



# Victorian Certificate of Education 2004

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

## STUDENT NUMBER

Figures

Words


Letter

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# BIOLOGY

## Written examination 1

Monday 7 June 2004

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

<i>Section</i>	<i>Number of questions</i>	<i>Number of questions to be answered</i>	<i>Number of marks</i>	<i>Suggested times (minutes)</i>
A	25	25	25	30
B	8	8	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 26 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 provided for multiple-choice questions.

Choose the response that is **correct** for the question.

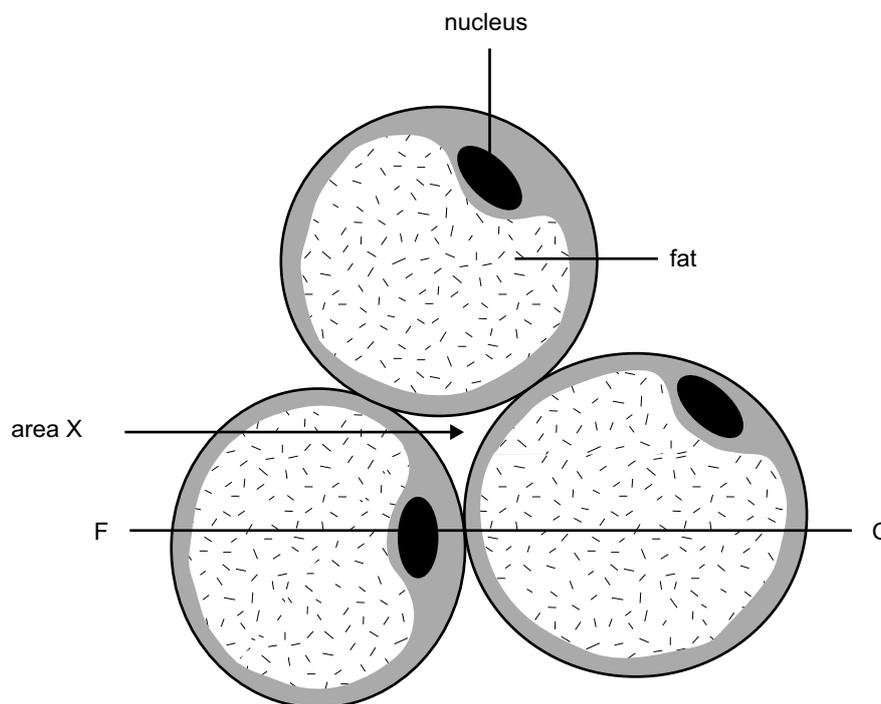
A correct answer scores 1, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

*The following information is required for Questions 1 and 2*

In animals, fats are stored in cells called adipose tissue. A small section of adipose tissue is shown in the following diagram.



Adipose cells are usually yellow in colour because of the fat that accumulates as an oil drop within each cell. The cytoplasm is a thin shell around the drop of fat but expands a little around the flattened nucleus.

**Question 1**

Area X would comprise

- A. fats.
- B. blood.
- C. water.
- D. tissue fluid.

**Question 2**

A section was cut through these cells, along the line FG, shown in the diagram. The section was examined with a light microscope.

The section under the microscope would be best represented by

- A. 
- B. 
- C. 
- D. 

**Question 3**

Skin cells are continually dying and being replaced by new cells.

The ongoing death of these skin cells is an example of

- A. cancer.
- B. mitosis.
- C. apoptosis.
- D. bacterial infection.

**Question 4**

The cell membrane of a nerve cell

- A. is impermeable to glucose.
- B. prevents the entry of water into the cell.
- C. contains pores lined with carbohydrates.
- D. is composed of phospholipids and protein.

**Question 5**

A prion is a form of

- A. DNA.
- B. virus.
- C. protein.
- D. bacterium.

*The following information is required for Questions 6, 7 and 8*

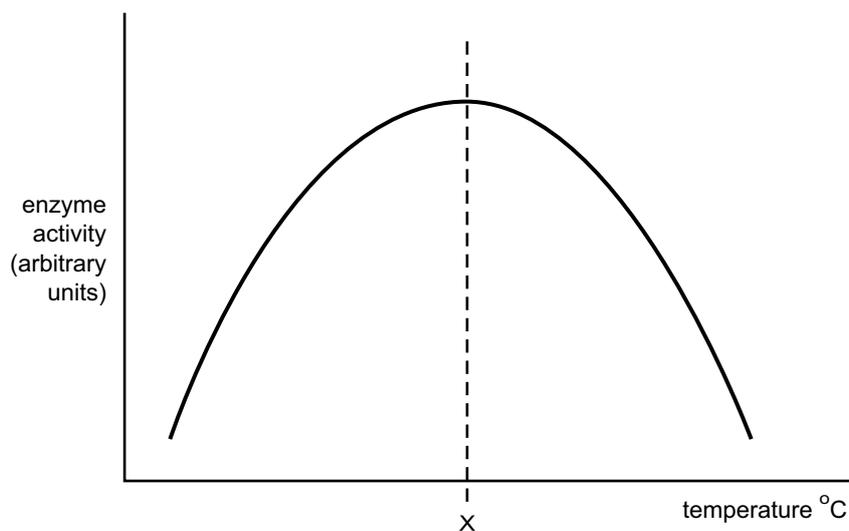
Scientists have found microorganisms living in springs of boiling water. Many of these microorganisms have been classified as prokaryotic.

### Question 6

A defining characteristic of a prokaryote is the

- A. presence of a cell wall.
- B. presence of a nucleus.
- C. absence of ribosomes.
- D. absence of membrane bound organelles.

The enzyme activity of these microorganisms was investigated over a range of temperatures. The results obtained were plotted and are shown in the following graph.



### Question 7

The temperature at point X is most likely to be

- A. 10°C.
- B. 37°C.
- C. 57°C.
- D. 100°C.

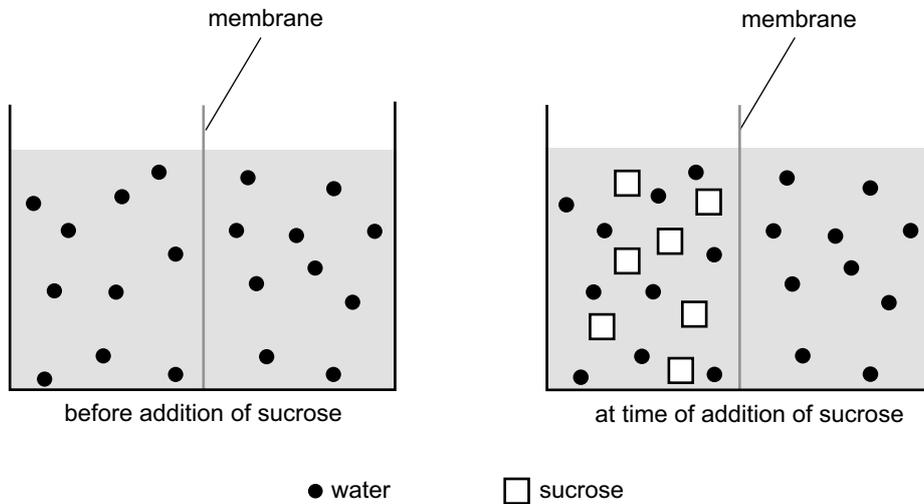
### Question 8

A graph with the same shape would be obtained if the variable plotted on the horizontal axis was

- A. pH.
- B. amount of light.
- C. concentration of substrate.
- D. concentration of product.

**Question 9**

A student set up an experiment with a semipermeable membrane. The membrane was not permeable to sucrose. At the beginning of the experiment the same amount of water was added to both sides of the membrane. The student then added sucrose to the left side of the membrane as shown in the following diagram.



You would expect

- A. the level of water to rise on the left of the membrane.
- B. the level of water to rise on the right of the membrane.
- C. the level of water to remain unchanged on both sides of the membrane.
- D. the concentration of sucrose to increase on the right side of the membrane.

**Question 10**

A hormone that increases the rate at which mature fruit ripens is

- A. auxin.
- B. ethylene.
- C. gibberellin.
- D. abscisic acid.

**Question 11**

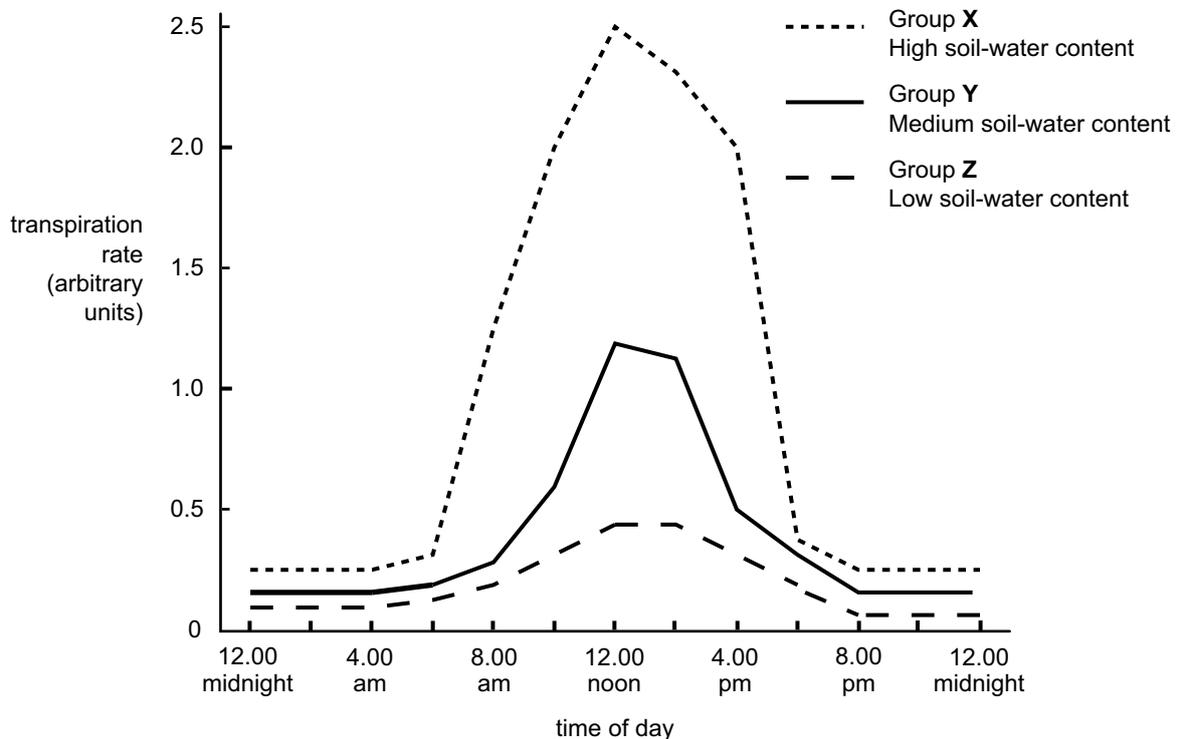
In mammals, organs are grouped into systems, for example the endocrine system, on the basis that they are

- A. close together.
- B. similar in structure.
- C. related through function.
- D. formed at the same time of development.

**Question 12**

Transpiration rate was measured in the bean, *Phaseolus vulgaris*. Three identical groups were tested. In group **X** the soil moisture was high, in group **Y** it was medium and in group **Z** it was low.

The graph below shows the results of the experiment.



It is reasonable to conclude that

- A. stomata were closed between 8.00 am and 4.00 pm in group **Z**.
- B. no water was lost between 8.00 pm and midnight in group **Z**.
- C. the rate of water loss through stomata was greatest in group **X**.
- D. at 12.00 noon, water loss in group **X** was four times greater than water loss in group **Y**.

**Question 13**

Many different strains of the influenza virus exist. Tests were carried out to determine whether an individual with influenza was infected with a new strain (strain X) or one of two previous strains, strain Y and strain Z.

It would be reasonable to claim that strain X was a new strain if

- A. strain Y reacted with strain X antibodies.
- B. strain Z reacted with strain X antibodies.
- C. strain X failed to react with strain Y antibodies only.
- D. strain X failed to react with both strain Y and strain Z antibodies.

**Question 14**

The advantage of a naturally acquired active immunity is that it

- A. is long lasting, sometimes for life.
- B. can develop without exposure to antigen.
- C. produces antibodies against a range of infective agents.
- D. provides antibodies immediately the first time one is exposed to a particular bacterium.

**Question 15**

The measles (rubella) virus causes a highly infectious childhood disease involving nasal discharge, cough and fever.

It is reasonable to assume that

- A. an antibiotic would be effective in curing measles.
- B. no vaccine against measles is available.
- C. the virus is eliminated by the action of plasma antibodies and cytotoxic T lymphocytes.
- D. the disease is highly infectious because the virus replicates on children's toys or play equipment.

**Question 16**

Defence mechanisms that plants have against insects include the

- A. cell walls of cellulose.
- B. production of toxic chemicals in some tissues.
- C. presence of an internal vascular system.
- D. ability of stomata to close both day and night.

**CONTINUED OVER PAGE**

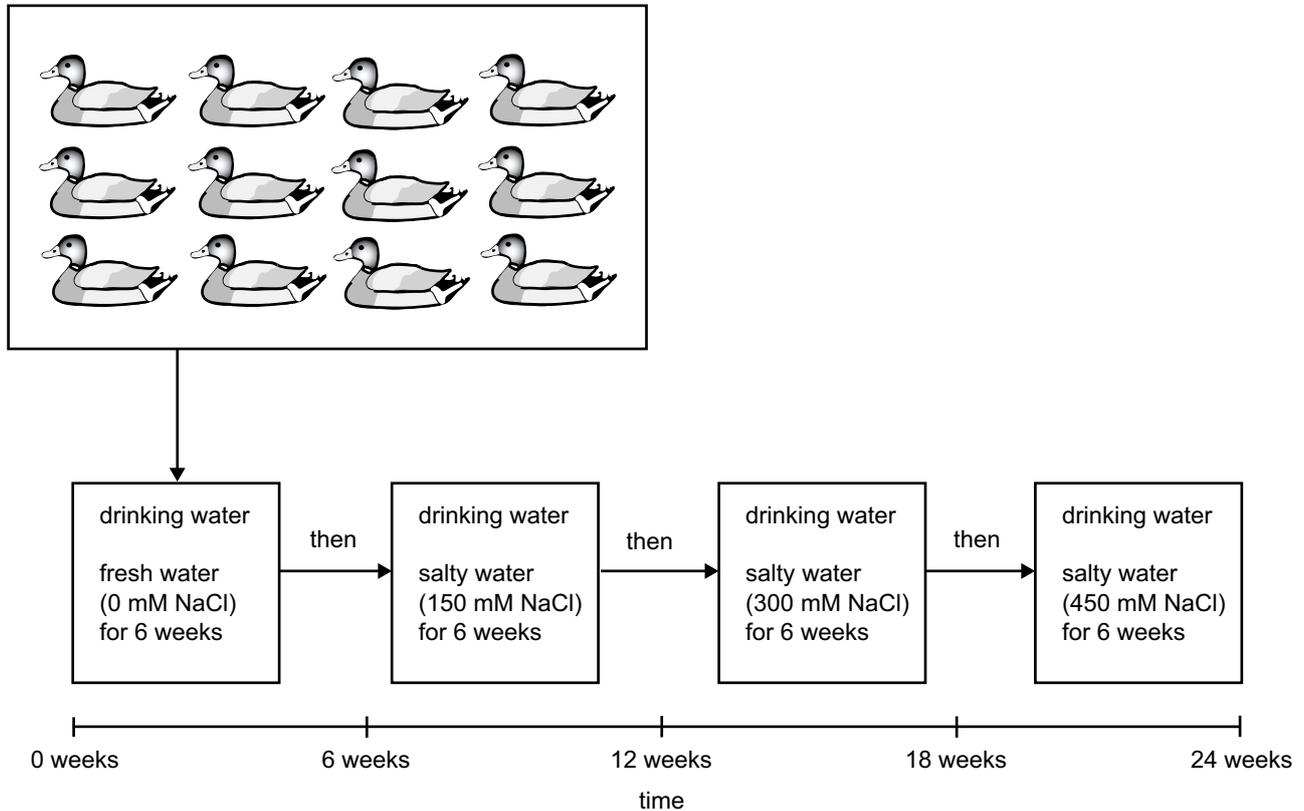
The following information is required for Questions 17 and 18

Biologists investigating the regulation of body water in Peking ducks, *Anas platyrhynchos*, put forward the hypothesis that Peking ducks drink more as the saltiness of their drinking water increases.

The drinking water was to be supplied in 70 litre wading pools and replenished twice each day. Twelve adult Peking ducks, males and females, were available and two experimental designs were suggested.

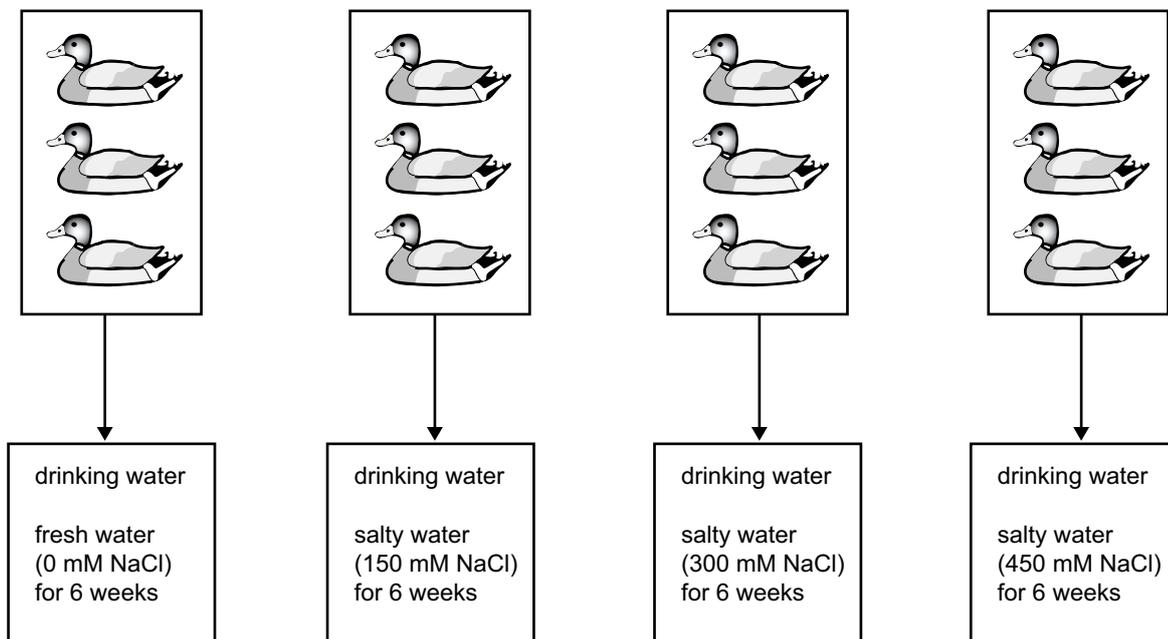
**Design 1**

The same twelve ducks are provided with drinking water of increasing saltiness over a 24-week period.



**Design 2**

The twelve ducks are divided into four groups of three ducks and each group is exposed to drinking water of a different saltiness.



**Question 17**

The variable being investigated is the

- A. time.
- B. species of duck.
- C. gender of the ducks.
- D. saltiness of the drinking water.

**Question 18**

Design 1 was chosen for the investigations because it better accounted for

- A. variation between individual ducks.
- B. homeostatic regulation of body water.
- C. other factors that could affect drinking.
- D. time taken for the ducks to acclimatise to the conditions.

**Question 19**

A group of students studied water balance in mice. Each student placed a mouse in a cage with dry food and a water bottle. They measured the amount of water consumed by each mouse every 24 hours. The students assumed that if a mouse was in water balance then the amount of water consumed would be equal to the volume of urine lost by the mouse each day.

In making their assumption about water balance, students had overlooked the point that

- A. larger mice would drink more water.
- B. water would be lost in faeces and saliva.
- C. more water would be consumed on hotter days.
- D. urine volume would vary with volume of water consumed.

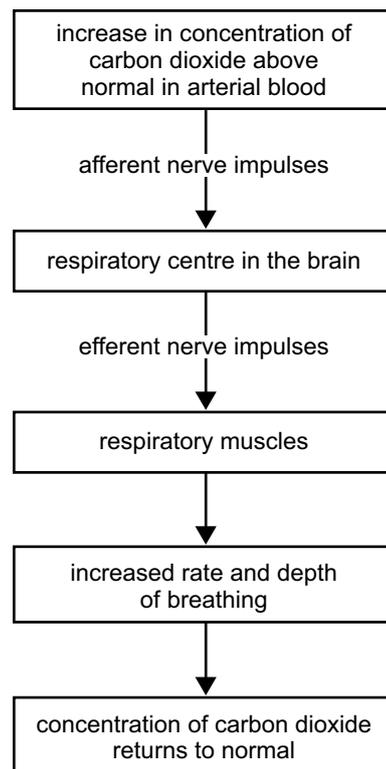
**Question 20**

Cats that have not been fed for two to three days are able to maintain a constant blood glucose concentration. After 24 hours without food, the structure from which glucose is released into the cat's blood is the

- A. liver.
- B. brain.
- C. pancreas.
- D. digestive tract.

*The following information is required for Questions 21 and 22*

The following diagram shows the regulation of carbon dioxide concentration in arterial blood.



**Question 21**

The effector in the regulation of carbon dioxide concentration is the

- A. respiratory muscles.
- B. efferent nerve impulses.
- C. respiratory centre in brain.
- D. afferent nerve impulses.

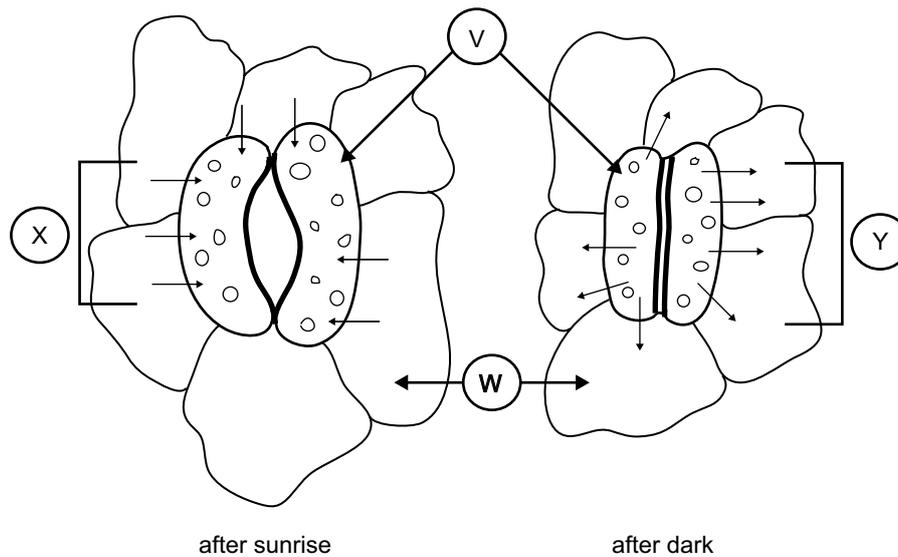
**Question 22**

When the concentration of carbon dioxide returns to normal it would be reasonable to conclude that the

- A. respiratory muscles stop contracting.
- B. rate and depth of breathing decrease.
- C. number of afferent nerve impulses increase.
- D. respiratory centre in the brain fails to send efferent nerve impulses.

**Question 23**

The following drawing shows a portion of the undersurface of a leaf at two different times of day.

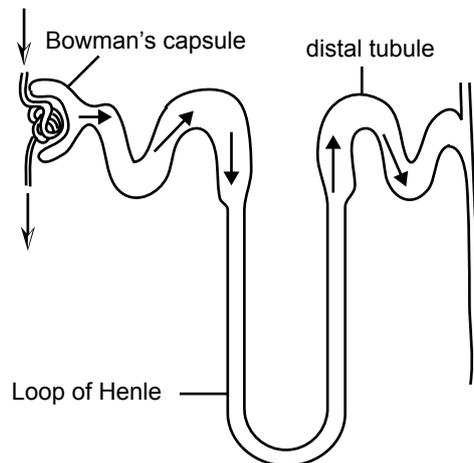


In this drawing, the arrows indicated by

- A. label V, point to non-respiring cells.
- B. label W, point to photosynthetic cells.
- C. label X, show the direction of movement of potassium ions.
- D. label Y, show the direction of movement of starch molecules.

**Question 24**

The kidney plays a vital role in homeostasis in mammals. The basic functional unit of a mammalian kidney is a nephron which is shown in the following diagram.



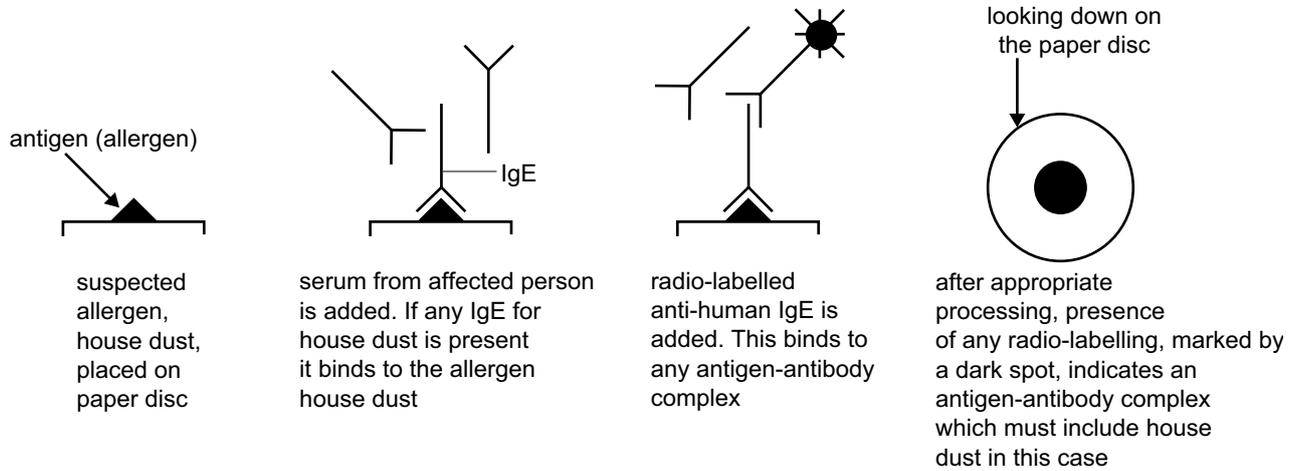
Normal functioning of a nephron relies on a

- A. decrease in renin production as blood pressure falls.
- B. secretion of ADH (antidiuretic hormone) by kidney cells.
- C. reabsorption of water into the blood from the Loop of Henle.
- D. decrease in water movement from distal tubules as ADH increases in the blood.

**Question 25**

An allergy is caused when a person has large numbers of IgE antibodies against an antigen (also called allergen). Tests can be carried out to determine which IgE antibodies are present in a person if they have an allergy of unknown origin.

An outline of the test, to determine whether house dust is the cause of allergy in a particular person, is as follows.



Several antigens can be tested at once on the same paper disc. If a person's serum contains IgE antibodies for any of the antigens tested, a radio-labelled spot will be obtained.

An individual who had many allergies was tested against garlic, pollen and peanuts. The paper disc set-up and the result received are shown in the following diagram.



Based on the result received it is reasonable to conclude that the individual tested is allergic to

- A. peanuts only.
- B. garlic and pollen only.
- C. pollen and peanuts only.
- D. garlic and peanuts only.

**SECTION B – Short-answer questions****Instructions for Section B**

Answer this section in **pen**.

Answer all questions in the spaces provided.

**Question 1**

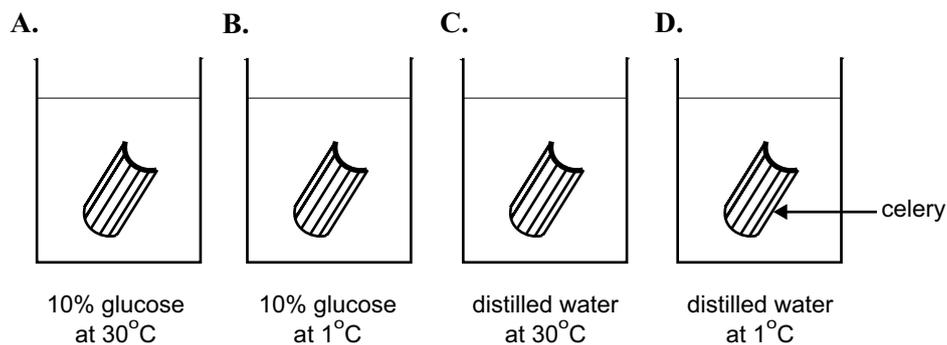
Our brain is composed of many different cell types, each type with its own specialised function. The structure of each cell can be related to its function.

- a. Complete the following table by making a relevant entry in each of the three empty rectangles.

Cell type	Particular cell structure	Function of structure
neuron	thin processes extending from cell body	
microglia		phagocytosis
ependymal cells	cilia on one surface	

3 marks

Identical pieces of celery of the same mass were placed in four different beakers and treated as follows.



The celery was left in the conditions shown for 30 minutes.

- b. Explain which piece of celery would show the greatest loss in mass after the 30 minutes.

Celery in beaker \_\_\_\_\_

Reason

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2 marks

Total 5 marks

**SECTION B – continued**  
**TURN OVER**

**Question 2**

Three experiments were carried out to investigate the control of growth in oat coleoptiles. In addition to the oat coleoptiles, materials used included

- agar, a jelly-like substance
- juices from ground-up oat coleoptiles.

**Experiment 1**

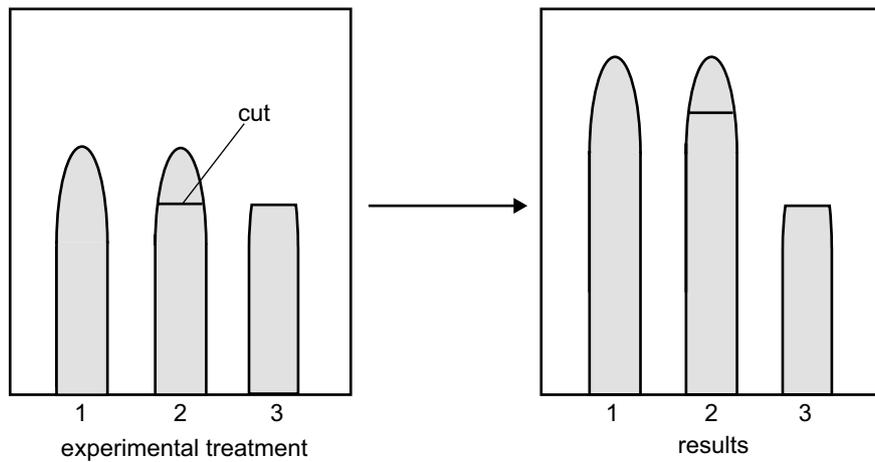
Three groups of oat coleoptiles were treated as follows.

Group 1 – no treatment

Group 2 – tip of coleoptile cut off and replaced in same position

Group 3 – tip of coleoptile cut off at same level as in group 2 and removed

The coleoptiles were incubated for four hours in darkness. The set-up and results are shown below.



a. Explain why group 2 coleoptiles grew and group 3 coleoptiles did not.

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1 mark

## Experiment 2

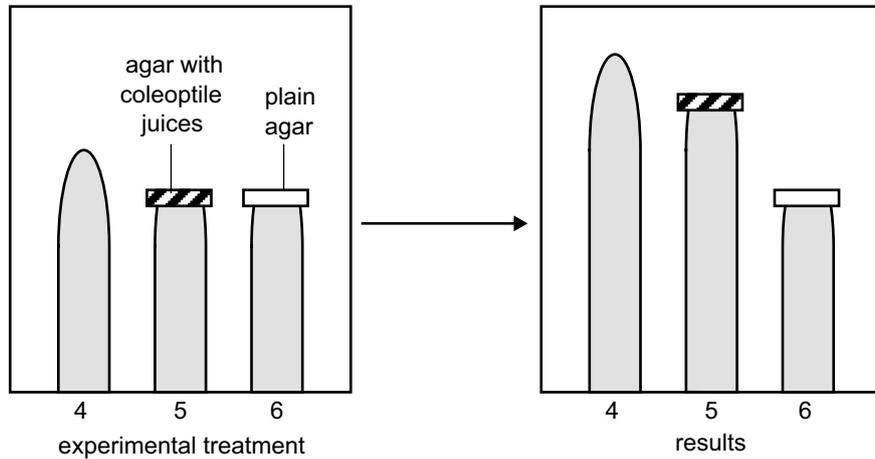
Three groups of oat coleoptiles were treated as follows.

Group 4 – no treatment

Group 5 – tip of coleoptile cut off and replaced by a piece of agar that had been soaking in juices from ground-up oat coleoptiles

Group 6 – tip of coleoptile cut off at same level as in group 5 and replaced by a piece of plain agar

The coleoptiles were incubated for four hours in darkness. The set-up and results are shown below.



- b. Explain why there is growth of coleoptiles in group 5 but no growth of coleoptiles in group 6.

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1 mark

**Experiment 3**

Four groups of coleoptiles (shown in the diagram below) were treated as follows.

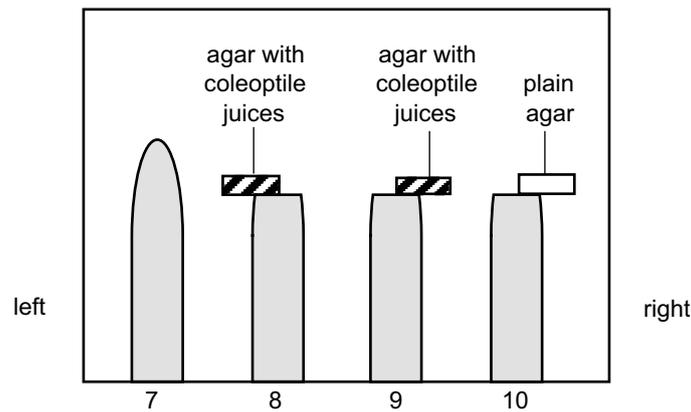
Group 7 – no treatment

Group 8 – tip of coleoptile cut off and replaced, in the position shown, by a piece of agar that had been soaking in juices from ground-up oat coleoptiles

Group 9 – tip of coleoptile cut off and replaced, in the position shown, by a piece of agar that had been soaking in juices from ground-up oat coleoptiles

Group 10 – tip of coleoptile cut off and replaced, in the position shown, by a piece of plain agar

The set-up is shown below.



The coleoptiles were incubated for four hours in darkness and then each group was examined to determine whether growth or bending had occurred in the coleoptiles.

c. Predict the growth result for each of the four groups of coleoptiles.

Record your answers in the table below by placing one tick in each of the four columns. Place your tick against the result you predict for each of the four groups.

	Experimental group			
Predicted growth result	7	8	9	10
no growth				
vertical growth				
bending to left				
bending to right				

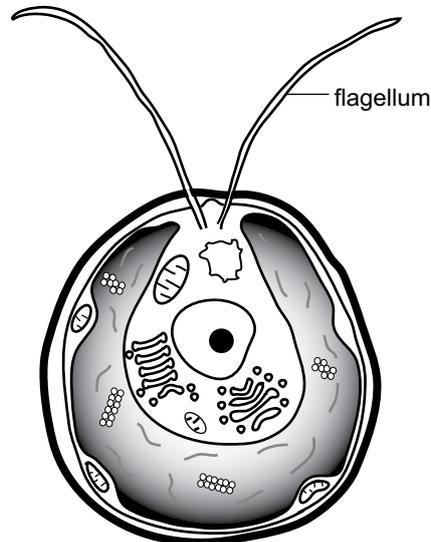
2 marks

Total 4 marks

### Question 3

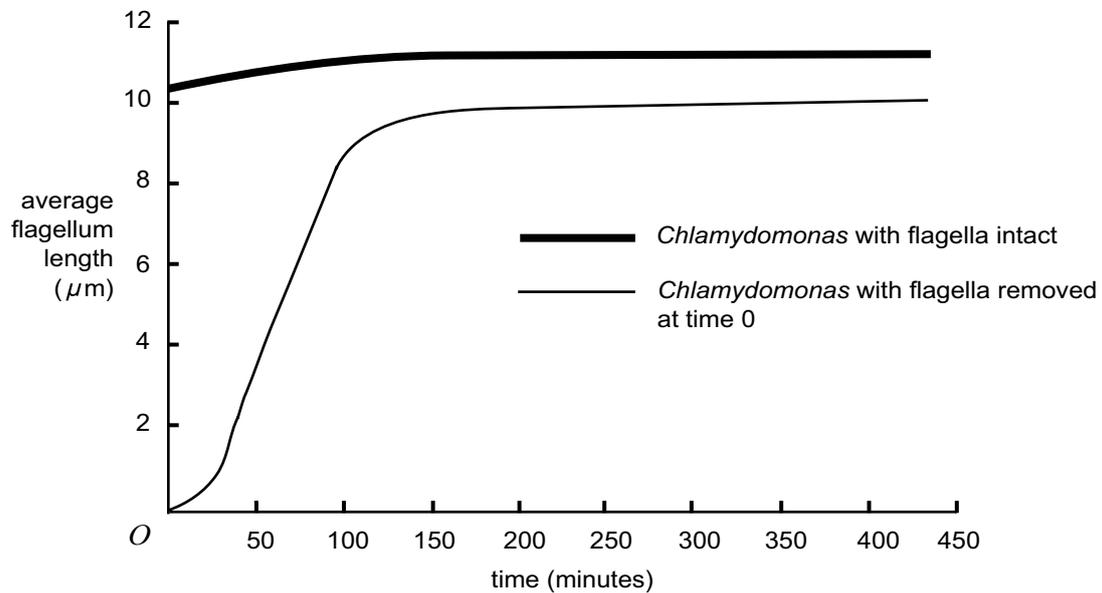
A variety of cell types possess flagella. Having the correct length of flagella is important; for example, a sperm without a flagellum is unable to swim.

*Chlamydomonas reinhardtii* is a unicellular organism, widely distributed in freshwater habitats. Each cell has two flagella of equal length.



These organisms are excellent for studying the regulation of flagella length.

In one experiment, both flagella on a number of *Chlamydomonas* were removed. These *Chlamydomonas* were observed over time and compared with a group of *Chlamydomonas* with intact flagella. The results are shown in the following graph.



- a. From the data shown in the above graph, what happens after flagella are removed?

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1 mark

To measure the length of the flagella, a light microscope was used. With the particular model of microscope used, the fields of view available were

- lens A – field of view was 1800  $\mu\text{m}$  diameter
- lens B – field of view was 450  $\mu\text{m}$  diameter
- lens C – field of view was 75  $\mu\text{m}$  diameter.

b. Explain which field of view would allow a more accurate measure of flagellum length.

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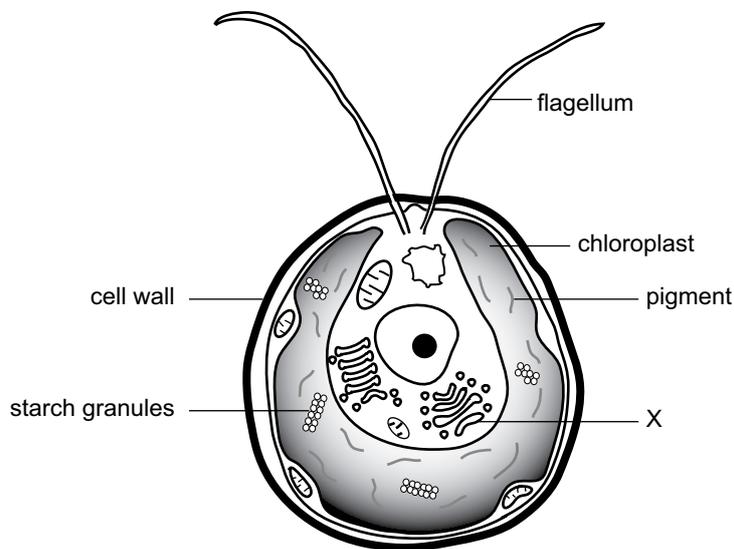
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1 mark

The following figure shows a drawing of a *Chlamydomonas* cell with some features labelled.



*Chlamydomonas* are classified into Kingdom Protista, Phylum Chlorophyta. Each cell has a cell wall made of a complex molecule called a glycoprotein.

c. In what way is this cell wall not typical of a true plant cell?

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1 mark

d. i. Name the structure labelled X in the *Chlamydomonas* figure above.

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ii. Describe its function.

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1 + 1 = 2 marks

A *Chlamydomonas* cell has a single large chloroplast containing a green pigment.

Photosynthesis and cellular respiration are two biochemical processes that are crucial for the maintenance of life on earth.

Photosynthesis takes place in two phases – a light-dependent phase and a light-independent phase.

One of the products of the reactions of the light-dependent phase takes no further part in the overall process and is sometimes referred to as a ‘waste’ product of photosynthesis.

e. What is this waste product of photosynthesis?

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1 mark

During the light-independent phase of photosynthesis, sugars are formed which are later used in respiration.

f. Name the high-energy compound produced during cellular respiration of glucose.

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1 mark

During cellular respiration, cells vary in the amount of usable energy they produce per molecule of glucose used.

g. i. Name the condition that determines how much of this high-energy compound is produced.

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ii. Compare the relative amounts of high-energy compound produced under the altered condition.

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1 + 1 = 2 marks

Total 9 marks

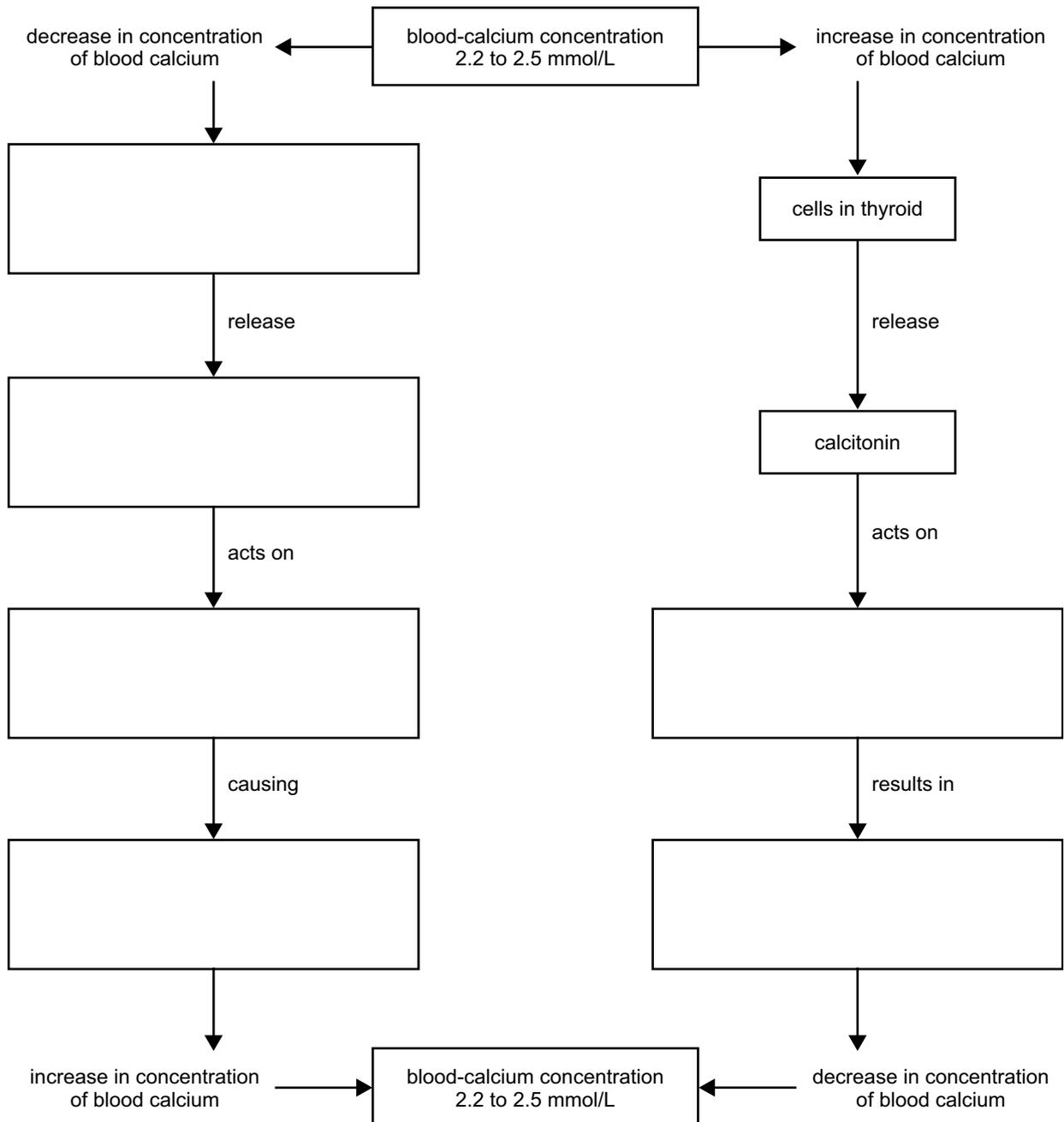
**Question 4**

Human blood-calcium concentrations are under homeostatic control. When the concentration of calcium in the blood begins to fall the parathyroid gland releases parathyroid hormone. This hormone stimulates bone cells called osteoclasts to break down bone and release calcium into the blood.

When the concentration of calcium rises in the blood, specialised cells associated with the thyroid gland release the hormone calcitonin. Calcitonin acts on bone and increases the amount of calcium that is deposited into bone.

This information can be presented in a flowchart such as that in the figure below. Note that some parts of the flowchart have been completed.

- a. Use the information given above to complete the flowchart by filling in the six empty boxes.



3 marks

- b. What is the general name given to structures that detect the changes in blood-calcium concentrations?

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1 mark

- c. The control of blood-calcium concentrations involves negative feedback. What is negative feedback?

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2 marks

Total 6 marks

### Question 5

Springhares are large nocturnally active rodents that live in arid regions of southern and eastern Africa. They spend much of the day sheltering in burrows. Biologists studied the characteristics of springhares that enable them to cope with the scarcity of water and extremes of temperature in their habitat. Eighteen adult springhares were caught and brought to the laboratory for study.

Each springhare was placed in an experimental chamber and the rate at which it used up oxygen was measured. The measurements were repeated for each springhare at a range of chamber temperatures.

- a. Explain why studying oxygen usage for each springhare enabled the scientists to calculate the metabolic rate of each animal.

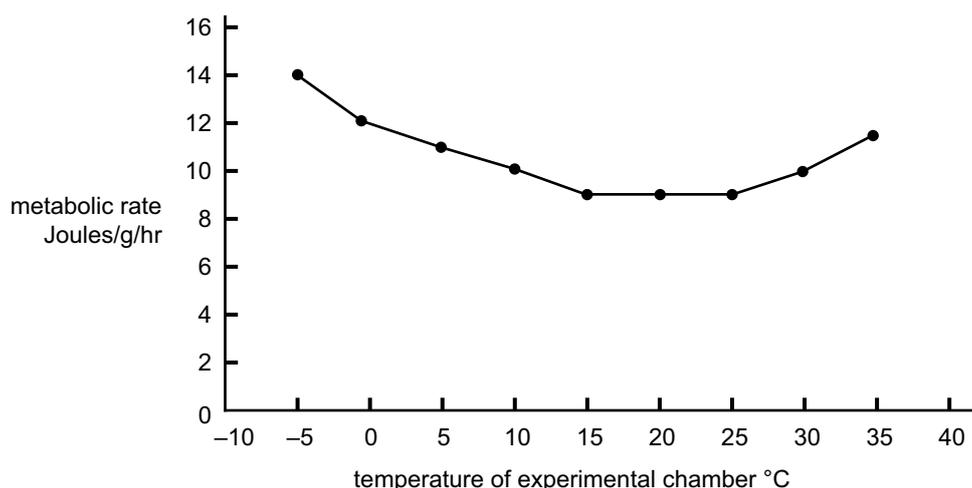
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1 mark

The average results are shown in the following graph.



The thermoneutral zone (TNZ) for an animal is that range of temperatures at which their energy expenditure is the lowest.

- b. What is the thermoneutral zone for these springhares during the experiment?

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1 mark

The biologists observed the springhares as the temperature of the experimental chamber was changed.

c. Explain how each of the observations listed below (**i.**, **ii.** and **iii.**) would contribute to regulation of body temperature.

**i.** As the chamber temperature decreased below 15°C, the springhares curled up with their heads between their hind legs and their tails wrapped around their backs.

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**ii.** As the chamber temperature decreased below 15°C, shivering became increasingly apparent.

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**iii.** At 35°C, blood vessels in the ears and legs were visibly dilated and the springhares spread saliva over their faces and throats.

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1 + 1 + 1 = 3 marks

After the experiment, the springhares were kept for a week in the laboratory animal house which was maintained at 20°C. Dry food and drinking water were provided; however, there was no evidence that the animals ever drank.

d. What would be the water source for these animals if they do not normally drink when the environmental temperature is 20°C?

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1 mark

The biologists returned to the region in which the springhares had been caught to investigate the temperatures in their burrows. They found that although outside day and night temperatures varied significantly between 33°C and 3°C, temperatures within burrows remained stable at about 12°C.

e. Explain how spending most of the daytime in burrows helps springhares maintain their water balance.

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1 mark

Total 7 marks

**Question 6**

Regulation of blood-glucose concentration relies upon functioning **B** cells in the Islets of Langerhans in the pancreas. These cells produce a hormone. Diabetes mellitus develops when **B** cells are destroyed.

- a. i. Name the hormone produced by **B** cells.

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- ii. A characteristic sign of a person suffering from diabetes mellitus is a high concentration of glucose in the blood.

Describe the action of the hormone produced by **B** cells.

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1 + 1 = 2 marks

Currently, individuals with diabetes mellitus are treated with injections of the missing hormone. These injections are usually given several times each day.

Recently, a pump capable of delivering the hormone continuously in response to changing blood-glucose concentration has been developed. The pump turns on and off automatically when the blood glucose changes.

- b. What would be the signal for the pump to turn on and begin delivering the hormone?

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1 mark

- c. Episodes of abnormally low concentration of blood glucose are reported to be less frequent in individuals when the hormone pump is used rather than hormone injections.

Explain why this would be the case.

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2 marks

Total 5 marks

**Question 7**

From time to time, local health agencies such as councils, health centres and doctors distribute information about recommended immunisation schedules for vaccination of Australian children and adults.

- a. Vaccines contain dead or attenuated (changed) cells of the disease-causing organisms. Explain why dead or attenuated cells are effective as a vaccine.

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1 mark

- b. Explain how vaccination leads to the production of memory cells.

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2 marks

A section of the vaccination schedules recommended by local health agencies is indicated below.

<b>Disease to be vaccinated against</b>	<b>Age recommended</b>
diphtheria tetanus pertussis (whooping cough) poliomyelitis	2 months
diphtheria tetanus pertussis (whooping cough) poliomyelitis	4 months
diphtheria tetanus pertussis (whooping cough) poliomyelitis	6 months
mumps	12 months

- c. Note that the first injections in the above schedule occur at 2 months of age. Explain the likely source of antibodies that a baby may have between the ages of 0 and 2 months.

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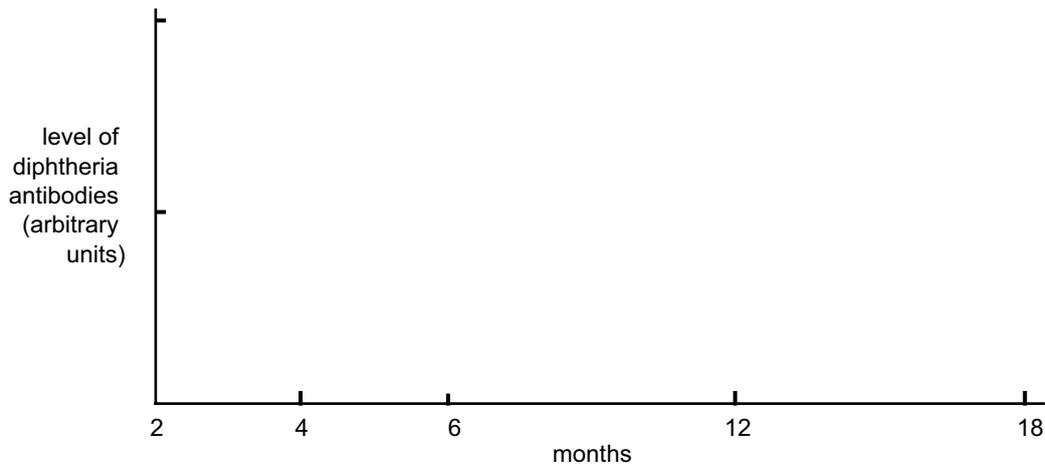


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1 mark

A newborn baby was monitored for the presence of diphtheria antibodies for the first two months of life. Over that period none were detected in the baby. The baby was then given the routine vaccinations against diphtheria at 2, 4 and 6 months of age.

- d. On the following figure, draw a graph indicating the level of diphtheria antibodies you would expect in the baby from the age of 2 to 18 months.



3 marks

Total 7 marks

### Question 8

A group of animal parasites is the flukes. One such example is the blood fluke, *Schistosoma mansoni*, which reproduces sexually in the small veins of the intestine of humans. The eggs move from the blood vessels into the intestine and are passed out in the faeces. In water, eggs hatch into larvae which infect snails. Asexual reproduction of this parasite occurs in the snail and results in a larva, called a cercaria, which can swim when it is released. Cercariae can burrow through the skin of humans working in irrigated fields contaminated with faeces. They enter the circulatory system, spend some time in the liver where they mature and then move to the small veins of the intestine.

- a. What type of cell division would occur in the snail during the asexual reproduction of the fluke?

\_\_\_\_\_

1 mark

- b. List **two** features a blood fluke is likely to have which assist its survival in a human. Describe the benefit to the fluke of each feature.

Feature 1 \_\_\_\_\_

Benefit \_\_\_\_\_

\_\_\_\_\_

Feature 2 \_\_\_\_\_

Benefit \_\_\_\_\_

\_\_\_\_\_

2 marks

Ticks are a group of parasitic spider-like arthropods which live on the outside of an animal. They attach to the skin of an animal such as a dog and suck blood from the host. This contrasts with the blood fluke which is an internal parasite.

- c. i. Describe a factor with which an external parasite such as a tick has to cope in order to survive, which is not a problem for an internal parasite such as a blood fluke.

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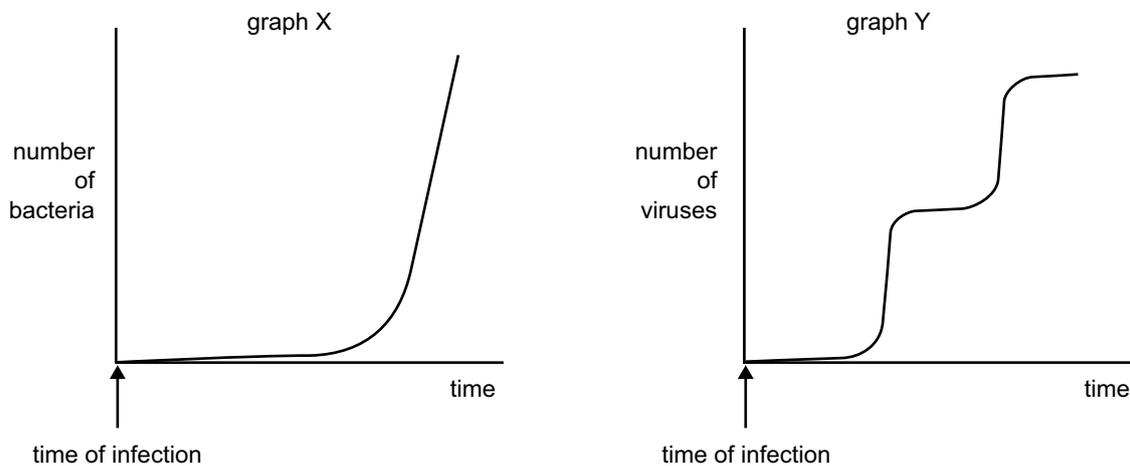
- ii. Explain how an external parasite could overcome this problem.

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1 + 1 = 2 marks

Investigations were carried out to monitor the patterns of growth of bacteria and viruses once they had infected an organism. Results were presented graphically as follows.



Graph X shows the increase in the number of bacteria in an organism after infection. Graph Y shows the increase in number of viruses in a similar organism after infection.

- d. Explain why there is a difference between the patterns of growth of bacteria and viruses after infection of an organism.

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2 marks

Total 7 marks