



Victorian Certificate of Education 2003

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER

Letter

Figures

Words

BIOLOGY

Written examination 1

Wednesday 11 June 2003

Reading time: 9.00 am to 9.15 am (15 minutes)

Writing time: 9.15 am to 10.45 am (1 hour 30 minutes)

QUESTION AND ANSWER BOOK

Structure of book

Section	Number of questions	Number of questions to be answered	Number of marks	Suggested times (minutes)
A	25	25	25	30
B	7	7	50	60
			Total 75	90

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners and rulers.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.
- No calculator is allowed in this examination.

Materials supplied

- Question and answer book of 25 pages.
- Answer sheet for multiple-choice questions.

Instructions

- Write your **student number** in the space provided above on this page.
- Check that your **name** and **student number** as printed on your answer sheet for multiple-choice questions are correct, **and** sign your name in the space provided to verify this.
- All written responses must be in English.

At the end of the examination

- Place the answer sheet for multiple-choice questions inside the front cover of this book.

Students are NOT permitted to bring mobile phones and/or any other electronic communication devices into the examination room.

SECTION A – Multiple-choice questions**Instructions for Section A**

Answer **all** questions in pencil on the answer sheet for multiple-choice questions. A correct answer scores 1, an incorrect answer scores 0. Marks will **not** be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Question 1

Chloroplasts

- A. contain glycogen.
- B. are found in all plant cells.
- C. are found in some bacterial cells.
- D. contain layers of internal membranes.

Question 2

The protozoan *Kentrophoros* carries a dense coat of bacteria on its surface. *Kentrophoros* engulfs these bacteria by bending its cell surface around them.

This process is known as

- A. osmosis.
- B. apoptosis.
- C. pinocytosis.
- D. phagocytosis.

Question 3

Many biological compounds are large molecules made of many smaller units joined together. Each of the units has the same basic structure. Such molecules are called polymers.

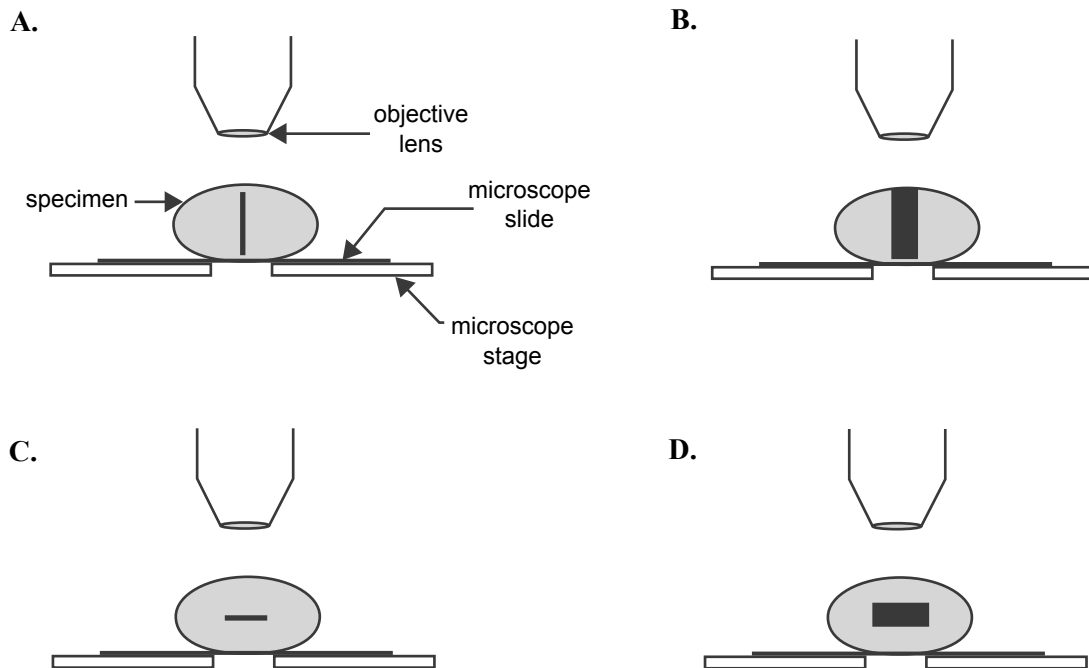
Biological polymers include

- A. cellulose composed of glucose.
- B. glycogen composed of glycerol.
- C. starch composed of amino acids.
- D. proteins composed of fatty acids.

Question 4

The optics of a confocal light microscope are constructed so that, when a specimen is viewed, only a single layer is observed and this is completely in focus. All out-of-focus images are removed.

This single layer is best represented by the black strip in diagram



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The following information applies to Questions 5 and 6.

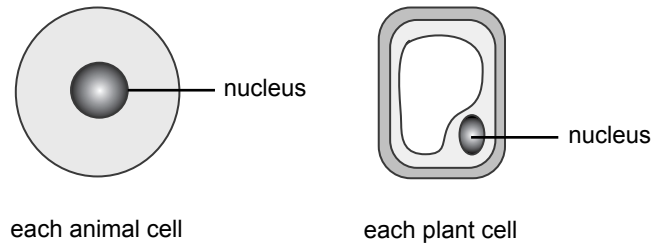
In a series of experiments, animal cells and plant cells were placed in solutions of different concentrations.

Solution X: distilled water

Solution Y: concentration the same as the cytosol of the cells at the start of the experiment

Solution Z: higher concentration of solute than the cytosol of the cells at the start of the experiment

The appearance of the cells at the start of the experiments was as follows.



After several minutes in the solutions, the cells appeared as follows.

experiment 1	experiment 2	experiment 3
experiment 4	experiment 5	experiment 6

Question 5

Analysis of the data reveals that

- A. experiment 1 represents an animal cell in solution X.
- B. experiment 2 represents an animal cell in solution Z.
- C. experiment 5 represents a plant cell in solution Z.
- D. experiment 6 represents a plant cell in solution X.

Question 6

The changes observed during these experiments were due to

- A. mitosis.
- B. osmosis.
- C. pinocytosis.
- D. active transport.

Question 7

The seeds of many plants cease developing in unfavourable conditions. They can survive for many years in this state which is called

- A. dormancy.
- B. geotropism.
- C. hibernation.
- D. germination.

Question 8

Evidence that a vascular plant has an infectious disease includes the

- A. drying out of root hairs during drought.
- B. yellowing of leaves due to deficiency of iron.
- C. presence of spores on fungal hyphae growing out of stomata.
- D. presence of nitrogen fixing bacteria in the root nodules of legume plants.

Question 9

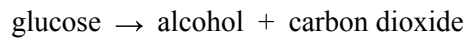
Insulin is produced by the

- A. liver.
- B. pancreas.
- C. hypothalamus.
- D. posterior pituitary gland.

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The following information applies to Questions 10 to 13 inclusive.

In the absence of oxygen, the respiration of glucose by many yeast species can be represented by



In the presence of oxygen, the respiration of these yeasts can be represented by



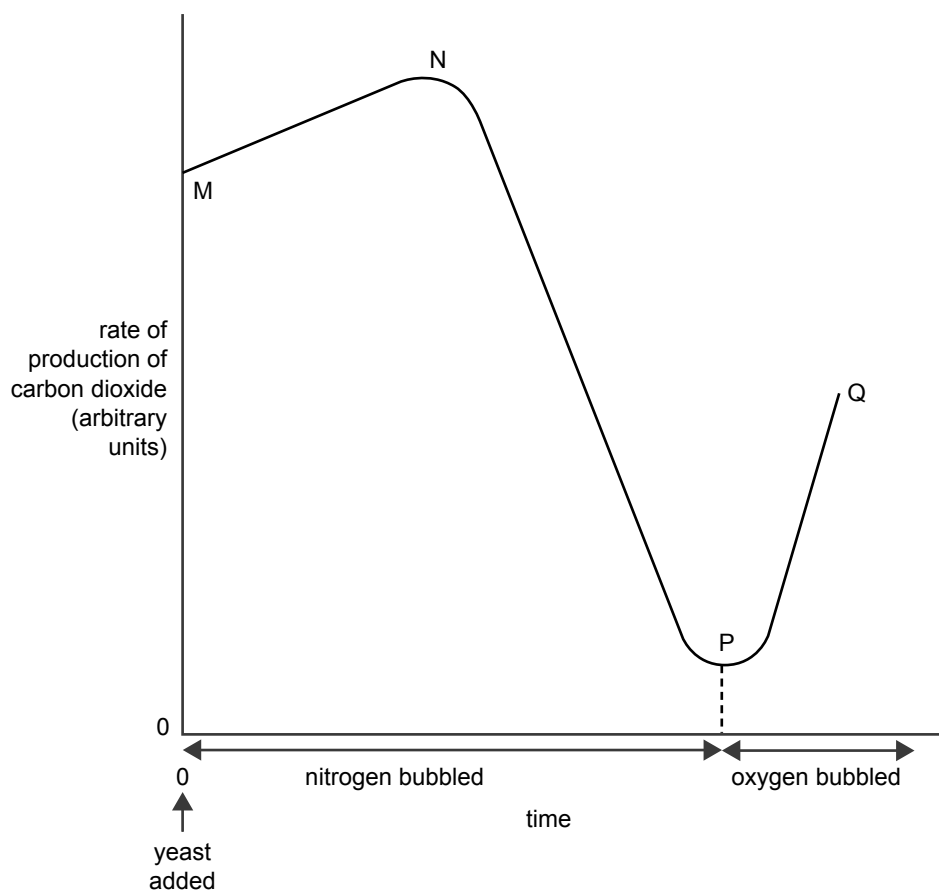
and



An experiment was carried out to investigate the rate of production of carbon dioxide by a particular species of yeast.

Nitrogen gas was bubbled through a solution of glucose overnight to remove any oxygen from the solution. A suspension of the yeast was then added to the solution (Time 0 on the graph). Nitrogen was then bubbled through the glucose plus yeast solution for a particular time period. The nitrogen supply was then removed and oxygen bubbled through the mixture.

Throughout the experiment, the rate of production of carbon dioxide was measured. The results obtained are shown in the following graph.



Question 10

The rate of production of carbon dioxide was greatest

- A. between points M and N.
- B. between points P and Q.
- C. at point N.
- D. at point Q.

Question 11

The low rate of production of carbon dioxide at point P is most likely because

- A. nitrogen killed all the yeast cells.
- B. most of the glucose had been used.
- C. the yeast culture was overcrowded.
- D. harmful waste products killed all the yeast cells.

Question 12

If oxygen had not been bubbled through the culture after point P, it is reasonable to assume that

- A. the rate of production of carbon dioxide would have continued to fall.
- B. the rate of production of carbon dioxide would have risen, but not as much as it did when oxygen was bubbled through.
- C. the rate of production of carbon dioxide would have levelled off and remained at a value similar to that at point P.
- D. there is insufficient data available to make a worthwhile prediction about what may have happened.

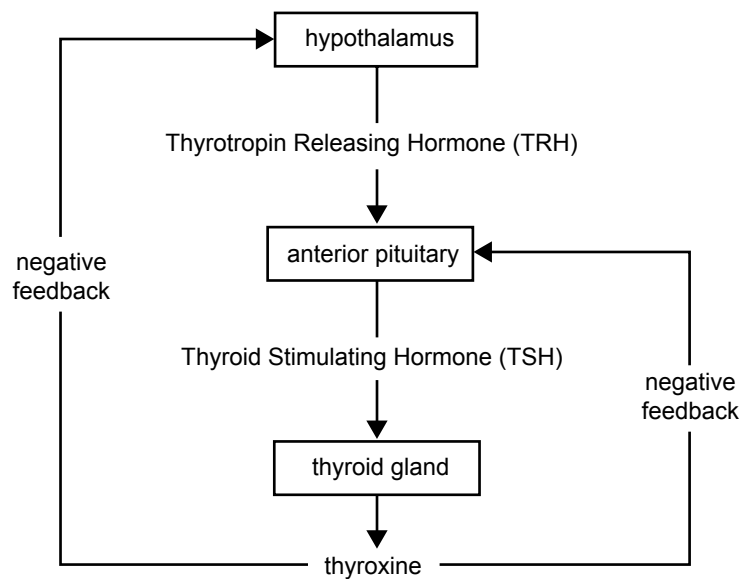
Question 13

The concentration of alcohol in the culture would have been

- A. greatest at point N.
- B. greatest at point P.
- C. greatest at point Q.
- D. much the same throughout the experiment.

Question 14

The following diagram shows the regulation of thyroxine secretion.



A person who lacks sufficient iodine in the diet is unable to manufacture thyroxine. This is because iodine is required by the thyroid gland to manufacture thyroxine.

It is reasonable to conclude that when a person lacks sufficient iodine in the diet

- A. TSH production would increase.
- B. TRH production would decrease.
- C. the negative feedbacks would cease to operate.
- D. the metabolic rate of cells in the body would increase.

Question 15

Homeothermy is the

- A. regulation of blood solute concentrations.
- B. maintenance of a relatively constant body temperature.
- C. increase in metabolic rate with increasing external temperatures.
- D. maintenance of body temperature the same as that of the external environment.

Question 16

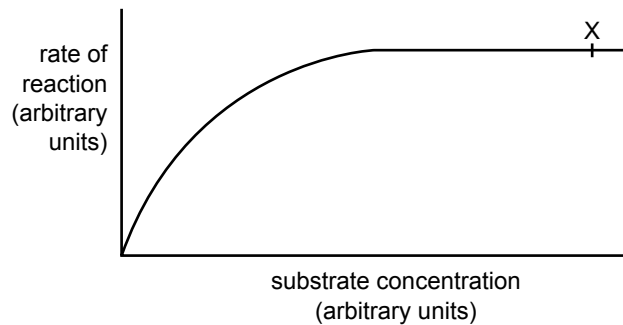
The nervous and endocrine systems are the two major regulatory systems of the body.

Both systems

- A. take the same time to respond to a stimulus.
- B. have the same duration of response to a stimulus.
- C. use the blood for the transport of their chemical signals.
- D. release chemical signals that act on tissues they control.

Question 17

The following graph illustrates the effect of different concentrations of a substrate on the rate of a cellular reaction.



In this series of experiments, the amount of enzyme, the pH and the temperature remain constant.

The limiting factor at point X is the

- A. pH.
- B. temperature.
- C. amount of enzyme.
- D. substrate concentration.

Question 18

Woolly mammoths are an extinct species of elephant that lived in very cold climates. They had very small ears.

Compared with the large ears of modern elephants, small ears would have assisted the survival of the mammoths by

- A. decreasing the core body temperature.
- B. increasing the effects of heat conduction.
- C. increasing the radiation of heat from the body.
- D. decreasing the surface area through which heat is lost.

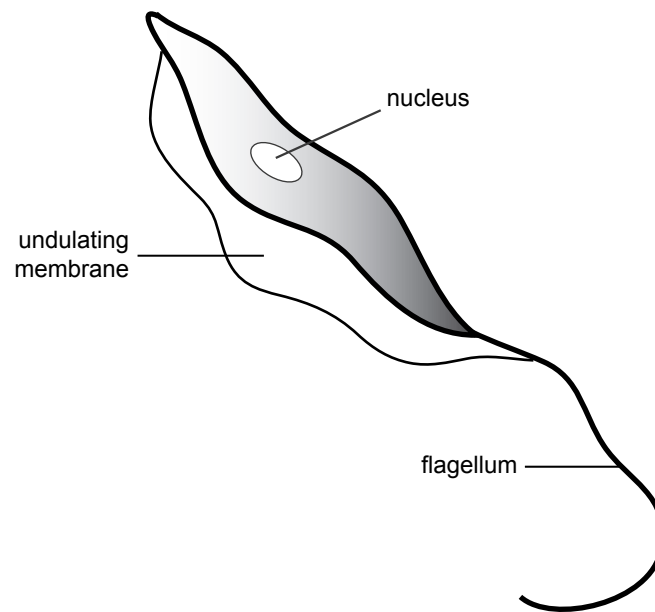
Question 19

Fish living in freshwater

- A. actively transport water into their body cells from their surroundings.
- B. produce urine with a high solute concentration.
- C. produce urine that contains ammonia.
- D. produce small volumes of urine.

Question 20

African sleeping sickness is caused by *Trypanosoma*, shown in the following diagram.



Trypanosoma have flattened bodies and are transmitted by biting insects from one human to another. *Trypanosoma* live in the blood stream in humans and reproduce there by splitting into two.

It is reasonable to conclude that

- A. *Trypanosoma* has a digestive system.
- B. the flagellum is important for locomotion.
- C. infection by *Trypanosoma* is likely to cause immediate death.
- D. *Trypanosoma* is likely to be attached to the walls of blood vessels.

Question 21

Many diseases are transmitted by vectors.

A vector would have been involved in the case of a person developing

- A. influenza after visiting a friend with influenza.
- B. diarrhoea after eating under-cooked chicken.
- C. gonorrhoea after sexual intercourse.
- D. malaria after a bite by a mosquito.

Question 22

Many bacteria and viruses are able to enter a body through mucosal surfaces that are only one cell thick.

If this occurs, they encounter features of specific immunity, including

- A. B cells.
- B. lysozymes.
- C. washing by tears.
- D. washing by urine.

Question 23

Four organisms or agents, and the diseases they cause, are listed in the following table.

causal organism or agent	resultant disease
Prion	Kuru
<i>Staphylococcus</i> bacteria	Boils
<i>Poliomyelitis</i> virus	Poliomyelitis
<i>Trichophyton</i> fungus	Athlete's foot

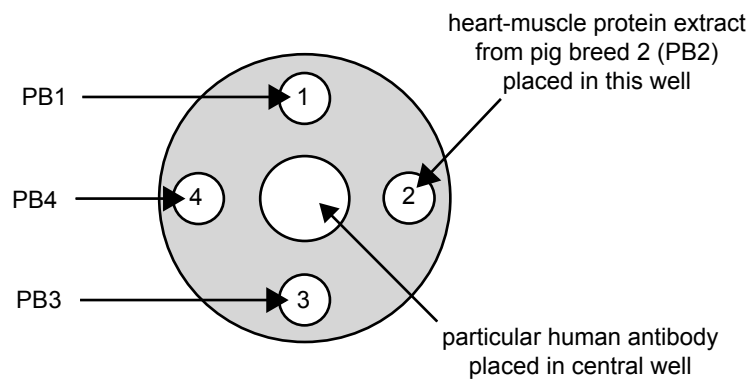
It is reasonable to assume that antibiotics are most likely to be used to treat

- A. kuru.
- B. boils.
- C. poliomyelitis.
- D. athlete's foot.

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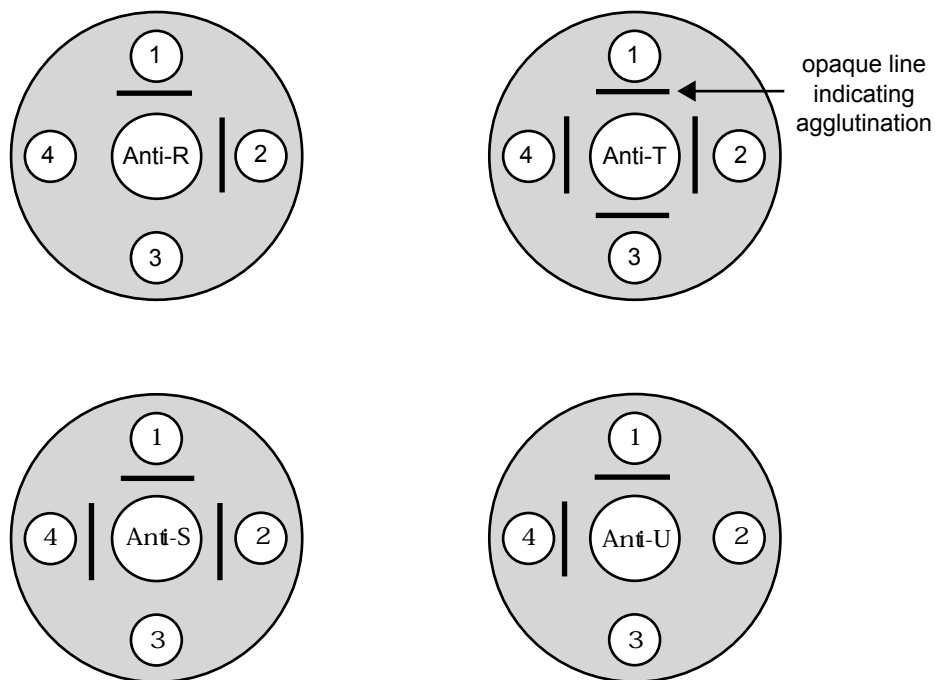
The following information relates to Questions 24 and 25.

Four different breeds of pigs were being investigated for their potential as organ donors for humans. Samples of heart-muscle proteins were prepared from each of the four breeds and tested against four different kinds of antibodies found in most humans. These antibodies are Anti-R, Anti-S, Anti-T and Anti-U. Tests were carried out in agar plates that were set up as in the diagram below.



The extracts of heart-muscle protein and human antibodies were able to diffuse through the agar. If an antibody reacted with a pig heart-muscle protein, agglutination occurred and was indicated by an opaque line forming in the agar.

The following results were obtained.



Question 24

Examination of the data reveals that

- A. heart-muscle extract 4 contains protein R.
- B. heart-muscle extracts 2 and 3 contain the same proteins.
- C. protein T is present in all four of the heart-muscle extracts.
- D. proteins S and U are each present in three of the heart-muscle extracts.

Question 25

The pig breed most likely to be chosen for ongoing experimentation and trials is pig breed number

- A. 1
- B. 2
- C. 3
- D. 4

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**END OF SECTION A
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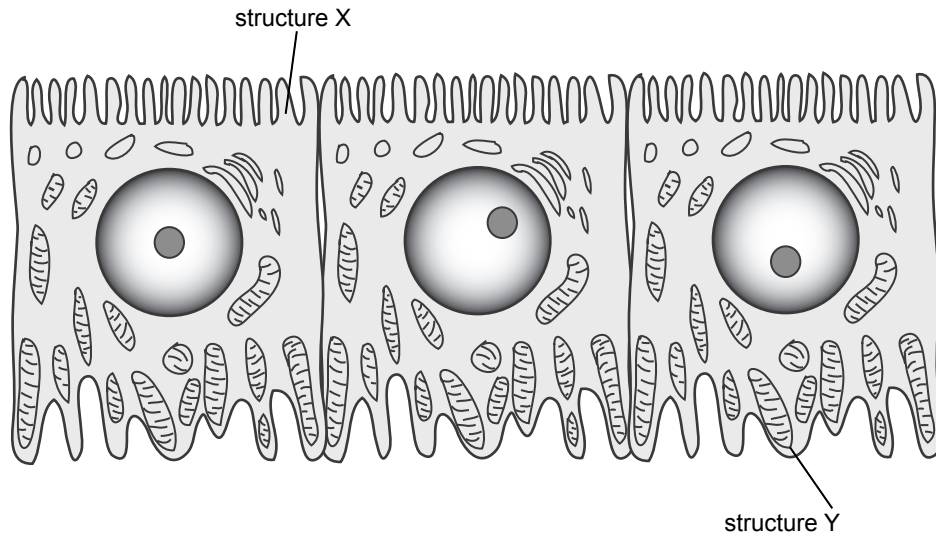
SECTION B – Short-answer questions**Instructions for Section B**

Answer this section in pen.

Answer all questions in the spaces provided.

Question 1

A student examined a section of animal tissue and observed the following three cells.



- a. Name a feature which confirms that the section was from animal tissue.

1 mark

- b. Name structure Y.

1 mark

- c. i. What is the function of structure X?

- ii. Justify your answer to part c.i.

1 + 1 = 2 marks

Total 4 marks

Question 2

Helicobacter pylori is a bacterium.

- a. i. Cells can be classified as prokaryotic or eukaryotic. To which group do bacterial cells belong?

- ii. Name one feature which distinguishes prokaryotic organisms from eukaryotic organisms.

1 + 1 = 2 marks

Helicobacter pylori infects the lining of the stomach and has been shown to cause stomach ulcers near the stomach's opening into the duodenum. When the bacteria were first discovered, doctors were surprised that the bacteria could survive in the environment of the stomach.

- b. Explain what makes the environment of the stomach unsuitable for the survival of some bacteria?

1 mark

- c. Suggest a feature of *Helicobacter pylori* that could assist the bacteria's survival in the stomach.

1 mark

- d. i. Scientists are trying to develop a vaccine against the bacterium, *Helicobacter pylori*. What is a vaccine?

- ii. How would the vaccine protect against infection by *Helicobacter pylori*?

- iii. Explain why this vaccine is unlikely to protect against infection by other bacteria as well as it does against *Helicobacter pylori*.

1 + 1 + 1 = 3 marks

Total 7 marks

Question 3

Figure 1 is a portion of the nervous system. The various parts are not drawn to scale.

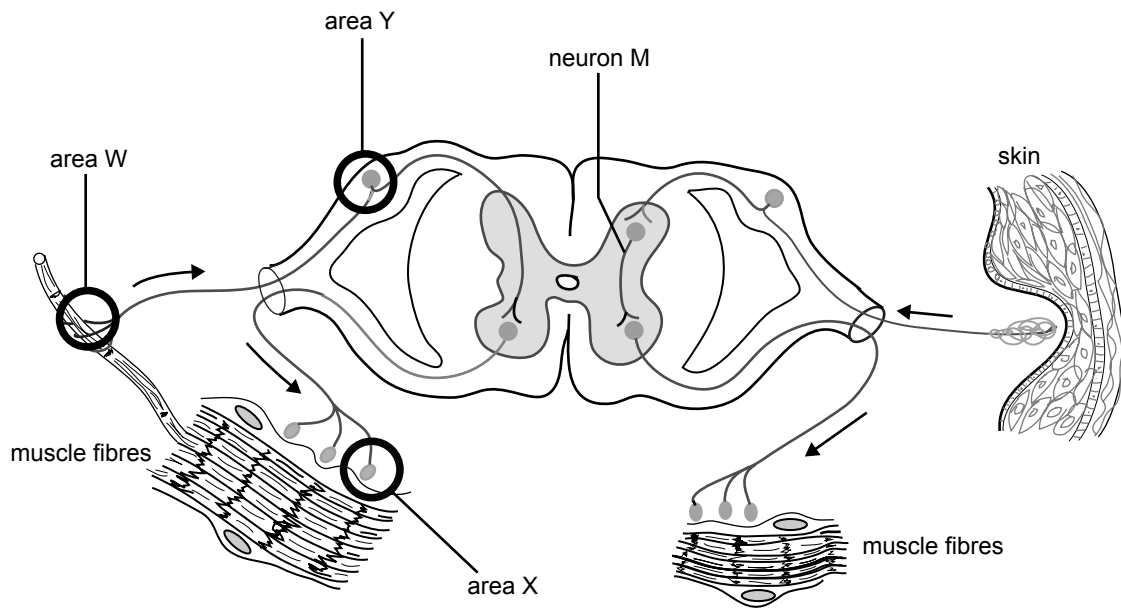


Figure 1

Examine Figure 1.

- a. What kind of neuron is neuron M?

1 mark

- b. The skin shown in Figure 1 is associated with a reflex arc. Outline the response that such a reflex arc controls and explain its importance for the body.

2 marks

- c. Some nerve axons have a myelin sheath. In what way does the presence of a myelin sheath affect the function of a nerve cell?

1 mark

Figure 2 is an enlargement of part of Figure 1.

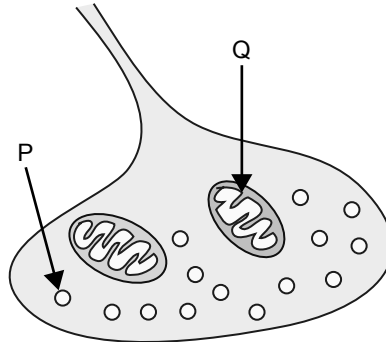


Figure 2

Examine Figure 2.

- d. i.** In which area, W, X, or Y on Figure 1, would you find a structure like that shown in Figure 2?

- ii.** Outline the functions of structures P and Q.

Structure P _____

Structure Q _____

1 + 2 = 3 marks

Total 7 marks

Question 4

A group of scientists investigated two species of mammals living in their natural habitat. The scientists recorded the ways in which water was lost and gained by the mammals.

The findings are summarised in the table below.

	mammal species A		mammal species B	
water gain	mL /day	% of total	mL /day	% of total
drinking	0	0	1500	60
eating	6	10	750	30
metabolism	54	90	250	10
water loss				
evaporation	43.9	73	900	36
urine	13.5	23	1500	60
third avenue of water loss	2.6	4	100	4

- a. State two pieces of evidence from the table that suggest that mammal species A is suited to survive in a hot, dry environment.

Evidence 1 _____

Evidence 2 _____

2 marks

Consider the ways in which the two species of mammals are losing water. The evaporation of water includes the water lost during respiration and water lost through the skin.

- b. i.** Describe one way in which a mammal may behave to reduce the amount of water lost in evaporation.

- ii.** Suggest the third avenue of water loss that may account for 4% of losses in each of the mammal species.

- iii.** The percentage of water lost in urine varies between the two mammal species. Describe a structural adaptation which would explain the difference.

1 + 1 + 1 = 3 marks

Total 5 marks

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Question 5

The table below shows the mean levels of glucose and insulin in two groups of people sampled one hour after the ingestion of 75 g of glucose. One of the experimental groups consisted of people with diabetes; the other acted as a control.

	group X		group Y	
time after glucose ingestion	0 min	60 min	0 min	60 min
plasma glucose (mmol/L)	5.3	13.0	5.3	7.8
plasma insulin (mmol/L)	68	66	69	380

- a. What is the purpose of the control group?

1 mark

- b. Using the above data, give two reasons to explain which group (X or Y) included the people with diabetes.

Group _____

Reason 1 _____

Reason 2 _____

2 marks

No other food or drink was ingested in the three hours following the conclusion of the experiment. Neither group received an injection of insulin. In that time the mean plasma glucose concentration in the control group returned to 5.3 mmol/L.

- c. Explain how this change occurred.

1 mark

Another hormone involved in the control of plasma glucose concentration is glucagon.

- d. i. From which organ is glucagon secreted?

- ii. Explain how high levels of glucagon would affect the plasma glucose level.

1 + 2 = 3 marks

Total 7 marks

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Question 6

The following is a list of events associated with stomatal opening. In the list, events 1 and 6 are in the correct order.

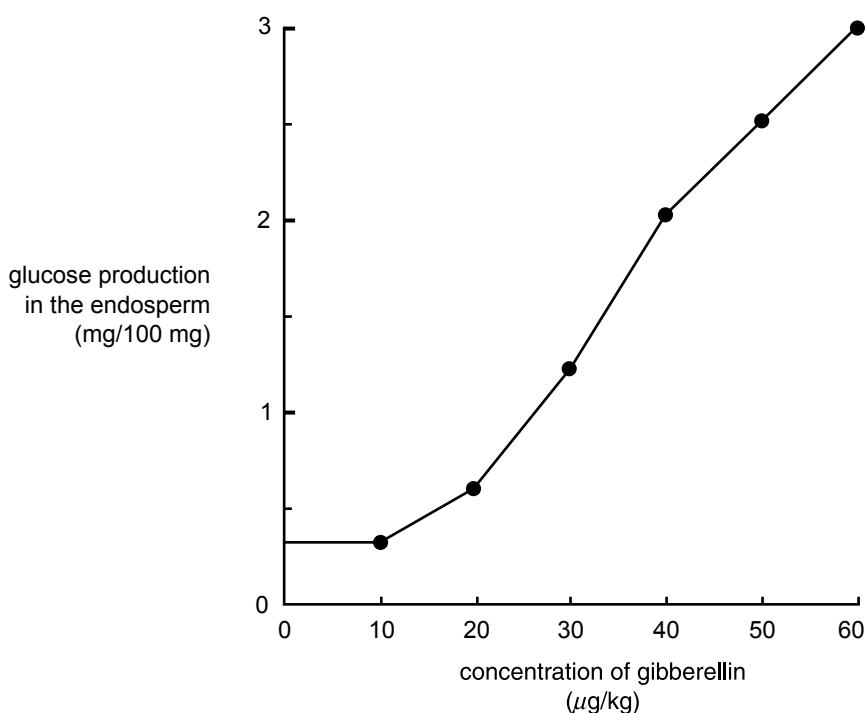
order (1–6)	event
1	Hydrogen ions move out of the guard cells.
	The solute concentration in the guard cells becomes greater than in the surrounding cells.
	The turgidity of the guard cells increases.
	Water moves by osmosis into the guard cells.
	Potassium ions move through the membrane into the guard cells.
6	The outer wall of the guard cells expands at a greater rate than the inner wall.

- a. Beside each of the remaining events, write a number (from 2 to 5 inclusive) that indicates the correct sequence of these events in the opening of the stomata.

2 marks

Seeds contain a store of starch in tissue called endosperm. When seeds begin to grow (germinate) this starch is converted to glucose. Slices of the endosperm of barley seeds were treated with different concentrations of the plant hormone gibberellin. The amount of glucose produced was monitored.

The graph below shows the amount of glucose produced at different concentrations of gibberellin.



Gibberellin stimulates the production of the enzyme amylase.

b. What is an enzyme?

2 marks

c. At what gibberellin concentration does glucose production in the endosperm begin to increase?

1 mark

d. Explain why photosynthesis is not used to produce sugar during the early stages of germination.

1 mark

e. Describe one action of gibberellin, other than the production of amylase, that you would expect in a mature plant.

1 mark

Corals are marine animals. Many species of coral have algae living in vesicles inside their cells. These algae require nutrients such as phosphorus to function. The concentration of phosphorus (present as phosphate ions) in sea water is generally less than two parts per million. However, in the cytoplasm of coral cells, the concentration of this nutrient may be as high as hundreds of parts per million.

f. Based on the above information, explain whether the transport of phosphate ions from sea water into coral cells is likely to be active or passive.

2 marks

Coral growth is assisted by photosynthesis carried out by the algae living inside its cells.

g. Explain how the products of photosynthesis would benefit the coral.

2 marks

Many of the coral species that contain algae have large flat surfaces or form tall rod-like branches.

h. Explain how these coral shapes would assist photosynthesis.

1 mark

Total 12 marks

Question 7

Blood is grouped according to the kinds of antigens on the surface of red blood cells of an individual.

One blood group in humans is the Rhesus blood group. With regard to this group, individuals are classified as follows.

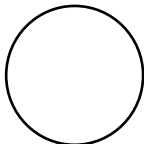
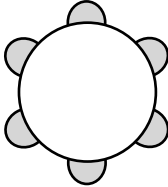
Rhesus positive	Individuals that have Rhesus protein on red blood cells (rbc)
Rhesus negative	Individuals with no Rhesus protein on red blood cells

Under normal conditions, no Rhesus antibodies exist in blood plasma but Rhesus antibodies can be produced in particular circumstances.

In an emergency, a male who is Rhesus negative may be given a transfusion.

A male, blood group Rhesus negative, unexpectedly lost a lot of blood during a minor operation and urgently needed a blood transfusion. No suitable Rhesus negative blood was available and he was given a transfusion of Rhesus positive blood. The man's blood was monitored over time.

Consider the following symbol code and answer part **a**.

structure 1	structure 2	structure 3
		
Rhesus -ve rbc	Rhesus +ve rbc	Rhesus antibody

- a. In the following table, list which of the structures, 1, 2 and 3, you would expect to find in the man's blood at each of the times indicated.

Prior to operation	One day after transfusion	One month after transfusion	One year after transfusion

4 marks

- b. Explain why you gave the particular answer you did for the box '**one month after transfusion**' in part a.

2 marks

The man had an accident about five years after his minor operation and again required a blood transfusion. A doctor examined the man's medical history and commented 'Well we certainly cannot give him Rhesus positive blood this time'.

- c. Explain whether you agree or disagree with the doctor's comment regarding a Rhesus positive blood transfusion.

2 marks

Total 8 marks