

SINGAPORE'S
#1 HOME TUITION AGENCY

.....○

Need A Home Tutor?

🌐 singaporetuitonteachers.com

☎ +65 9695 3522

Contact Us Today For A 100% Free Tutor Request!

○.....

OUR TEST PAPERS ARE:

- ✓ **COMPLETELY FREE!**
- ✓ **SOURCED FROM TOP SCHOOLS**
- ✓ **HIGH-QUALITY**
- ✓ **USED BY 10,000+ SATISFIED STUDENTS**



SINGAPORE'S #1 HOME TUITION AGENCY

Need A Home Tutor?

 singaporetuitionteachers.com

 +65 9695 3522

Contact Us Today For A 100% Free Tutor Request!

OUR TEST PAPERS ARE:

- ✓ **COMPLETELY FREE!**
- ✓ **SOURCED FROM TOP SCHOOLS**
- ✓ **HIGH-QUALITY**
- ✓ **USED BY 10,000+ SATISFIED STUDENTS**



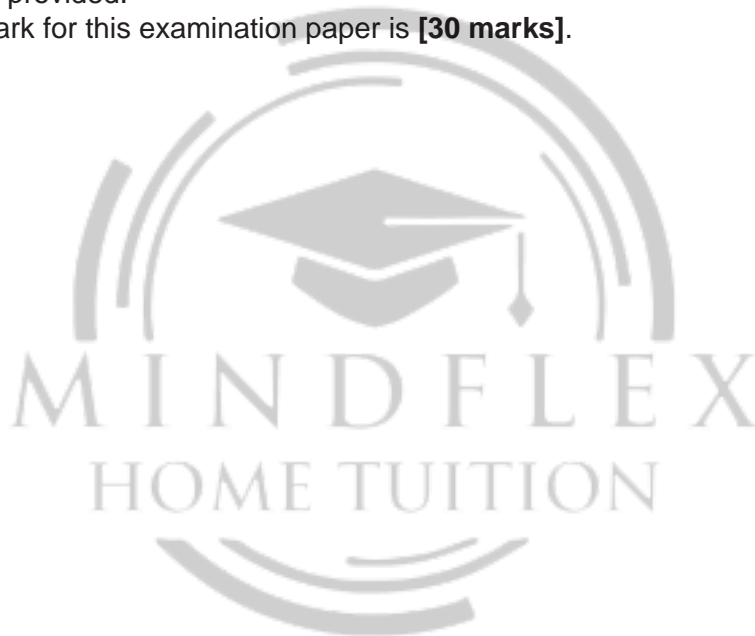
Biology
Standard level
Paper 1

Friday 4 November 2016 (morning)

45 minutes

Instructions to candidates

- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- The maximum mark for this examination paper is **[30 marks]**.



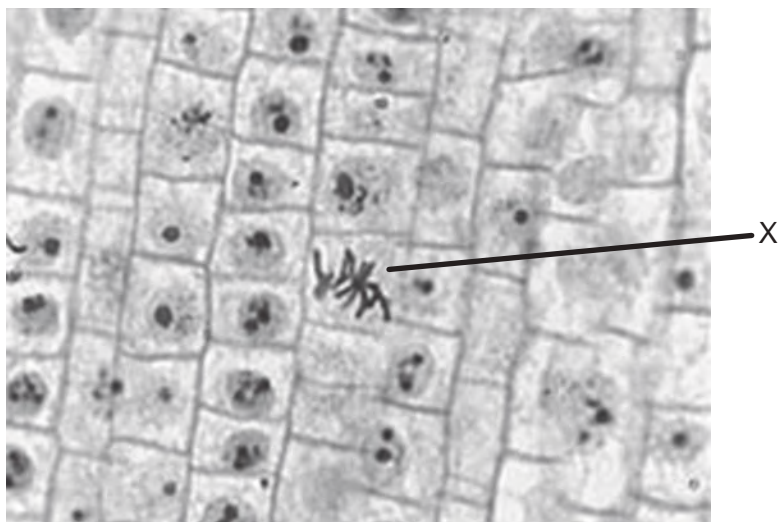
1. Which feature of striated muscle cells allows them to be considered as a possible exception to the cell theory?
 - A. They are found in multicellular organisms.
 - B. They contain more than one nucleus.
 - C. They are specialized for movement.
 - D. They do not carry out mitosis.

2. Which characteristic of stem cells makes them useful for treating Stargardt's disease?
 - A. They can differentiate into retinal cells.
 - B. They are readily available from especially created embryos.
 - C. They transport white blood cells to the eyes.
 - D. They divide by binary fission so provide sufficient cells.

3. The cell membrane model proposed by Davson–Danielli was a phospholipid bilayer sandwiched between two layers of globular protein. Which evidence led to the acceptance of the Singer–Nicolson model?
 - A. The orientation of the hydrophilic phospholipid heads towards the proteins
 - B. The formation of a hydrophobic region on the surface of the membrane
 - C. The placement of integral and peripheral proteins in the membrane
 - D. The interactions due to amphipathic properties of phospholipids

4. What provides evidence for the endosymbiotic theory?
 - A. Mitochondrial DNA in eukaryotic cells
 - B. 70S ribosomes in prokaryotic cells
 - C. Gene transfer from prokaryotic cells to eukaryotic cells using plasmids
 - D. Prokaryotic cells (*Escherichia coli*) in the large intestine digest proteins

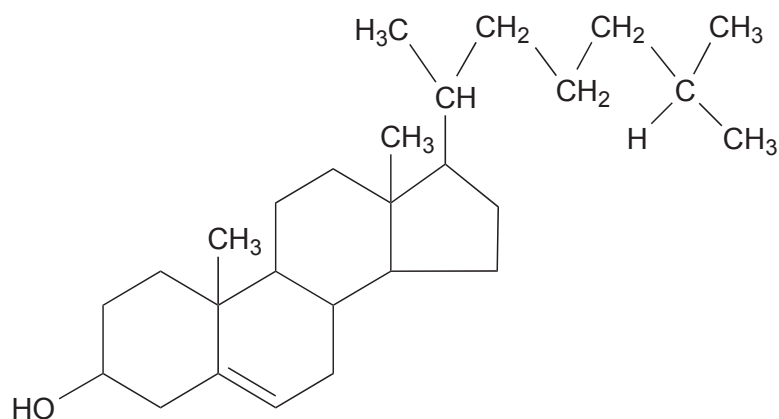
5. Which mitotic phase is labelled X in the micrograph of an onion (*Allium cepa*) root tip?



[Source: adapted from Microscope-microscope.org (www.microscope-microscope.org)]

- A. Prophase
B. Metaphase
C. Anaphase
D. Telophase
6. Which type of reaction is the breakdown of starch into sugars?
- A. Denaturation
B. Reduction
C. Catabolic
D. Condensation

7. The diagram shows a molecular structure.



Which type of molecule is shown?

- A. Amino acid
 - B. Lipid
 - C. Carbohydrate
 - D. Nucleotide
8. Which properties explain the ability of water to dissolve solutes?
- I. Polarity of water molecules
 - II. High specific heat capacity of water
 - III. Hydrogen bonding
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III

9. A fever in a normally healthy adult during an illness is not usually a problem and can be regarded as a defence mechanism. However, a fever higher than 41 °C might be dangerous. What is the cause of the possible damage due to a high fever?
- A. Loss of body mass
 - B. Muscle damage due to shivering
 - C. Overactive metabolic enzymes
 - D. Spread of infection
10. What is a similarity between DNA and RNA?
- A. Both are polymers of nucleotides.
 - B. Both are composed of antiparallel strands.
 - C. Both contain adenine, cytosine and thymine.
 - D. Both contain ribose sugar.
11. What enables bacteria to produce human growth hormone?
- A. DNA replication is semi-conservative.
 - B. The polymerase chain reaction can be used.
 - C. They need the hormone for growth.
 - D. The genetic code is universal.

12. Which pair of molecules are products of aerobic and anaerobic cell respiration in some organisms?

	Aerobic cell respiration	Anaerobic cell respiration
A.	oxygen	pyruvate
B.	lactate	adenosine triphosphate
C.	carbon dioxide	glucose
D.	adenosine triphosphate	carbon dioxide

13. What is produced by somatic-cell nuclear transfer?

- A. Adult sheep
- B. Cloned embryos
- C. Rooted stem-cuttings
- D. Genetically modified food

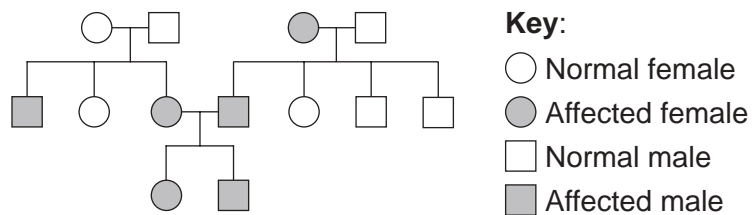
14. The diploid number of chromosomes in humans (*Homo sapiens*) is 46 and the diploid number of chromosomes in rice (*Oryza sativa*) is 24. What does this indicate about diploid chromosome numbers?

- A. Plant species have a lower diploid number of chromosomes than animals.
- B. Members of a species have the same diploid number of chromosomes.
- C. The evolutionary progress of species is determined by the diploid number of chromosomes.
- D. The complexity of the organisms is correlated to the diploid number of chromosomes.

15. Which is a valid comparison between prokaryotic and eukaryotic DNA?

	Prokaryotic DNA	Eukaryotic DNA
A.	one circular chromosome	one linear chromosome
B.	plasmids present	plasmids absent
C.	contains uracil	contains thymine
D.	associated with histones	associated with proteins

16. The diagram shows a pedigree chart.



What does it reveal about the inheritance of the blood disorder beta-thalassaemia?

- A. The allele is autosomal recessive.
B. The allele is autosomal dominant.
C. The allele is sex-linked.
D. The allele is co-dominant.
17. What is the classification of an organism that is able to make organic compounds from inorganic nutrients?
- A. Autotroph
B. Consumer
C. Detritivore
D. Saprotroph
18. What restricts the length of a food chain?
- A. Energy losses between the trophic levels
B. A greater biomass at the higher trophic levels
C. The number of species in the food web
D. The consumption of waste by detritivores

19. Lichens are returning to the forests of the industrial areas of the United Kingdom due to strict pollution control.



[Source: adapted from www.the-scientist.com]

What is the expected outcome in the population of peppered moths (*Biston betularia*)?

- A. Increased numbers of light-coloured peppered moths
 - B. Increased industrial melanism in peppered moths
 - C. Increased predation of peppered moths
 - D. Increased speciation of peppered moths
20. Which evidence for evolution do the common features in the bone structure of vertebrate limbs provide?
- A. Adaptive radiation
 - B. Divergent radiation
 - C. Convergent evolution
 - D. Discontinuous variation
21. What is the major contributor to the increase in antibiotic resistance in bacteria?
- A. Sexual reproduction
 - B. Mutation
 - C. Natural selection
 - D. New antibiotics

22. In which domain are bryophyta found?
- A. Plantae
 - B. Archaea
 - C. Eubacteria
 - D. Eukaryote
23. The scientific name of the Wakatobi flowerpecker is *Dicaeum kuehni*.



[Source: By Seán B. A. Kelly, David J. Kelly, Natalie Cooper, Andi Bahrin, Kangkuso Analuddin, Nicola M. Marples - Edit of File:Dicaeum_celebicum_compared_to_Dicaeum_kuehni_(realigned).jpg, CC BY 4.0, <https://commons.wikimedia.org/w/index.php?curid=33618785>]

Which species is most closely related?

- A. *Amerila kuehni*
 - B. Wakatobi white-eye
 - C. *Kuehneon duchyense*
 - D. *Dicaeum celebicum*
24. What is the main method of transport of monosaccharides such as fructose across the intestinal epithelium?
- A. Osmosis
 - B. Facilitated diffusion
 - C. Endocytosis
 - D. Active transport

25. What is the position of heart valves when blood pressure is highest in the aorta?

	Atrioventricular valves	Semilunar valves
A.	open	closed
B.	closed	open
C.	closed	closed
D.	open	open

26. Why is penicillin **not** used in the treatment of human immunodeficiency virus (HIV)?

- A. HIV patients may be allergic to penicillin.
- B. Penicillin does not affect viruses.
- C. Penicillin affects helper T-cell metabolism.
- D. Penicillin causes antibiotic resistance.

27. What is the purpose of pulmonary surfactant?

- A. Promotes capillary growth
- B. Decreases surface tension
- C. Adheres alveoli and capillaries
- D. Stretches the inside surface of the alveoli

28. Which conditions are correct for inspiration?

	Muscles contracted	Pressure in thorax
A.	external intercostal	decreases
B.	internal intercostal	increases
C.	diaphragm	increases
D.	abdominal	decreases

29. Which hormone controls circadian rhythms?
- A. Thyroxin
 - B. Melatonin
 - C. Leptin
 - D. Glucagon
30. Which is a negative feedback mechanism in the menstrual cycle?
- A. Follicle stimulating hormone inhibits estrogen
 - B. Estrogen inhibits luteinizing hormone
 - C. Estrogen inhibits follicle stimulating hormone
 - D. Progesterone inhibits estrogen



Markscheme

November 2016

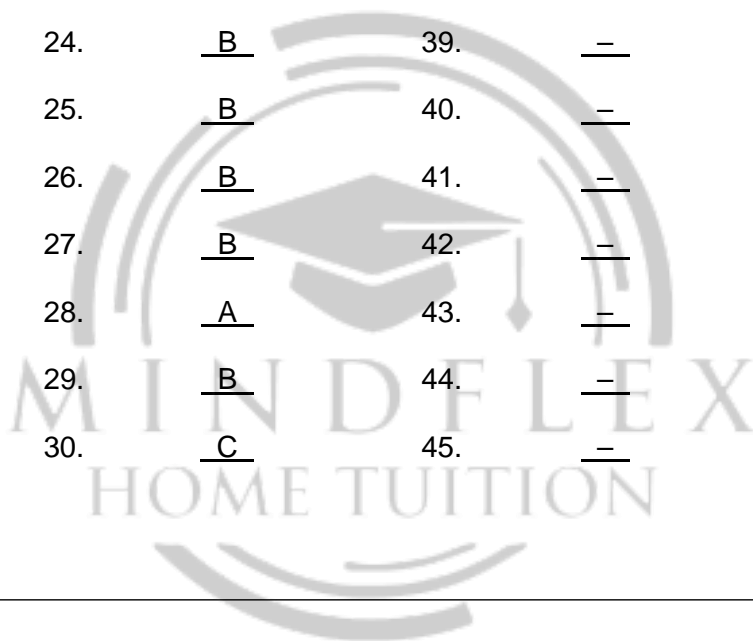

Biology

Standard level

Paper 1

2 pages

1.	<u>B</u>	16.	<u>A</u>	31.	<u>–</u>	46.	<u>–</u>
2.	<u>A</u>	17.	<u>A</u>	32.	<u>–</u>	47.	<u>–</u>
3.	<u>C</u>	18.	<u>A</u>	33.	<u>–</u>	48.	<u>–</u>
4.	<u>A</u>	19.	<u>A</u>	34.	<u>–</u>	49.	<u>–</u>
5.	<u>B</u>	20.	<u>A</u>	35.	<u>–</u>	50.	<u>–</u>
6.	<u>C</u>	21.	<u>C</u>	36.	<u>–</u>	51.	<u>–</u>
7.	<u>B</u>	22.	<u>D</u>	37.	<u>–</u>	52.	<u>–</u>
8.	<u>B</u>	23.	<u>D</u>	38.	<u>–</u>	53.	<u>–</u>
9.	<u>C</u>	24.	<u>B</u>	39.	<u>–</u>	54.	<u>–</u>
10.	<u>A</u>	25.	<u>B</u>	40.	<u>–</u>	55.	<u>–</u>
11.	<u>D</u>	26.	<u>B</u>	41.	<u>–</u>	56.	<u>–</u>
12.	<u>D</u>	27.	<u>B</u>	42.	<u>–</u>	57.	<u>–</u>
13.	<u>B</u>	28.	<u>A</u>	43.	<u>–</u>	58.	<u>–</u>
14.	<u>B</u>	29.	<u>B</u>	44.	<u>–</u>	59.	<u>–</u>
15.	<u>B</u>	30.	<u>C</u>	45.	<u>–</u>	60.	<u>–</u>



Biology
Standard level
Paper 2

Friday 4 November 2016 (morning)

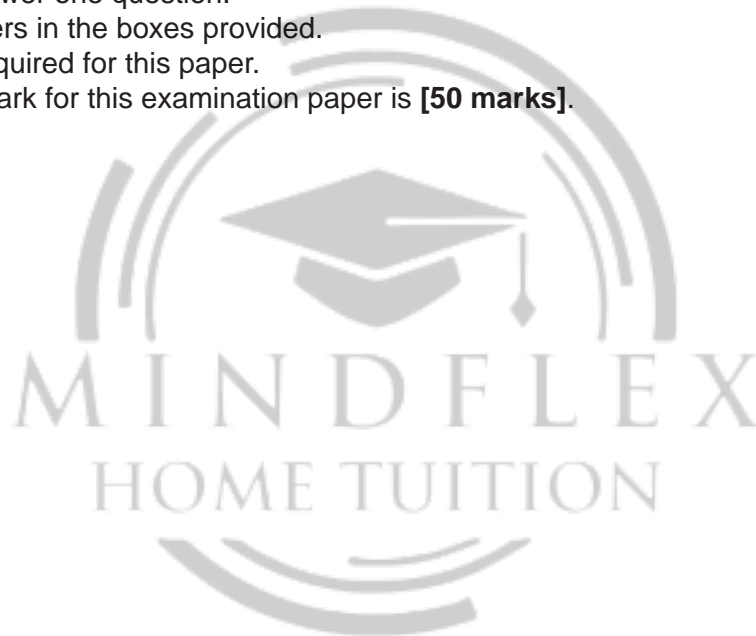
Candidate session number

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.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[50 marks]**.



Section A

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

1. Beavers are large rodents that live in waterways throughout the northern hemisphere. Dams made by beavers change the temperature of the streams and affect the mayfly, *Baetis bicaudatus*. In the summer of 2008, beaver ponds in West Brush Creek and Cement Creek, Colorado, were studied to evaluate their impacts on mayflies. The study sites included streams flowing into (upstream) and out of (downstream) each beaver pond.



[Source: adapted from https://upload.wikimedia.org/wikipedia/commons/thumb/d/d4/Beaver_lodge.jpg/330px-Beaver_lodge.jpg]

Mayflies, including the species *B. bicaudatus*, are aquatic insects that hatch and spend their larval stages in water emerging from the water as adults. Larger females produce an increased number of better quality eggs.

Removed for copyright reasons

(This question continues on the following page)

(Question 1 continued)

The table shows the mean temperature differences (downstream – upstream) and mean dry mass for female and male mayflies.

	Beaver pond	Relative height of dam	Mean temperature differences / °C	Mean dry mass / mg					
				Female			Male		
				Up-stream	Down-stream	Difference	Up-stream	Down-stream	Difference
West Brush Creek	1	low	+0.1	1.97	1.83	-0.14	1.39	1.37	-0.02
	2	high	-0.3	1.43	1.51	+0.08	1.15	1.18	+0.03
	3	high	-0.2	1.55	1.67	+0.12	1.19	1.23	+0.04
	4	low	+0.4	2.27	2.15	-0.12	1.53	1.51	-0.02
Cement Creek	5	low	0.0	2.12	2.07	-0.05	1.39	1.33	-0.06
	6	high	-0.1	1.79	1.76	-0.03	1.34	1.31	-0.03
	7	high	-0.2	2.10	2.14	+0.04	1.53	1.49	-0.04
	8	low	+0.2	2.14	2.10	-0.04	1.49	1.53	+0.04
	9	high	-0.3	2.05	2.09	... I ...	1.57	1.45	... II ...

[Source: Fuller, M. R. and Peckarsky, B. L. (2011), Ecosystem engineering by beavers affects mayfly life histories. *Freshwater Biology*, 56: 969–979. doi:10.1111/j.1365-2427.2010.02548.x © 2011 Blackwell Publishing Ltd]

- (a) Calculate the difference in the mean dry mass of mayflies upstream and downstream of Cement Creek pond 9 for female and male mayflies. [1]

I.	Female: mg
II.	Male: mg

- (b) Describe the effect dams have on water temperature. [2]

.....

.....

.....

.....

.....

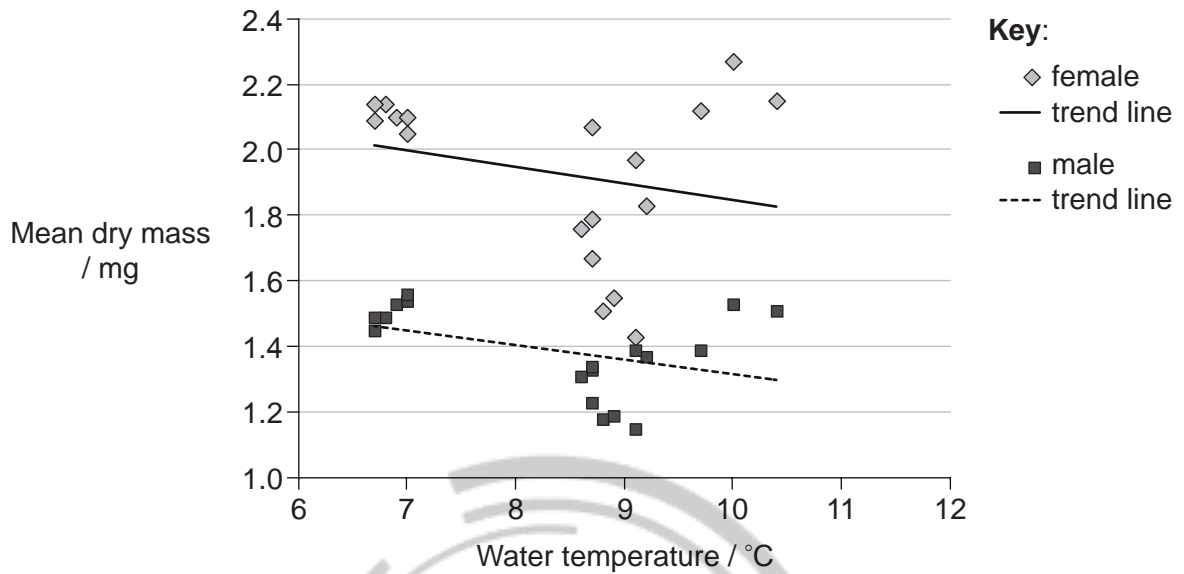
.....

.....

(This question continues on the following page)

(Question 1 continued)

The graph shows the mean dry mass of mayflies relative to the water temperature in their habitats.



[Source: Fuller, M. R. and Peckarsky, B. L. (2011), Ecosystem engineering by beavers affects mayfly life histories. *Freshwater Biology*, 56: 969–979. doi:10.1111/j.1365-2427.2010.02548.x
© 2011 Blackwell Publishing Ltd]

(c) Using the graph, discuss evidence for the hypothesis that mayflies grow to greater dry mass in cooler water. [2]

MIND FLEX HOME TUITION

.....

.....

.....

.....

.....

.....

.....

.....

.....

(This question continues on the following page)

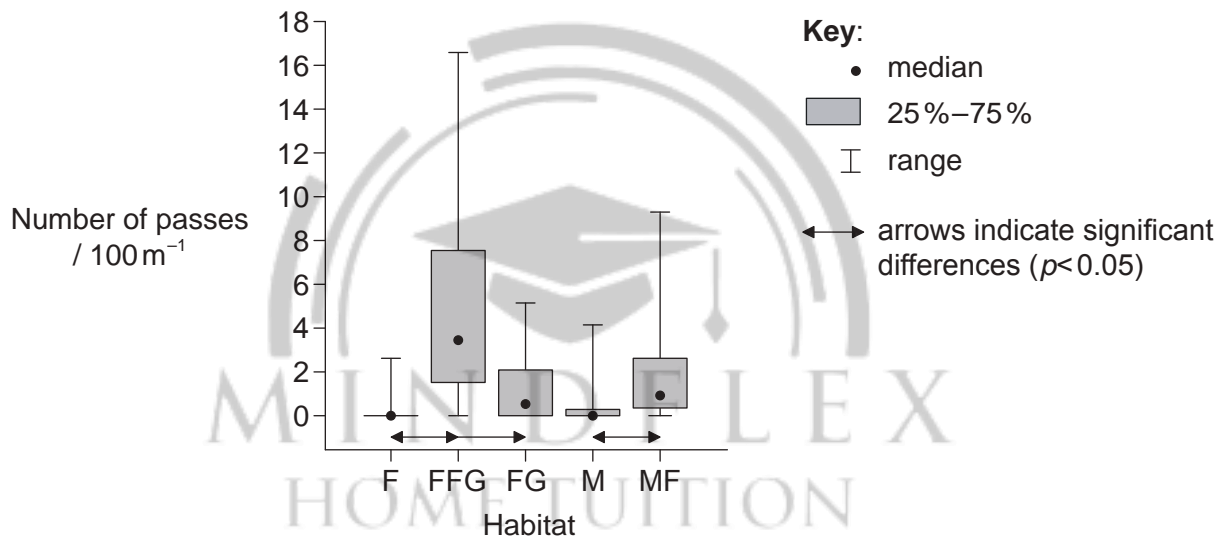


(Question 1 continued)

The bat, *Pipistrellus nathusii*, feeds on insects including mayflies. A study was undertaken in Poland to see the effect of European beavers (*Castor fiber*) on the activity of bats. Beaver activity can affect forests that are covered by trees and meadows that are covered by grasses and have no trees. The following habitats were studied:

- forest (F)
- flooded forest with canopy gaps created by beavers and flooding due to the presence of beaver dams (FFG)
- forest with canopy gaps created by beavers but no flooding (FG)
- meadow (M)
- meadow with flooding due to the presence of beaver dams (MF).

As bats feed they fly through the air catching insects. The number of feeding passes made by bats was counted. The graph shows differences in the bat activity between particular habitats.



[Source: adapted from Ciechanowski, M., Kubic, W., Rynkiewicz, A. et al. (2011), "Reintroduction of beavers *Castor fiber* may improve habitat quality for vespertilionid bats foraging in small river valleys". *European Journal of Wildlife Research*, Volume 57, Number 4, Page 737.]

(d) Analyse the data to find the effect of flooding and tree felling by beavers on the activity of bats. [2]

.....

.....

.....

.....

.....

.....

(This question continues on page 7)


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

Answers written on this page
will not be marked.



(Question 1 continued from page 5)

- (e) The trout, *Oncorhynchus mykiss*, that live in West Brush Creek and Cement Creek also feed on the mayflies. Fishermen come to Colorado to catch and eat trout. Draw a diagram of part of a food web for the creeks in Colorado, including mayflies, humans, trout and bats. [2]



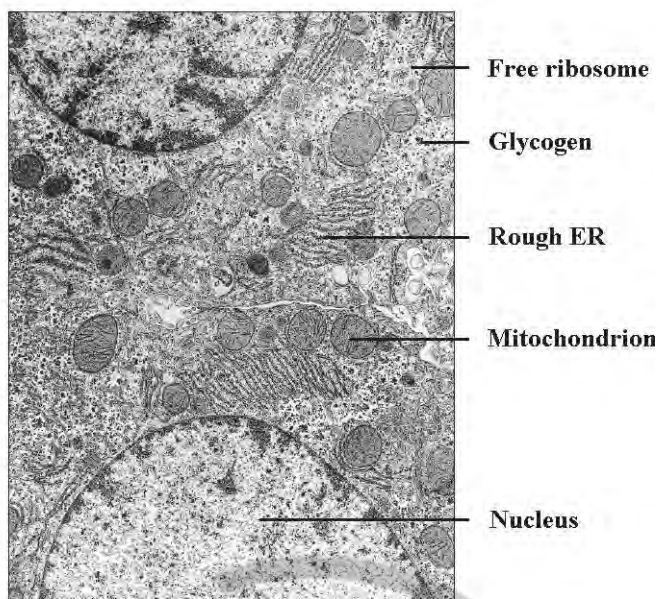
- (f) Identify an example of competition between organisms in this food web. [1]

.....

- (g) The North American beaver (*Castor canadensis*) was introduced to islands adjacent to Argentina and Chile where they have become an invasive species. Discuss **one** ecological criterion (a basis for deciding) whether beavers are harmful **or** helpful to the ecosystems there. [2]

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

2. The image is an electron micrograph.



[Source: <http://image.wikifoundry.com/image/2/H1jghtjAjTutprovXh4VCA200205/GW720H652>]

(a) Determine, with a reason, whether the image is of a prokaryotic cell or eukaryotic cell. [1]

.....
.....

MIND FLEX
HOME TUITION

(b) (i) State the process that divides one nucleus into two genetically identical nuclei. [1]

.....

(This question continues on the following page)



(Question 2 continued)

(ii) Explain how the cell cycle is controlled.

[4]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

3. (a) Define metabolism.

[1]

.....

.....

(b) Identify the following processes as **either** anabolism **or** catabolism by placing a tick (✓) in the correct box.

[2]

Process	Anabolism	Catabolism
Photosynthesis	<input type="checkbox"/>	<input type="checkbox"/>
Glycolysis	<input type="checkbox"/>	<input type="checkbox"/>

(c) Describe cell respiration in terms of metabolism.

[2]

.....

.....

.....

.....

.....

.....

4. The diploid number of chromosomes in horses (*Equus ferus*) is 64 and the diploid number in donkeys (*Equus africanus*) is 62. When a male donkey and a female horse are mated, the result is a mule which has 63 chromosomes.

(a) State the haploid number for horses.

[1]

.....

(b) Explain reasons that mules cannot reproduce.

[2]

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

(c) Discuss whether or not horses and donkeys should be placed in the same species.

[2]

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

(d) A mule was born at the University of Idaho in the USA with 64 chromosomes. Suggest a mechanism by which this could happen.

[1]

.....



5. (a) Living organisms have been placed in three domains: archaea, eubacteria and eukaryote. Distinguish archaea from eubacteria.

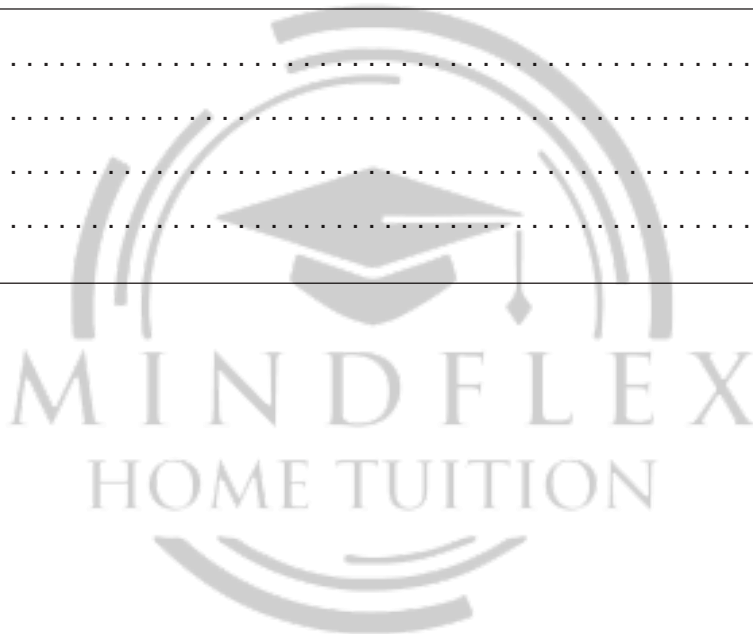
[3]

Archaea	Eubacteria

- (b) List **two** types of evidence used to determine which species belong in the same clade.

[2]

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



Section B

Answer **one** question. Up to one additional mark is available for the construction of your answer. Write your answers in the boxes provided.

6. The human circulatory system is structured to serve the organs and tissues of the body efficiently.
- (a) Outline the exchange of materials between capillaries and tissues. [3]
 - (b) Explain the structures and functions of arteries and veins. [8]
 - (c) Describe what happens in alveoli. [4]
7. In ecosystems, energy is used to convert inorganic compounds into organic matter. Energy enters ecosystems through producers.
- (a) Explain the processes by which energy enters and flows through ecosystems. [8]
 - (b) Producers extract phosphates and nitrates from soil. Outline how these ions are used in the synthesis of organic molecules. [3]
 - (c) Draw a labelled diagram of a pyramid of energy. [4]



Biology
Standard level
Paper 3

Monday 7 November 2016 (morning)

Candidate session number

1 hour

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

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]**.

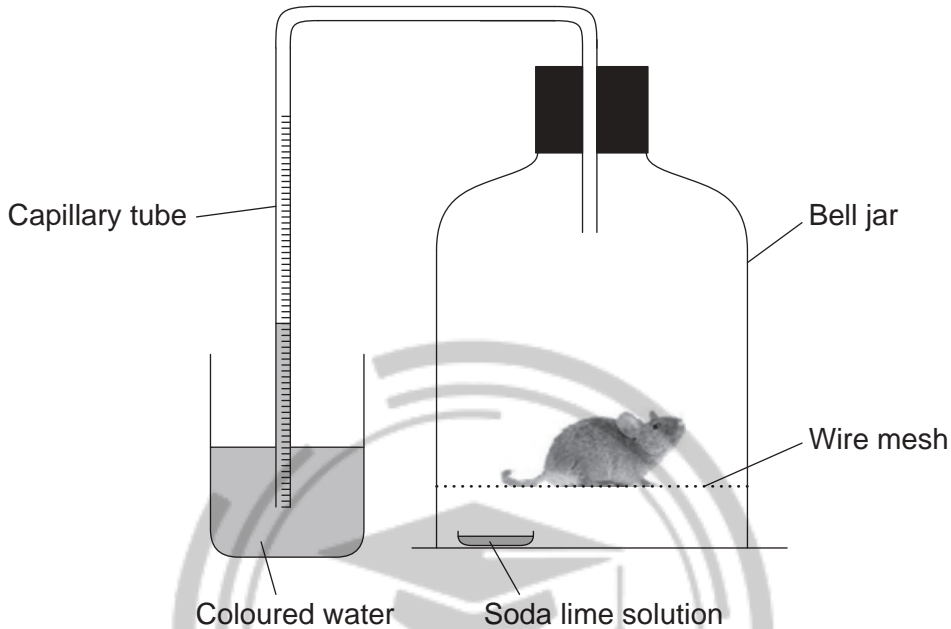
Section A	Questions
Answer all questions.	1 – 3

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]

.....

.....

- (b) Describe how the apparatus measures the oxygen consumption of the mouse. [3]

.....

.....

.....

.....

.....

.....

(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]

.....

.....

.....

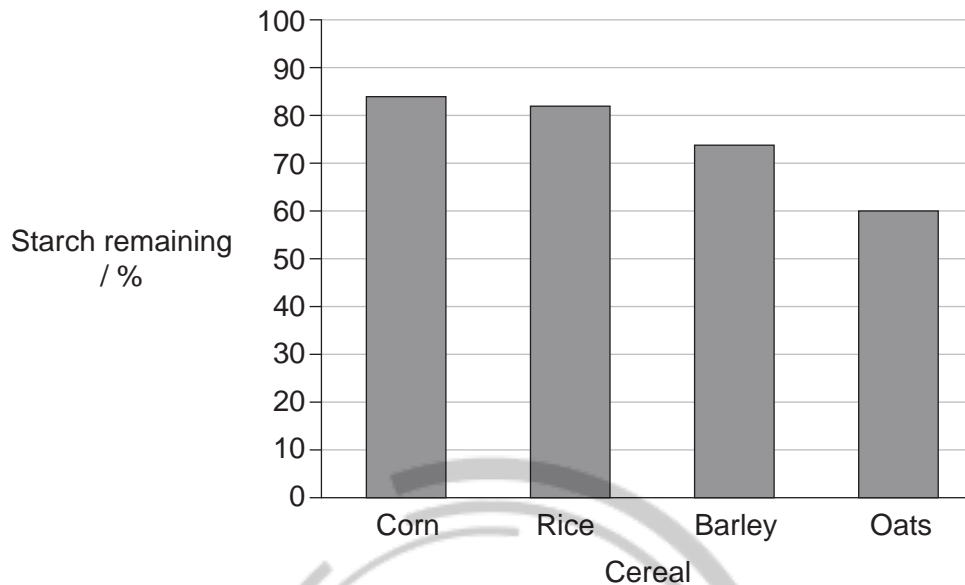
.....

.....

.....



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.uned.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]

.....

.....

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

.....

.....

(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]

.....

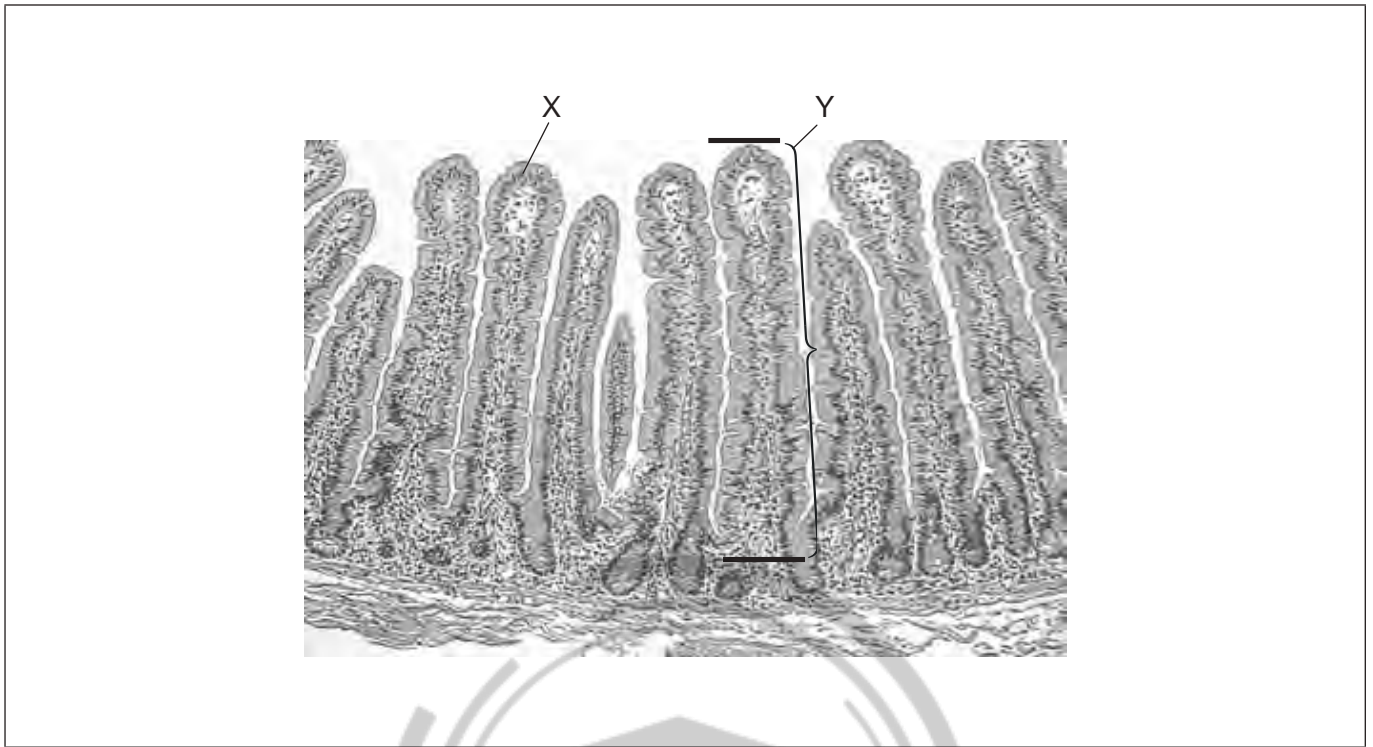
.....

.....

.....



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]

.....

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

.....

(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]

.....

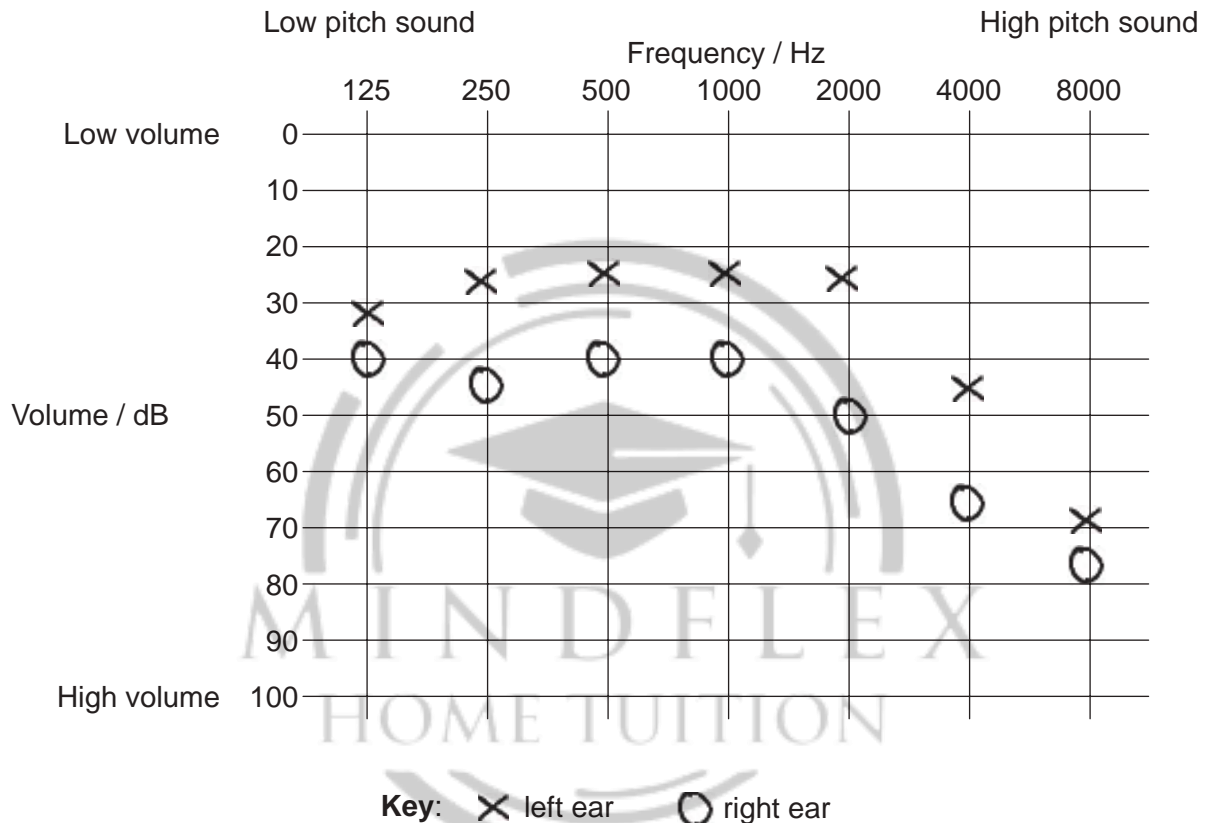


Section B

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]

.....

.....

(Option A continues on the following page)

(Option A, question 4 continued)

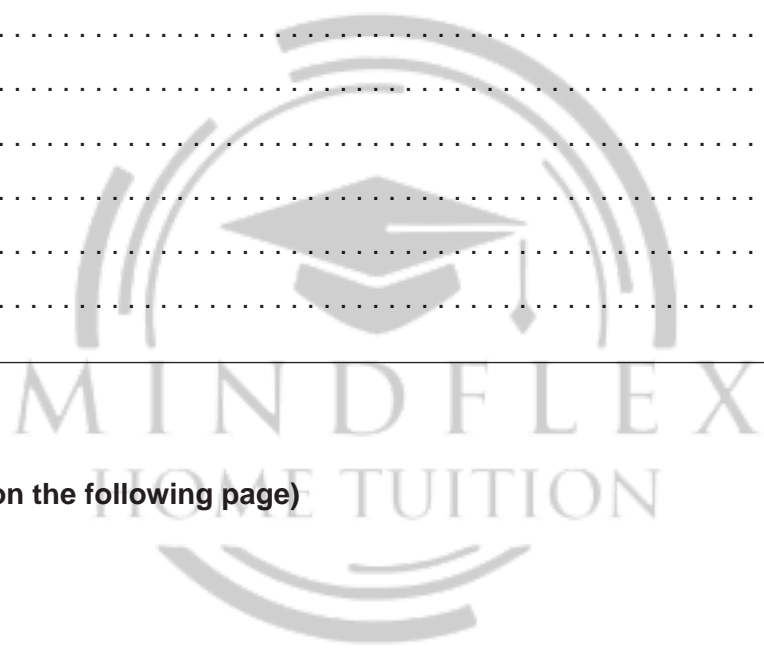
- (b) The woman suffers from otosclerosis in the right ear, a condition where the bones of the middle ear do not function properly. Describe how this is consistent with the hearing test result shown in the audiogram. [2]

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

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

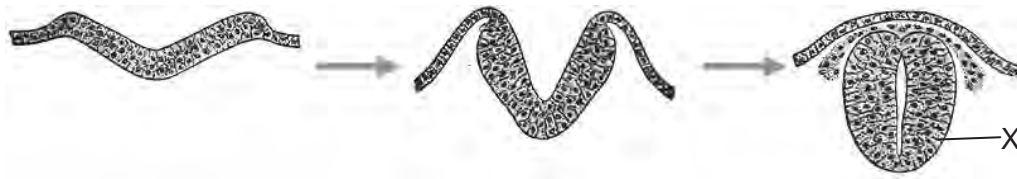
.....
.....
.....
.....
.....
.....

(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]

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

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

[1]

.....

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

[1]

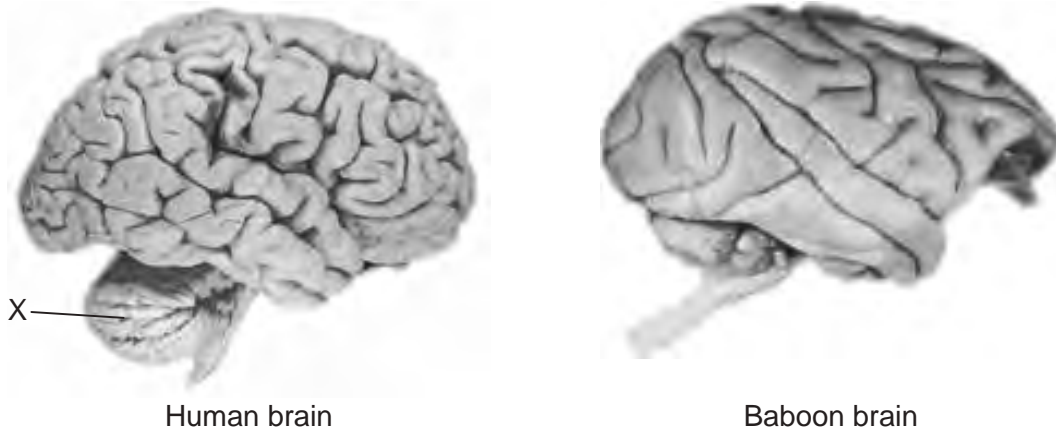
.....
.....
.....

(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.



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

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

.....

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

.....

.....

.....

.....

- (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]

.....

.....

.....

.....

(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



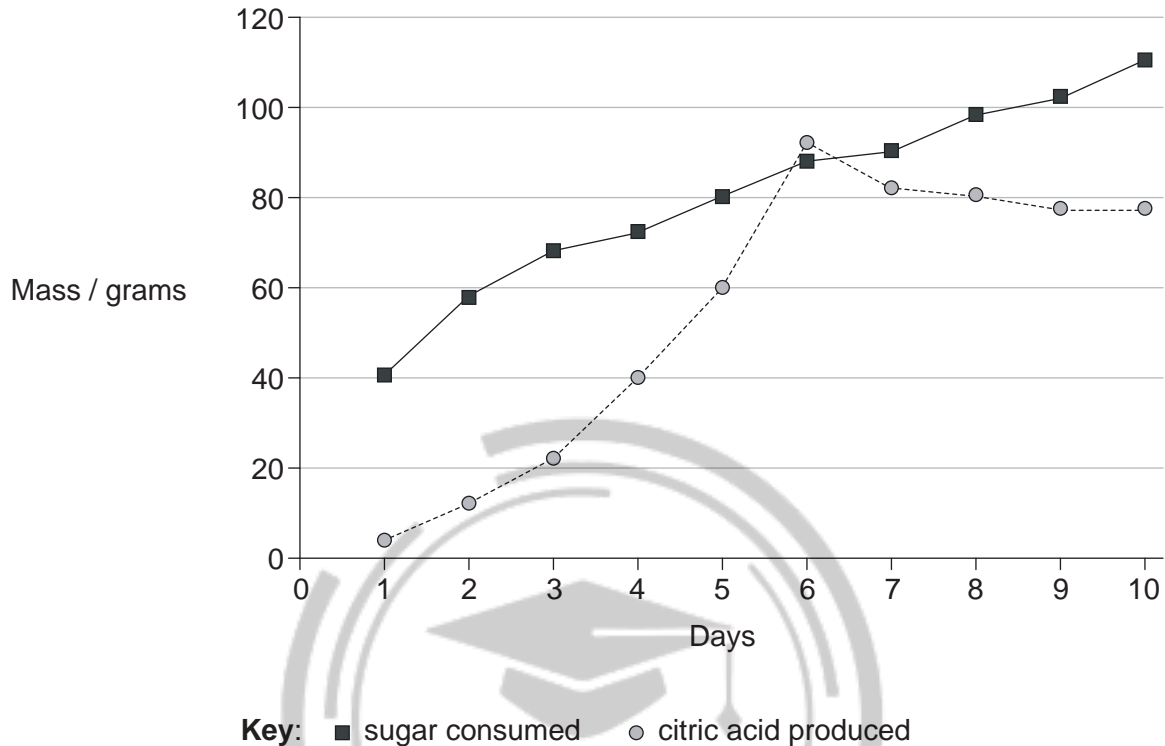
Please **do not** write on this page.

Answers written on this page
will not be marked.



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.



[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]

.....

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

.....
.....

(Option B continues on the following page)



(Option B, question 8 continued)

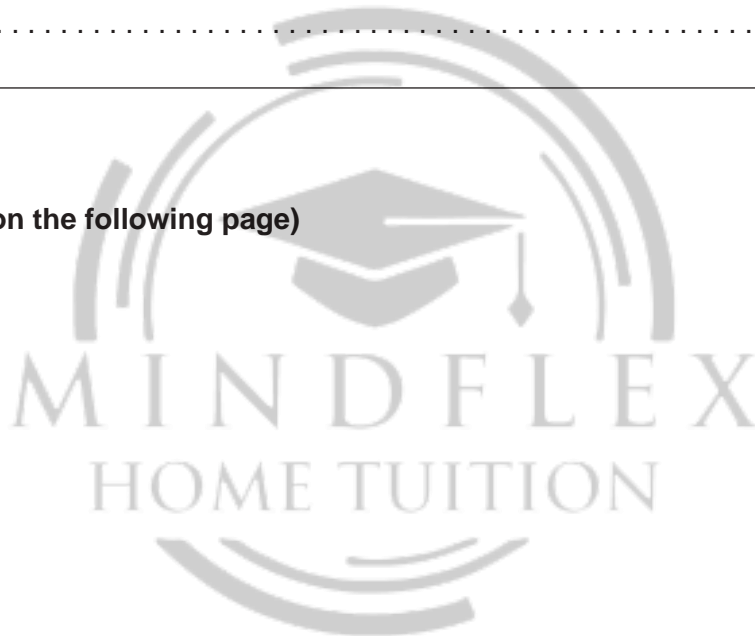
- (c) Suggest reasons for the changes in mass of sugar and citric acid after day 6. [2]

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

- (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]

.....

.....

.....

.....

- (b) Marker genes are often inserted together with the new gene. State the function of the marker genes. [1]

.....

.....

- (c) Outline the characteristics of an open reading frame. [2]

.....

.....

.....

.....

(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]

.....

.....

.....

.....

.....

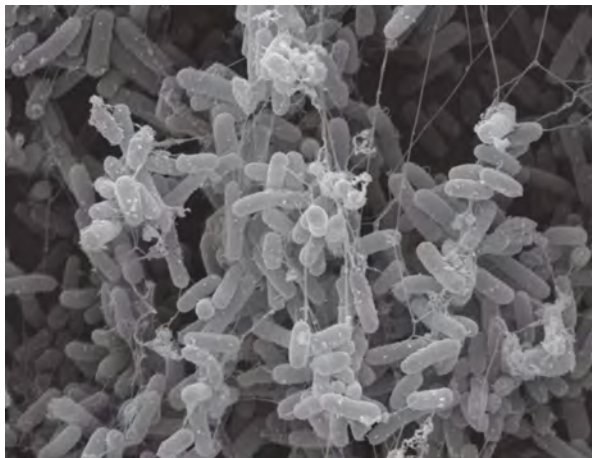
.....

(Option B continues on the following page)



(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]

.....

.....

.....

.....

MINDFLEX
HOME TUITION

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

[4]

.....

.....

.....

.....

.....

.....

.....

.....

End of Option B



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

Answers written on this page
will not be marked.

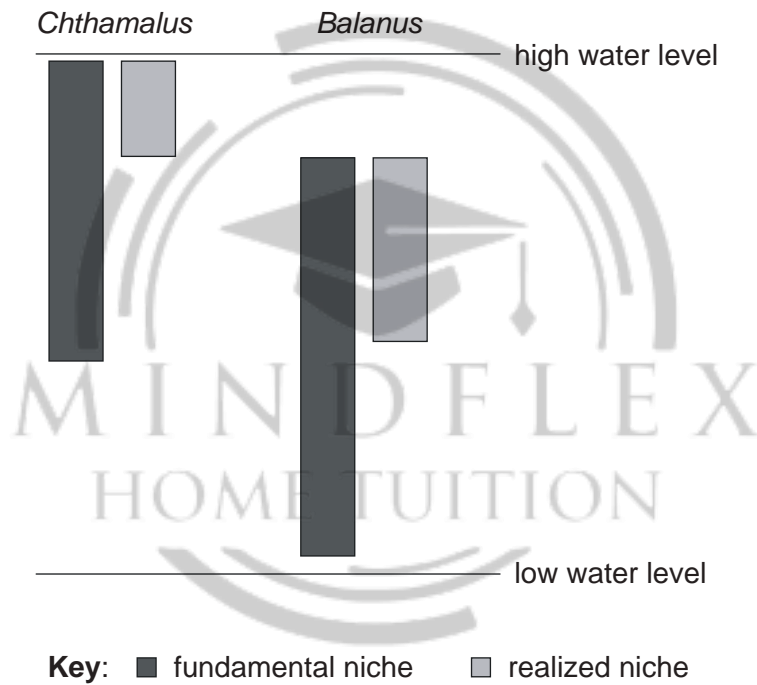


Option C — Ecology and conservation

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]

.....

.....

(Option C continues on the following page)



(Option C, question 11 continued)

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

.....

.....

.....

.....

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

.....

.....

.....

.....

.....

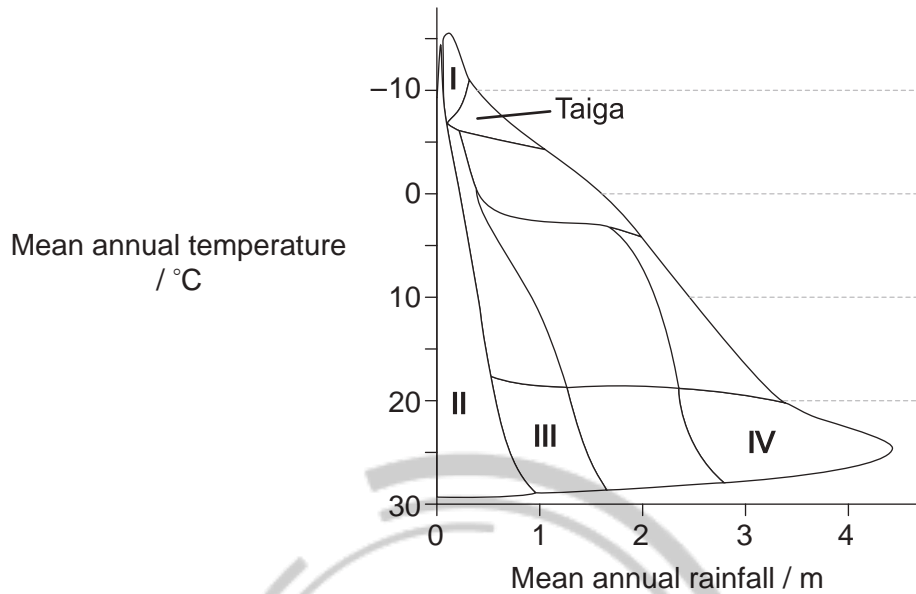
.....

(Option C continues on the following page)



(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]

.....

.....

.....

.....

.....

.....

(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]

.....

.....

.....

.....

.....

.....

(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]

.....

.....

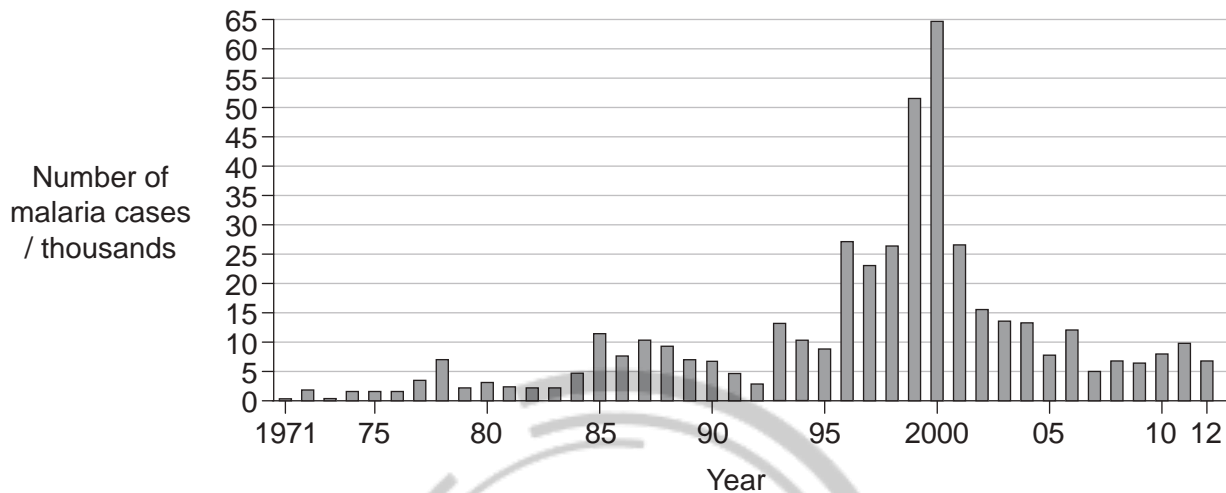
.....

.....

(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]

.....
.....

- (b) One pesticide used in killing mosquitoes was DDT. Considering its harmful effects, discuss whether the decision to reintroduce it was justified. [4]

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

End of Option C



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

Answers written on this page
will not be marked.



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, Fleita 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]

.....

.....

.....

.....

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

.....

.....

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

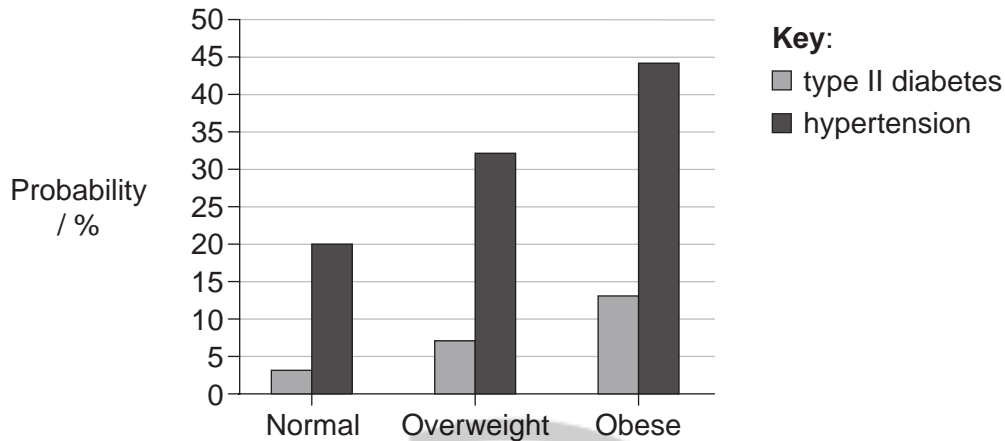
1.

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]

.....

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

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

(Option D continues on the following page)

(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			Skimmed Milk		
	Mass	RDA / %		Mass	RDA / %
Total fat	8 g	13	Total fat	480 mg	1
Saturated fat	5 g	24	Saturated fat	322 mg	2
Cholesterol	26 mg	9	Cholesterol	5 mg	2
Total carbohydrates	12 g	4	Total carbohydrates	12 g	4
Protein	8 g	16	Protein	5 g	10
Sodium	102 mg	4	Sodium	132 mg	6

RDA / %		RDA / %		RDA / %		RDA / %	
Vitamin A	5	Vitamin D	26	Vitamin A	11	Vitamin D	26
Vitamin B12	29	Calcium	29	Vitamin B12	18	Calcium	37
Vitamin B6	5	Magnesium	6	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]

.....

(Option D continues on the following page)



(Option D, question 17 continued)

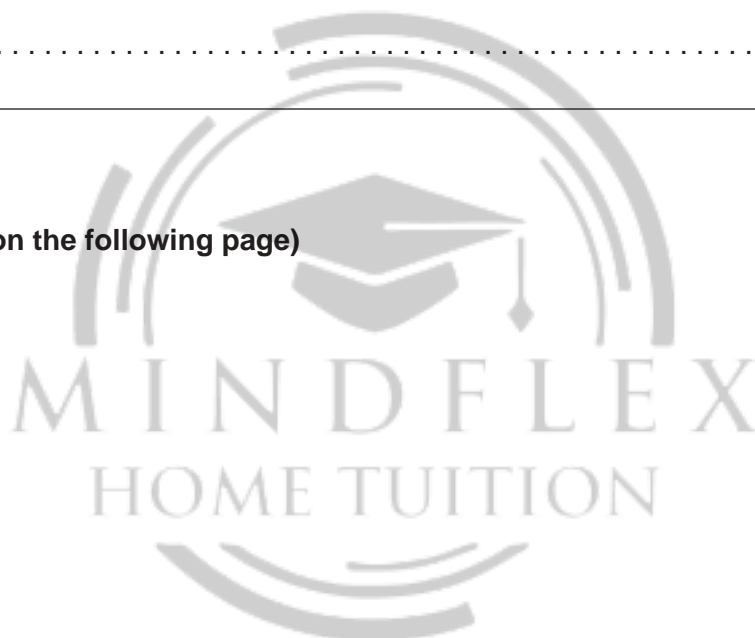
- (c) Identify, with a reason, which milk provides more energy in a 250g serving. [1]

.....
.....

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

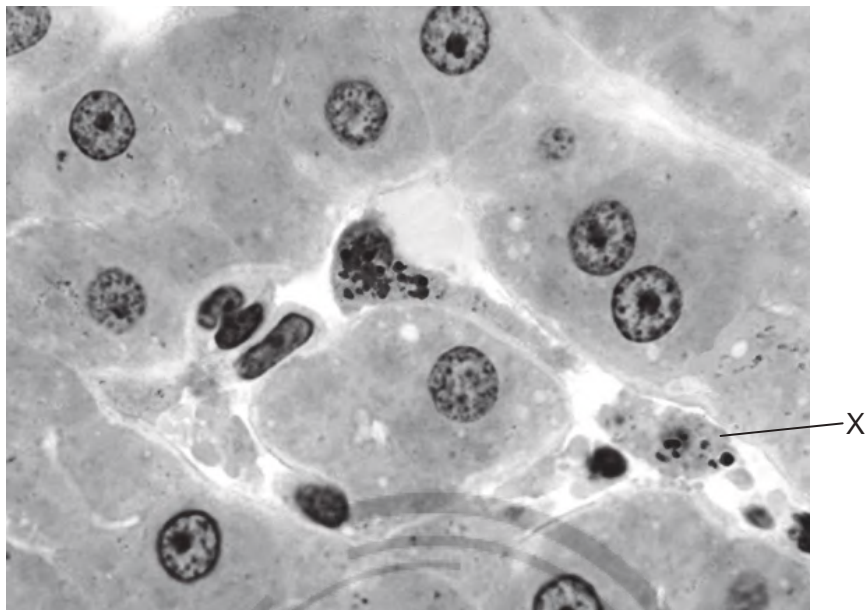
.....
.....
.....
.....

(Option D continues on the following page)



(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]

.....

(ii) Outline the function of cell X.

[2]

.....
.....

(Option D continues on the following page)



(Option D, question 18 continued)

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

[4]

.....

.....

.....

.....

.....

.....

.....

.....

End of Option D

MINDFLEX
HOME TUITION





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

Answers written on this page
will not be marked.

