b) State the type of reaction which converts excess monosaccharides to polysaccharides. [1]

.....

(This question continues on the following page)



(Question 2 continued)

(c) The process X uses oxygen and produces ATP. Identify the process X. [1]

.....

(d) Outline the uses of ATP in plant cells. [2]

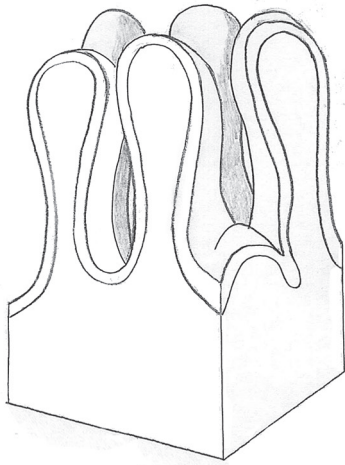
.....
.....
.....
.....

(e) With reference to the diagram, identify **one** example of catabolism. [1]

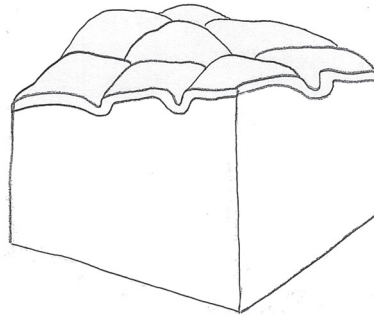
.....



3. Celiac disease is an immune reaction to eating gluten, a protein found in many cereals. The diagram shows the arrangement of normal villi and villi affected by celiac disease in the small intestine.



Normal villi



Villi affected by celiac disease

- (a) Outline the functions of the villi in the small intestine. [2]

.....

.....

.....

.....

- (b) Explain the consequences of celiac disease for absorption of digested nutrients. [2]

.....

.....

.....

.....

- (c) Wheat, barley and rye all contain gluten. Outline how a protein such as gluten is digested. [2]

.....

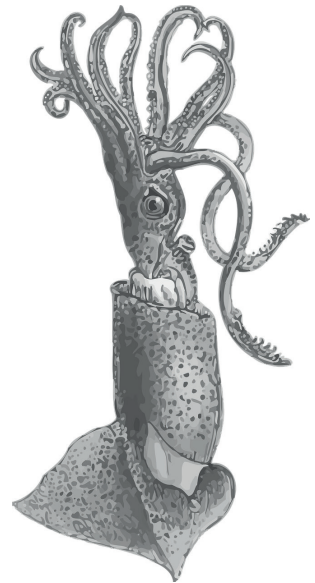
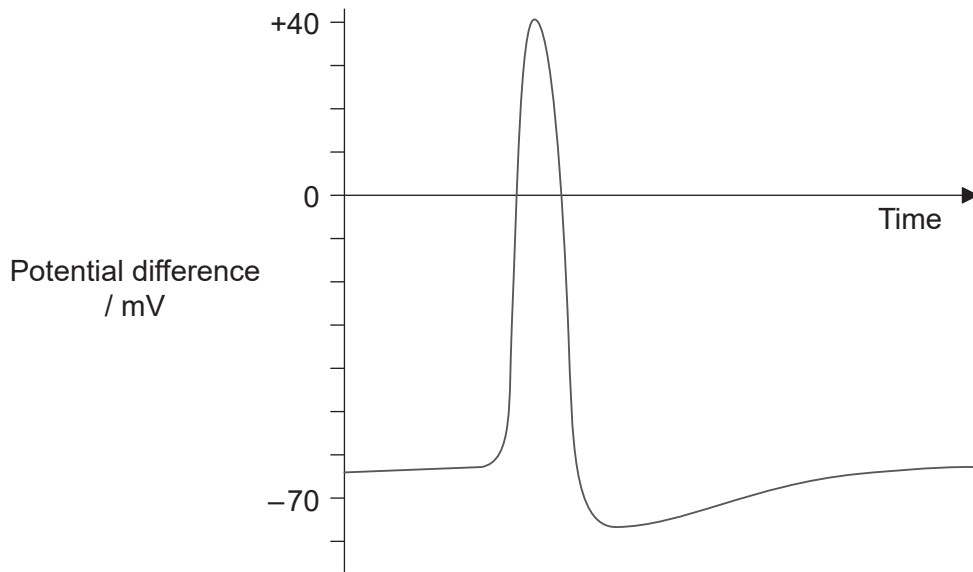
.....

.....

.....



4. Squid have been used for research on nerve impulses. The mechanism of nerve transmission in these animals is the same as that in humans. The image shows an oscilloscope trace from a nerve impulse in a squid's giant axon.



- (a) Estimate the resting potential for this axon.

[1]

.....

- (b) Outline the role of the sodium-potassium pump in maintaining the resting potential.

[2]

.....
.....
.....
.....

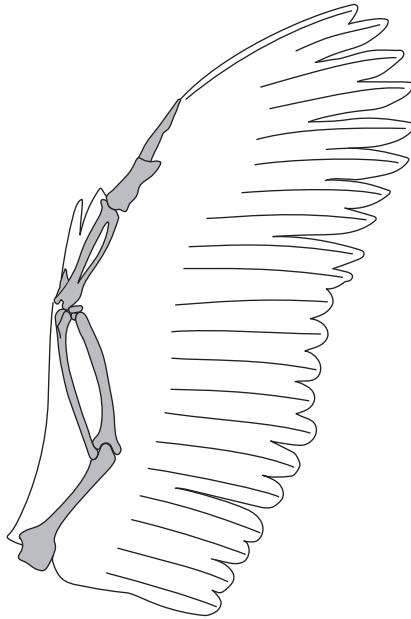


5. The image shows the wings of an insect, bird and bat.

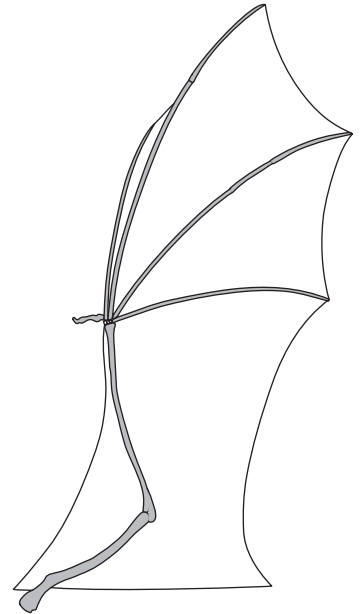
Insect



Bird



Bat



(a) (i) Based on their structure, the insect and bat wings are analogous. Outline what is meant by an analogous trait. [2]

.....
.....
.....
.....

(ii) The bird and bat wings share homologous bone structures whereas the insect wing does not. Outline the conclusion that can be drawn about the evolution of these wings, based on homologous structures. [1]

.....
.....

(This question continues on the following page)



(Question 5 continued)

- (b) Explain how cladistics can be used to investigate evolutionary relationships. [2]

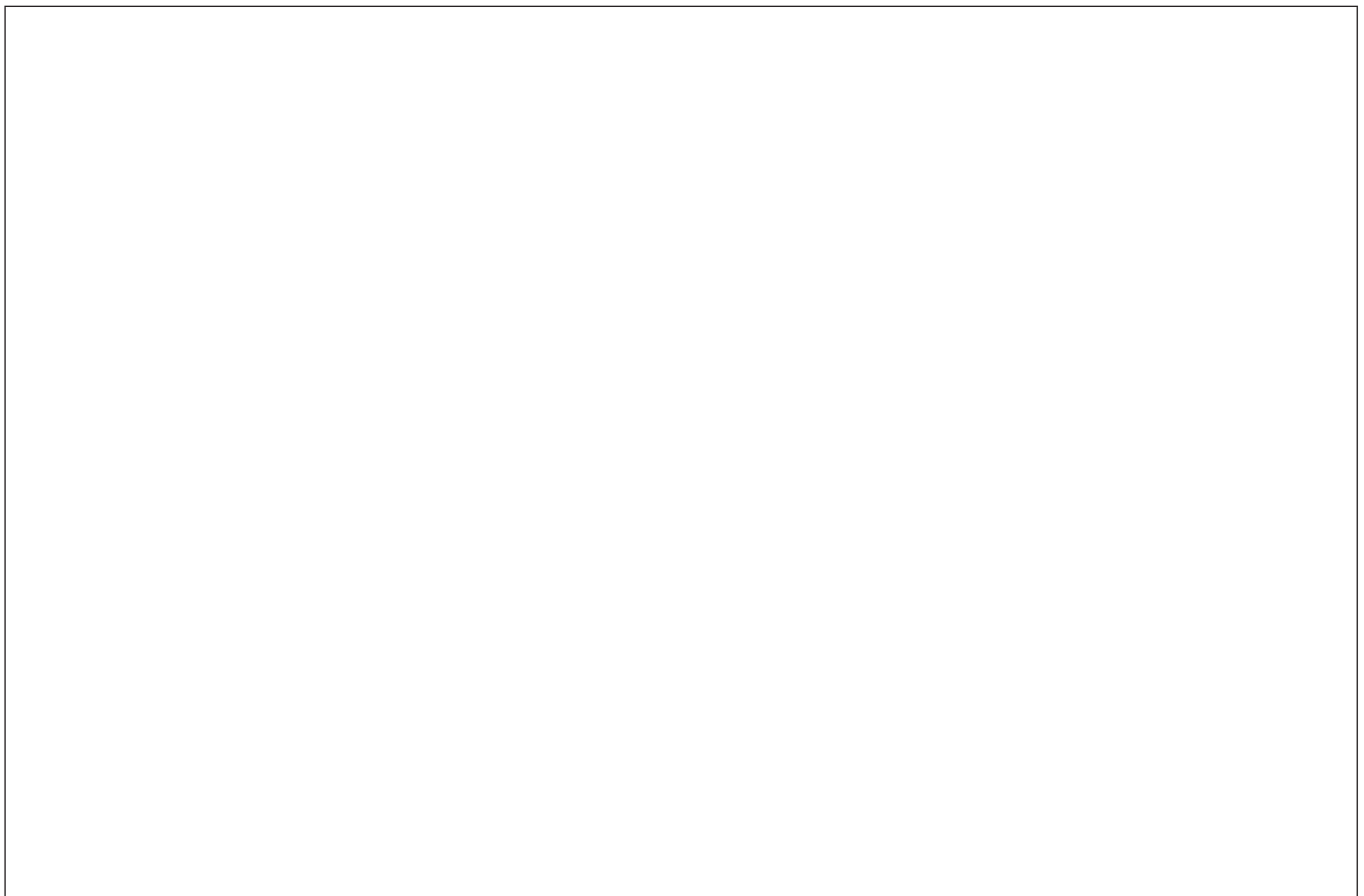
.....

.....

.....

.....

- (c) Cladistics and other evolutionary evidence suggest that mammals and birds have a more recent common ancestor than mammals and amphibians. Draw a cladogram to show the relationships between mammals, birds and amphibians. [1]



Section B

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

6. (a) Outline the structure of proteins. [3]
- (b) Cells produce a large variety of proteins with different sequences of amino acids. Explain how this is done. [7]
- (c) Outline the range of functions of proteins in cells. [5]
7. (a) Outline the process of inhalation. [4]
- (b) Explain the process of gas exchange taking place in the alveoli. [7]
- (c) Discuss the relationship between atmospheric carbon dioxide concentration and global temperatures. [4]



A large rectangular area containing 25 horizontal dotted lines for writing.



16EP13

Turn over

A large rectangular area containing 25 horizontal dotted lines for writing.



16EP15

Turn over

