PENRITH SELECTIVE HIGH SCHOOL

PRELIMINARY BIOLOGY 2023

WRITTEN EXAMINATION

General Instructions:

Reading time: 5 minutes

Working time: 90 minutes

Write using black pen. Answers written in pencil could be disqualified from review.

Diagrams and graphs to be drawn using pencil.

Planning space is provided at the back of the task, this is to be used to plan any extended responses.

Weighting: 30%

Marks: 50

Total Mark:

Student Number ……..

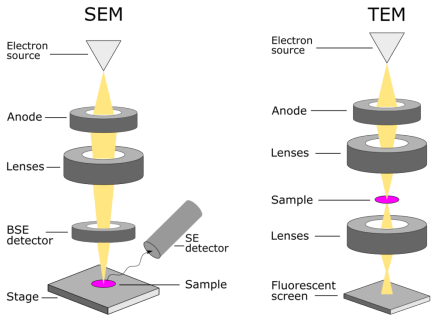
PART A – MULTIPLE CHOICE QUESTIONS

Attempt Questions 1-15

Allow about 20 minutes for this section

Use the multiple-choice answer sheet for questions 1-15

Question 1 The diagram below shows the mechanisms behind how scanning electron (SEM) and transmission electron (TEM) microscopes work. Based on the information and your own understanding of microscopes, which of the following statements is true:



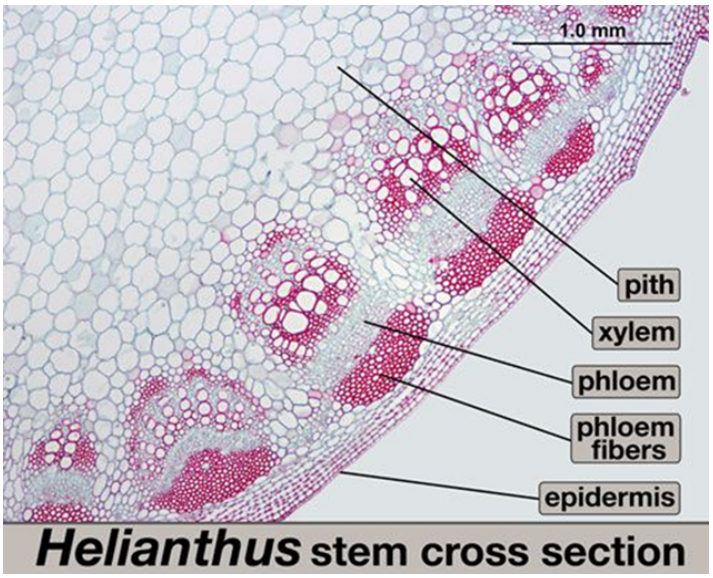
(A) The sample must be cut into thin sections in the TEM to allow the electrons to pass through

(B) Electron beams are used in the same way in each microscope

(C) Both microscopes have the same maximum magnification

(D) Both microscopes require the sample to be placed at the same location

Question 2 Consider the diagram below.



What name is given to the structures made up of phloem fibres, phloem and xylem?

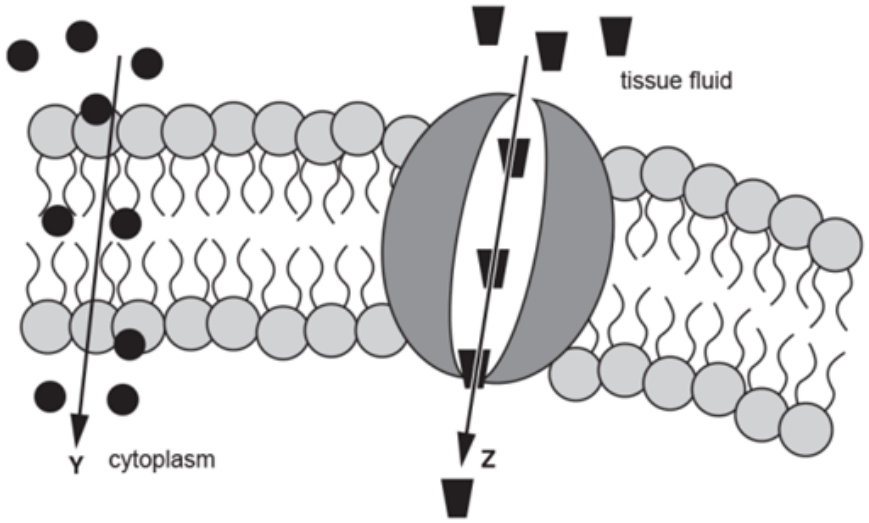
(A) Vascular strand

(B) Vascular bundle

(C) Stele

(D) Cambium

Question 3 This diagram shows the transport of two molecules across a plasma membrane. Which row, A to D, correctly identifies the molecule being transported and the mechanism of transport across the plasma membrane?



	Y	Z
(A)	Glucose by active transport	Oxygen by diffusion
(B)	Glucose by diffusion	Oxygen by active transport
(C)	Oxygen by active transport	Glucose by active transport
(D)	Oxygen by diffusion	Glucose by facilitated diffusion

Question 4 A microorganism is able to make organic compounds from water, sunlight and inorganic sources.

Which type of organism is described above?

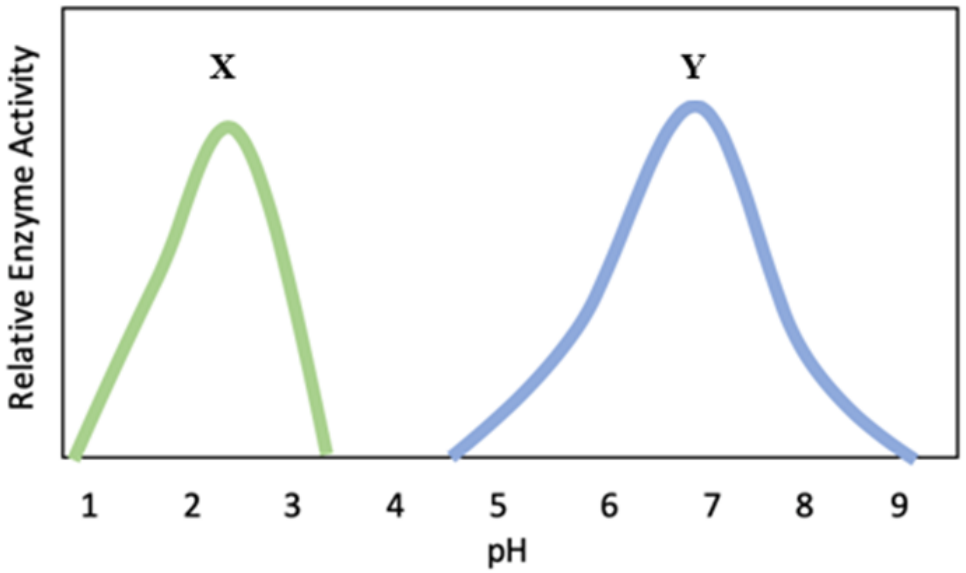
(A) A heterotrophic organism

(B) A eukaryotic organism

(C) A prokaryotic organism

(D) An autotrophic organism

Question 5 The following graph shows the effect of pH on the activity of two enzymes



What is the most likely identity for enzyme X?

(A) Pepsin

(B) Catalase

(C) Trypsin

(D) Amylase

Question 6 Slaters are small invertebrates living in the leaf litter that accumulates on the forest floor.

Slaters obtain their energy by feeding on decomposing leaves.

Which alternative below best describes the *chemical process* by which slaters obtain their energy?

(A) glucose + oxygen → energy

(B) $CO_2 + H_20 \rightarrow$ glucose + $O_2 + H_20$

(C) light + $CO_2 + H_20 \rightarrow$ glucose + $O_2 + H_20$

(D) glucose + $O_2 \rightarrow$ energy + $CO_2 + H_20$

Question 7 Which of the following statements about the structure and function of xylem vessels are correct?

I The cells have lignin walls

II The cells are non-living

III The thick walls withstand low pressures

IV They can form new xylem tissue by mitosis

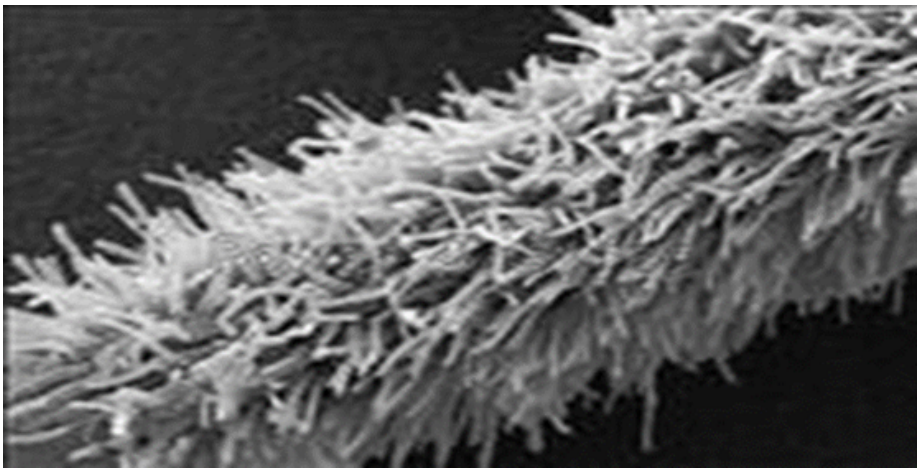
(A) I only

(B) I, II and III only

(C) I and II only

(D) All of them

Question 8 The image below shows hairs on the root of an herbaceous plant.



What is the main *function* of these root hairs?

(A) To increase surface area for the absorption of water

(B) To prevent attack from worms and wood borers

(C) To help anchor the plant in the ground

(D) To increase surface area for photosynthesis

Question 9 Which of the following is a compartment that often takes up much of the volume of a plant cell?

(A) Chloroplast

(B) Vacuole

(C) Mitochondrion

(D) Golgi apparatus

Question 10 The table summarises information on three structures of the circulatory system.

Characteristic	**X**	**Y**	**Z**
Valves	No valves	Presence of valves to prevent backflow	No valves
Blood Pressure	High pressure due to the pumping action of the heart	Lower pressure	Low pressure due to narrow diameter
Diameter	Varies in diameter	Generally larger in diameter	Very narrow, about the size of a single blood cell
Structure	Thicker walls and distinct layers	Thinner walls and less distinct layers	Single layer of endothelial cells

The correct identification for structures X, Y and Z is;

	X	Y	Z
(a)	phloem	xylem	cambium
(b)	artery	vein	capillary
(c)	capillary	artery	vein
(d)	vein	artery	capillary

Question 11 An experiment was carried out by students to test the effect of temperature on the growth of bacteria. Bacterial cells were spread onto plates of nutrient agar that were then kept at three different temperatures: –10 °C, 15 °C and 25 °C. All other variables were kept constant. The experiment was carried out over four days. The nutrient agar was observed every day at the same time and the percentage of nutrient agar covered by bacteria was recorded. At the conclusion of the experiment, the results were recorded in a table, which is shown below.

Time (days)	Percentage of nutrient agar covered by bacteria at three different temperatures		
	–10 °C	15 °C	25 °C
0	0	0	0
1	0	5	10
2	0	10	20
3	0	15	40
4	0	20	60

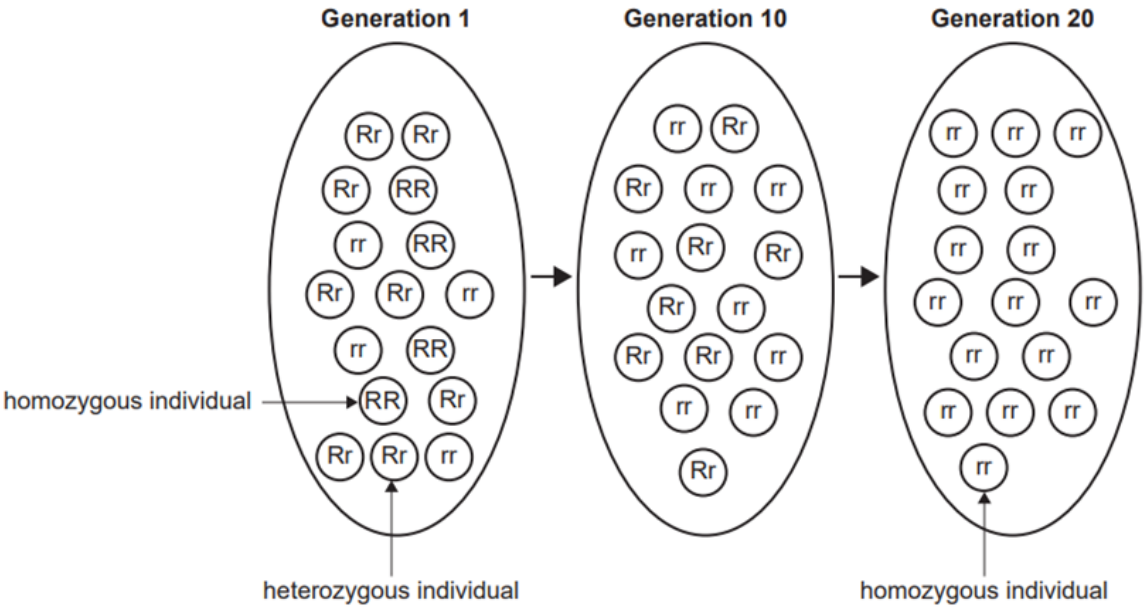
In this experiment, the dependent variable is

(A) Time
(B) Temperature
(C) The number of bacterial cells
(D) The percentage of nutrient agar covered by bacteria

Question 12 Macroplastics are marine litter that is larger than approximately 0.5 centimetres. Macroplastics consist of a large variety of plastic, from small plastic fragments to large objects such as shipwrecks and trawl bags. Macroplastics can have a significant effect on marine life by

(A) decreasing the toxicological risks of microplastics on oceanic organisms
(B) causing abrasions on large corals introducing the potential for bacterial contamination
(C) coral polyps can consume the macroplastics and die
(D) all of the above.

Question 13 Consider the diagram below showing the gene pool of a population over 20 generations.



It would be correct to conclude that, over the 20 generations

(A) genetic diversity is increasing in this population

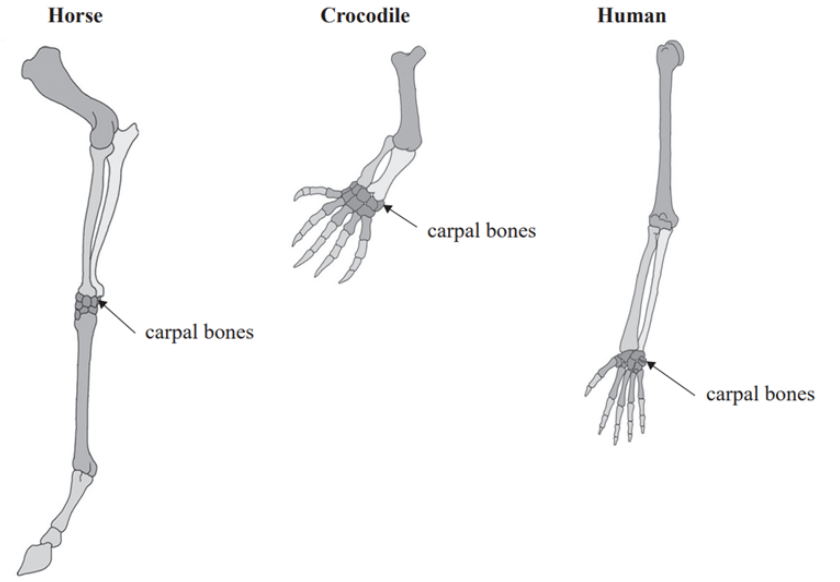
(B) individuals with the genotype RR had a selective advantage in this population

(C) the frequency of each allele is equal in Generation 1 but not in other generations

(D) new advantageous alleles for this gene were introduced as individuals joined this population

Question 14

The images below show the bones in the forelimbs of three vertebrates. The carpal bones of a human are located in the wrist. Note that the three images are not shown at the same scale.



Source: adapted from Amadeu Blasco/Shutterstock.com

The arrangement of bones in the forelimbs of these vertebrates can be described as

(A) Putative
(B) Vestigial
(C) Analogous
(D) Homologous

Question 15

Based on your knowledge of evolution and the images above, which one of the following is the most reasonable conclusion?

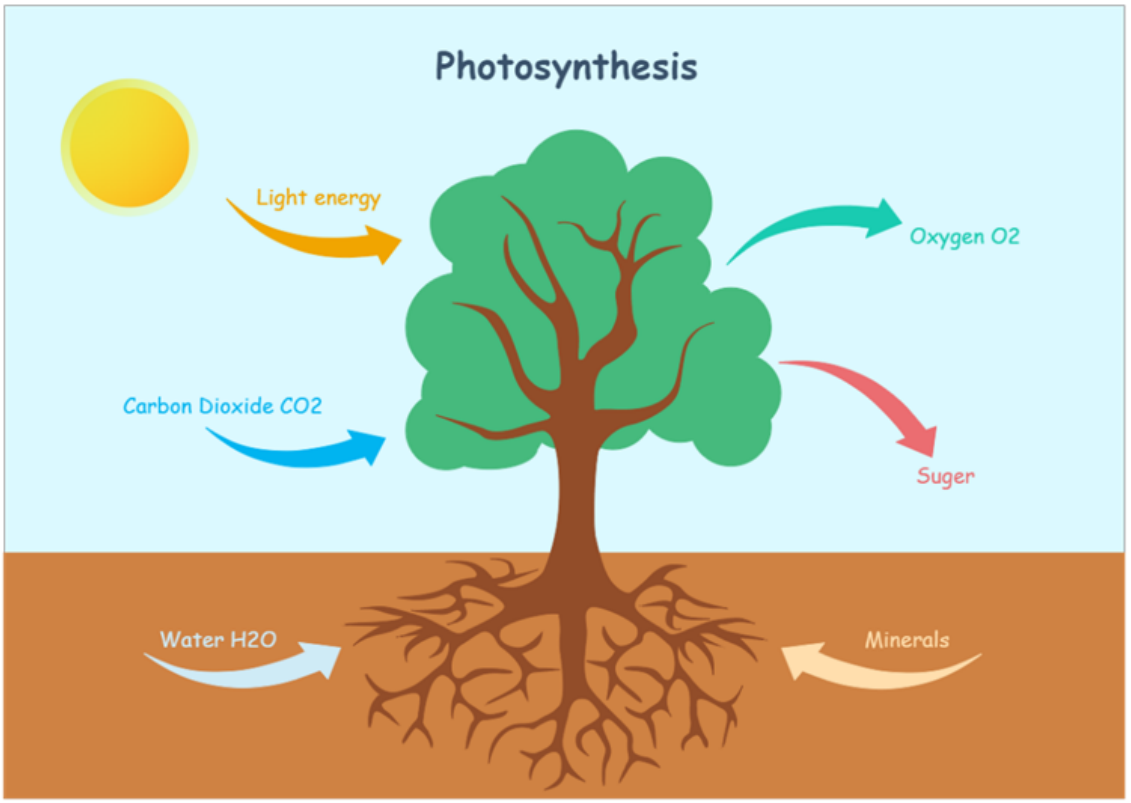
(A) The earliest ancestors of horses had only one digit on their forelimbs
(B) The crocodile is a transitional form between horses and humans
(C) Humans are more closely related to crocodiles than to horses
(D) Humans, crocodiles and horses share a common ancestor

PART B – FREE RESPONSE QUESTIONS

Attempt Questions 16 –23

Allow 1 hour and 10 minutes for Part B

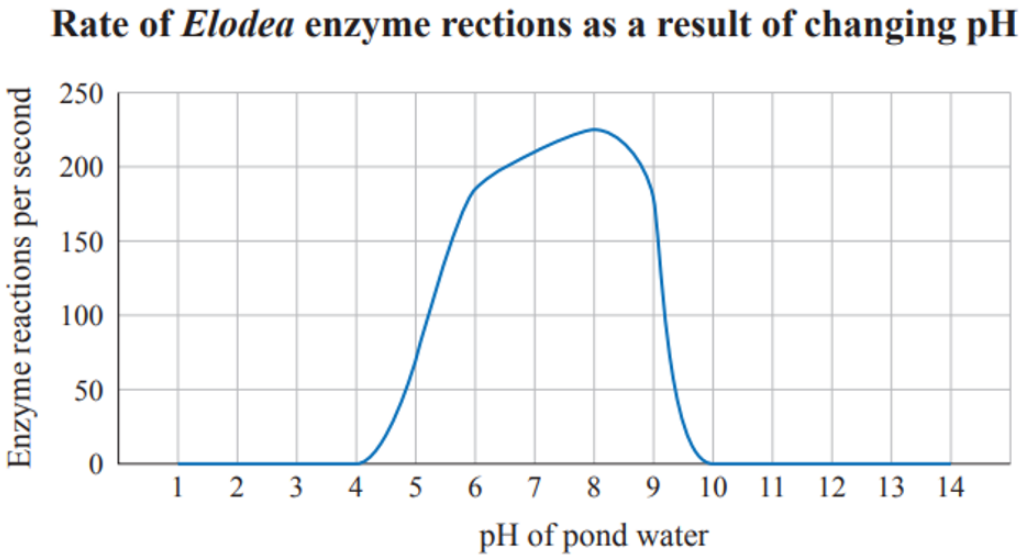
Question 16 All plants require specific components to facilitate the process of photosynthesis.



Fill out the table below to identify and explain the main plant structures and processes responsible for the intake and transport of these components. 5 marks

Component	**Main plant structure responsible for intake/transport**	**Explanation of how component is taken in and used by plant**
Light energy		
Carbon dioxide (CO_2)		
Water (H_2O)		
Minerals (e.g. iron (Fe^{2+}), sodium (Na^+) etc)		

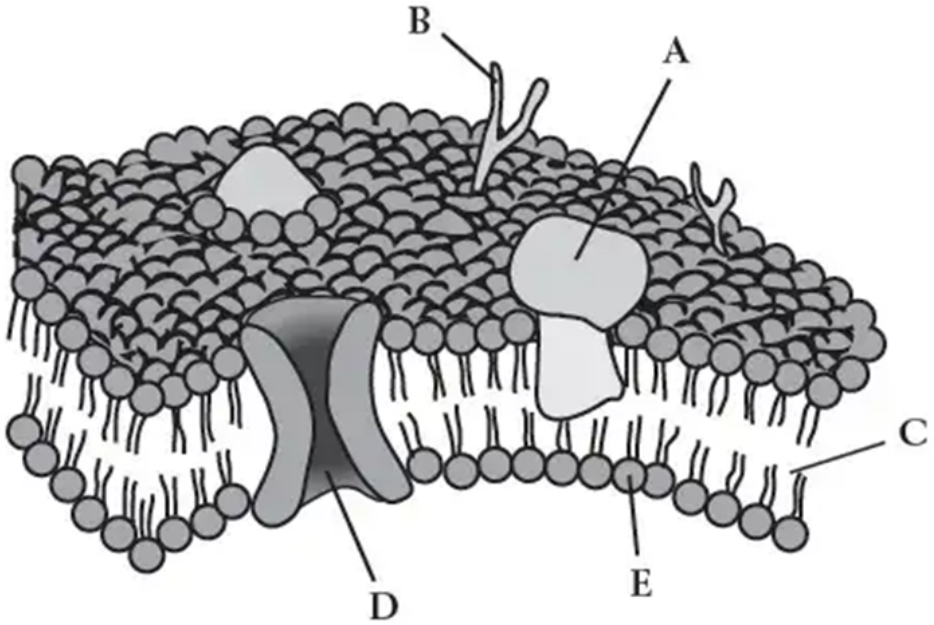
Question 17 Conditions of the water in a small pond can change throughout the day, and over a year. A change in pH can affect the rate of photosynthesis reactions. In an experiment to test the effect of pH on enzyme activity in Elodea cells, the following results were produced.



Adapted from: https://pubmed.ncbi.nlm.nih.gov/20118304/

Describe the effect of pH on enzyme activity by making reference to the shape of the graph. 4 marks

Question 18 Consider the diagram of a cell membrane shown below.



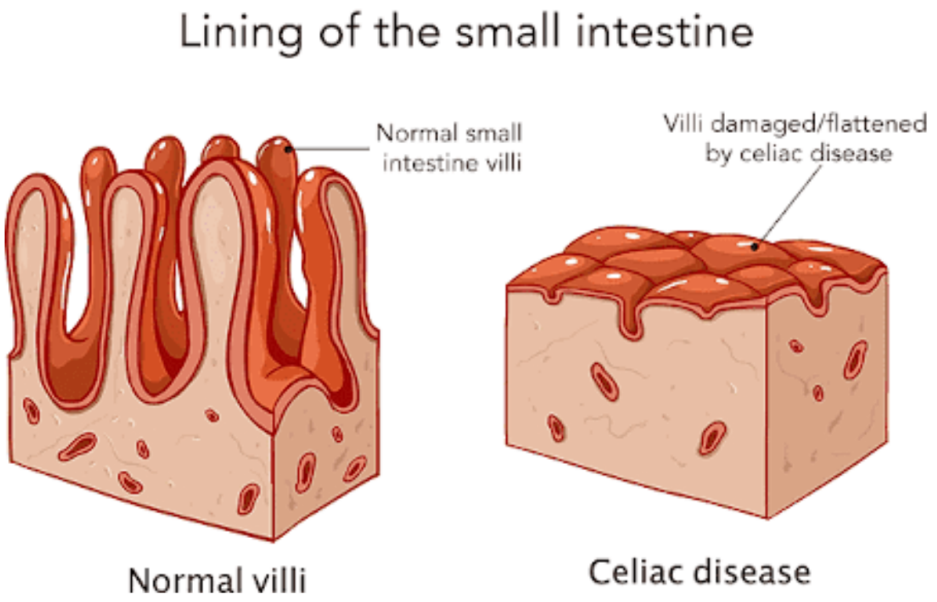
a) Identify structures E and D. 2 marks

E: ……

D: ……

b) Explain how the structure of cell membranes allows control of transport of materials into and out of the cell. 3 marks

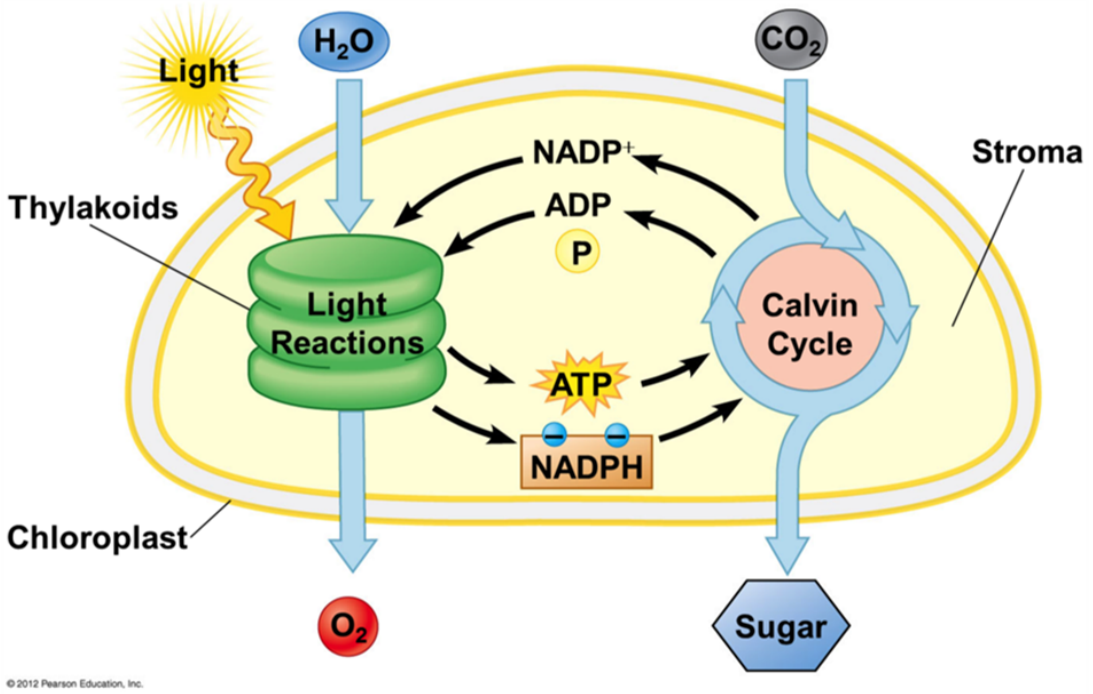
Question 19 The diagram below shows the effect of celiac disease on the small intestine.



(a) Describe the function of the small intestine. 2 marks

(b) Explain one possible negative effect of celiac disease on sufferers. 2 marks

Question 20 Consider the image below, which summarises the structure and function of chloroplasts.



(a) Identify the reaction shown in the image. 1 mark

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(b) Explain how surface area to volume ratios are maximised to increase the efficiency of sugar production in chloroplasts. 3 marks

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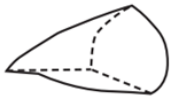
Question 21 The table below shows the beak shapes (depth and length) of several Galapagos finches. The expression of the BMP4 gene affects beak depth. The expression of another gene, CaM, affects beak length, as illustrated in the table.

Beak shape (depth and length)	Gene expression	
	BMP4	CaM
 shallow and short	low	low
 deep and short	high	low
 shallow and long	low	high

Source: beak images based on Chegg Study, <www.chegg.com/study>

a) Using the information in the table, identify the beak shape (depth and length) expected in a Galapagos finch where BMP4 and CaM were both highly expressed. 1 mark

b) Another gene found in birds, the Gremlin gene, inhibits the expression of BMP4 in the cells of the feet. Using your knowledge and the information above, explain what would happen to beak shape (depth and length) if the Gremlin gene also had an effect on the cells of the beak. 2 marks

Question 22 Consider the information provided on the three species shown in the table below.

Species	rock hyrax	elephant	dugong
			
Size	small terrestrial mammal (2–5 kg)	large terrestrial mammal (4500–6000 kg)	mid-sized marine mammal (150–300 kg)

Sources (from left): Bartosz Budrewicz/Shutterstock.com; Patryk Kosmider/Shutterstock.com; vkilikov/Shutterstock.com

a) These three species are closely related, sharing a relatively recent common ancestor, but have different features. Identify the type of evolution involved. Justify your response. 2 marks

b) In 2014 palaeontologists discovered a frozen, well-preserved, complete specimen of an extinct species, the steppe bison, in Siberia. The intact specimen was dated at 9300 years old. Scientists are debating the cause of the steppe bison's extinction. Identify one possible cause of its extinction. 1 mark

c) Though steppe bison are extinct, palaeontologists know a lot about them as they have found several frozen, intact steppe bison bodies. Describe what would have occurred to lead to the preservation of the animal from when the steppe bison died to when the frozen, well-preserved remains were discovered. 3 marks

Question 23 Antibiotics are absorbed into the body with the aim of killing bacteria or inhibiting their multiplication providing a defence strategy against potential bacterial infections. Over recent years however, bacteria are gradually evolving to develop antimicrobial resistance.

a) Identify one factor which promotes this resistance. 1 mark

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A study by Tagoe, Gyande and Anash (2011) identified mobile phones as a significant source of bacterial contamination. Within the study, 100 phones were swabbed and assessed for the presence of bacterial colonisation. Dilutions were used to quantify the presence of bacterial growth on the surface of each phone. The study then assessed the antibiotic resistance of the bacterial colonies as presented in Figure 1.

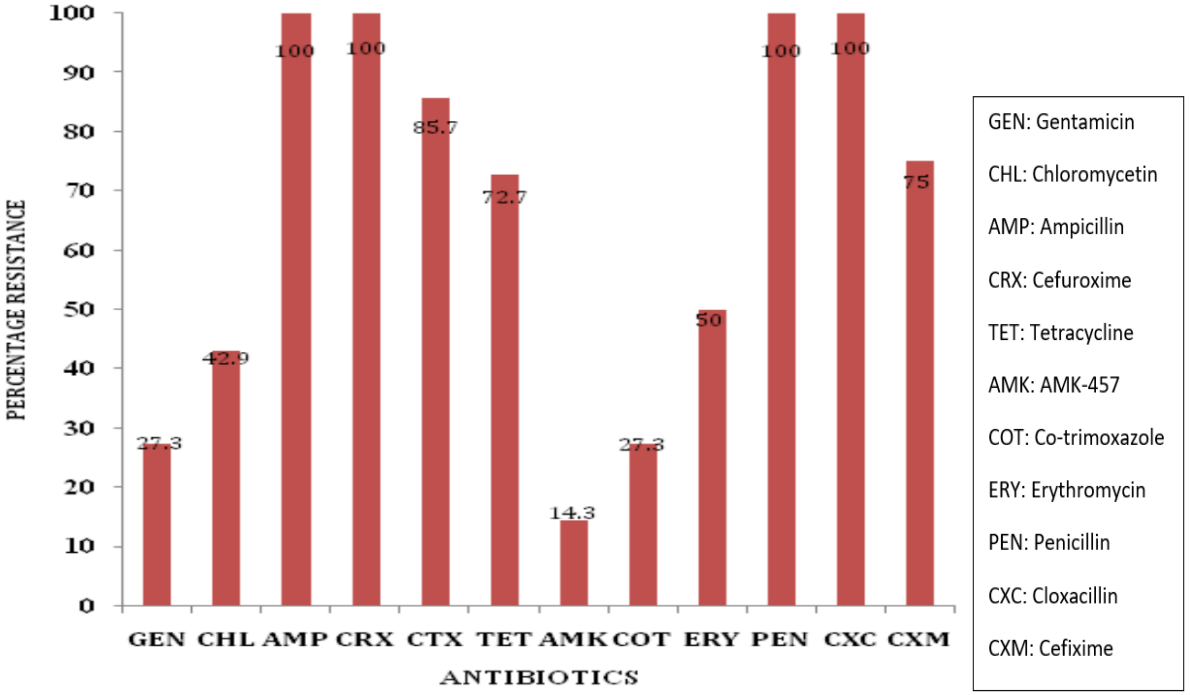

Figure 1: The antibiotic resistance patterns of the isolated bacteria.

Modified from the original source: Tagoe, Daniel & VK, Gyande & EO, Ansah. (2011). Bacterial Contamination of Mobile Phones: When Your Mobile Phone Could Transmit More Than Just a Call. WebmedCentral MICROBIOLOGY. 2. 10.9754/journal.wmc.2011.002294.

b) Using your understanding of antibiotic resistance, describe the data presented in Figure 1.
3 marks

PART A – INSTRUCTIONS FOR MULTIPLE CHOICE QUESTIONS

Use the multiple-choice answer sheet provided to answer PART A.

Select the alternative A, B, C or D that best answers the question.
Fill in the response in the oval completely.
Example 2 + 4 = ?

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

If you change your mind and have crossed out what you consider to be the correct answer then indicate this by writing the word 'correct' and drawing an arrow as follows:

STUDENT NUMBER ……..

MULTIPLE CHOICE ANSWER SHEET

Place an X in the correct cell to indicate your response. If you make a mistake, completely scribble out the incorrect response and clearly label your correct answer.

	A	B	C	D
1				
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