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Tasmanian Secondary Assessment Board

Tasmanian Certificate of Education

External Assessment

2002

BY826 BIOLOGY

SECTION A

Time: 35 minutes

On the basis of your performance in this examination, the examiners will provide a rating of A, B, C or D on the following criterion taken from the syllabus statement:

Criterion 3 Demonstrate understanding and knowledge of biological principles and how they apply to the molecular and cellular levels of biological organisation.

Pages: 7
Questions: 6

CANDIDATE INSTRUCTIONS

Answer **ALL** questions. Answers must be written in the spaces provided on the examination paper.

Candidates are reminded that spelling and expression which make it difficult for the examiner to understand what candidates mean, will result in loss of marks.

Question 1

The diagram below relates to the following questions.

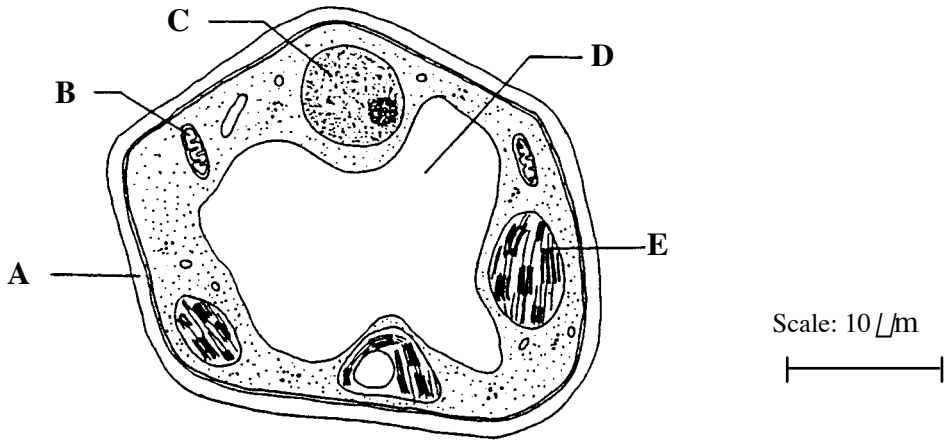

Diagram of plant cell

(a) Identify by name and letter, **two** structures never found in animal cells. (2 marks)

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(b) Which organelle produces glucose? Explain your answer. (2 marks)

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(c) If the plant was deprived of water, what would be the likely effect on the shape of the cell and its contents? Explain why this would happen. (3 marks)

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Question 1 continues opposite.

Question 1 (continued)

(d) Is it likely that this cell is a root cell that is involved in active uptake of mineral ions? Explain your answer giving **two** reasons. (3 marks)

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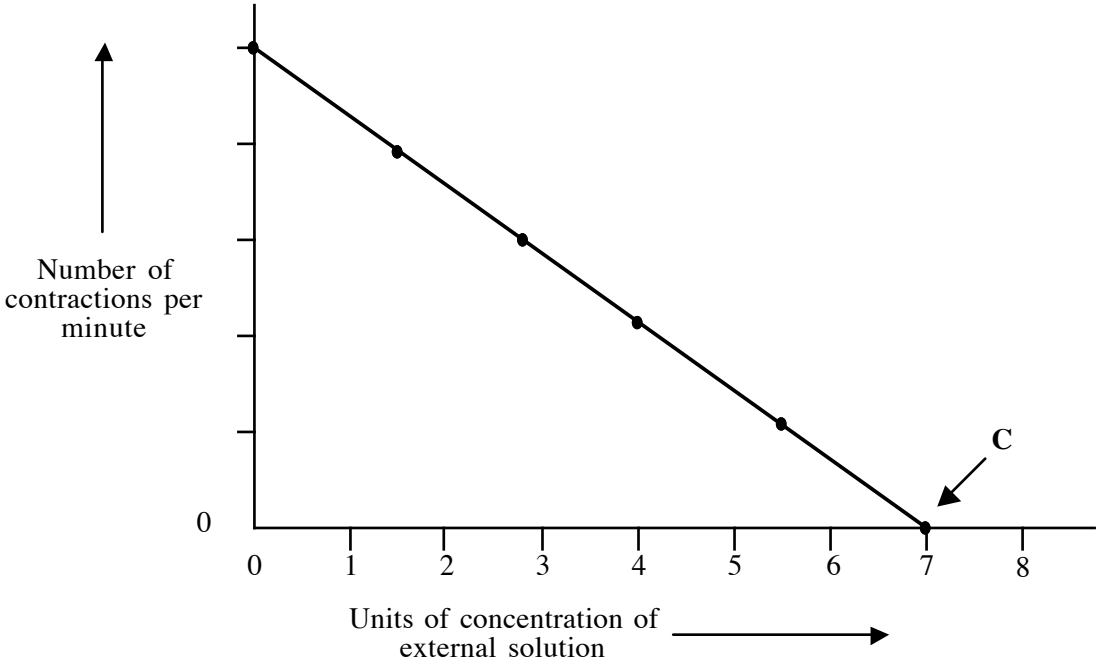
Total Question 1: /10

Question 2

Paramecium, a freshwater protozoan, has a contractile vacuole which collects and expels water from the cell.

In an experiment, a scientist mounted a *Paramecium* in distilled water on a slide, and examined it microscopically. He counted the number of times the contractile vacuole contracted per minute. The experiment was repeated, using various concentrations of salt solution instead of the distilled water. The results of the experiment are given in the below graph. It can be seen that as the concentration of the external solution increased, the frequency of contraction of the contractile vacuole decreased.



(a) Explain why the contractile vacuole slows down as the concentration of the external solution increases. (3 marks)

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(b) Predict what would happen to the *Paramecium* if the external concentration was increased past 7 units, include a brief explanation. (2 marks)

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Total Question 2: /5

Question 3

Every normal cell in the body contains identical DNA. Why don't we grow toenails in our brains? (3 marks)

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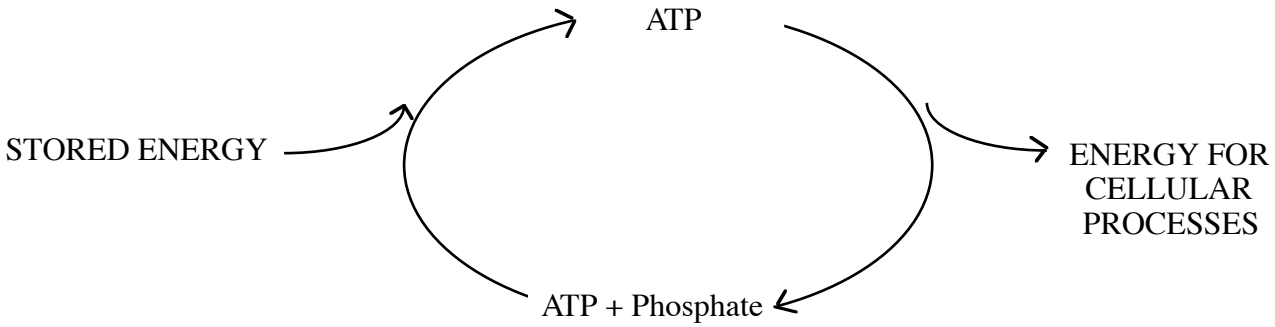
Total Question 3: /3

Question 4

The diagram below shows the ATP cycle. This represents the formation of ATP within a cell and its breakdown to ADP and phosphate. Energy is needed for the formation of ATP and energy is released when it breaks down. In a typical cell, 10 million molecules of ATP are consumed and regenerated in this way every second.



(a) What are **two** properties of ATP which make it effective as a molecule for transferring energy in cells? (2 marks)

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(b) Name **four** cellular processes which depend on the energy provided by ATP. (2 marks)

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Total Question 4: /4

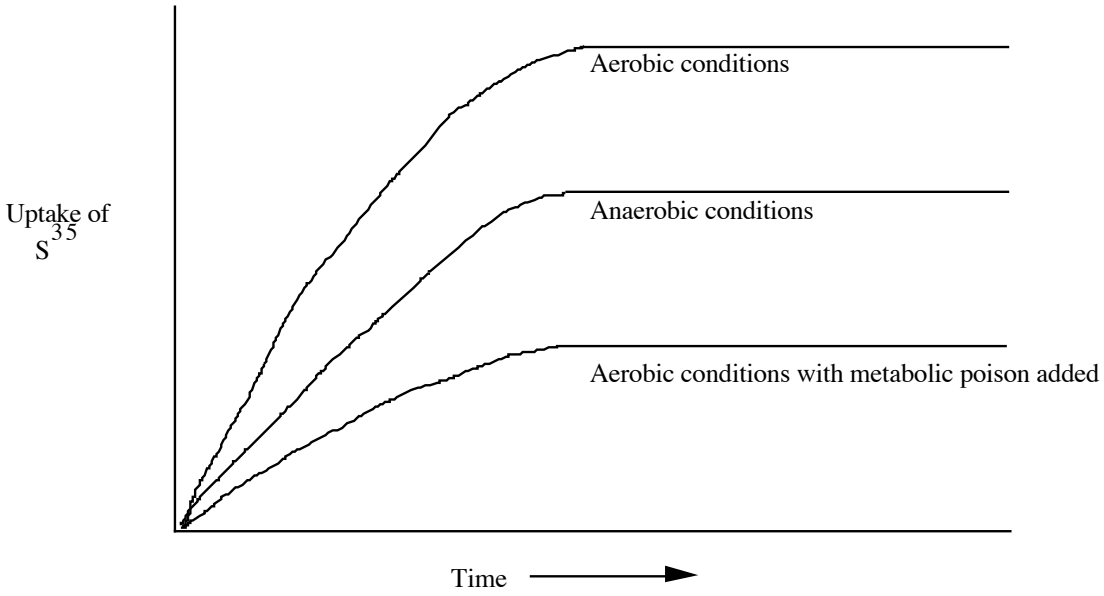
Question 5

A series of experiments was conducted to investigate the uptake of sulfate ions by barley plants when exposed to:

- low oxygen levels
- a metabolic poison

The plants were provided with sulfate labelled with radioactive S^{35}, and the amount of this taken up by the plant was estimated by using a Geiger Counter.

The results are shown in the graph below



It was noted that the uptake of S^{35} in anaerobic conditions was greatly reduced when compared to the uptake of S^{35} under aerobic conditions. This was also true with the metabolic poison.

Explain why uptake of the sulfate ions is different under each of these conditions. (6 marks)

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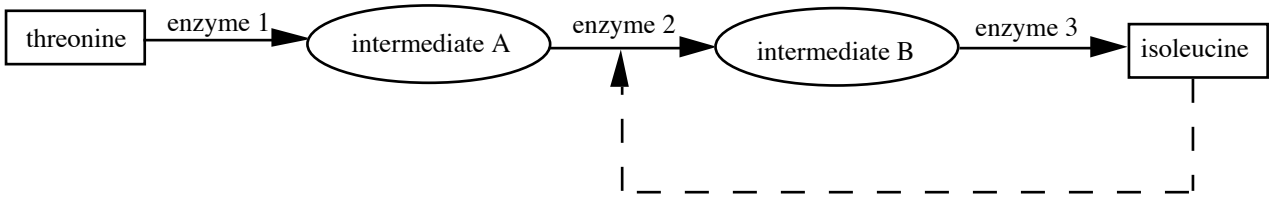
Total Question 5: /6

Question 6

A common method of metabolic control in living cells is feedback inhibition. This occurs when a metabolic pathway is switched off by its end-product.

An example of a feedback inhibitor loop is shown below.



(a) As isoleucine accumulates, it switches off its own synthesis by inhibiting enzyme 2. What effect would this have on intermediate A? (1 mark)

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(b) Explain **three** situations or conditions that would result in the continuous production of isoleucine by the cell. (3 marks)

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Total Question 6: /4

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Tasmanian Secondary Assessment Board

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2002

BY826 BIOLOGY

SECTION B

Time: 35 minutes

On the basis of your performance in this examination, the examiners will provide a rating of A, B, C or D on the following criterion taken from the syllabus statement:

Criterion 4 Display understanding and knowledge of biological principles and how they apply to the organism.

Pages: 11
Questions: 6

CANDIDATE INSTRUCTIONS

Answer **ALL** questions. Answers must be written in the spaces provided on the examination paper.

Candidates are reminded that spelling and expression which make it difficult for the examiner to understand what candidates mean, will result in loss of marks.

Question 7

Briefly discuss **one** adaptation you would expect to find in the digestive systems of animals which feed on:

(a) coarse vegetation (2 marks)

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(b) blood from other animals (2 marks)

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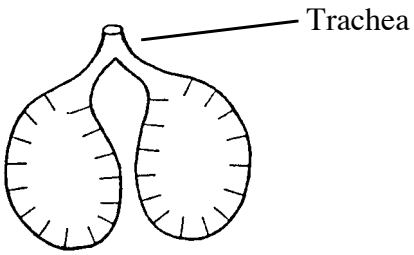
Total Question 7: /4

Question 8

A frog's lung has a simple sac-like structure, as shown in the diagram.



The surface of the sac is richly supplied with blood capillaries.

When the efficiency of a frog's lung is compared with that of a mammal's lung, the frog's lung is found to be much less efficient.

Give **two** possible explanations for this difference in lung efficiency. (4 marks)

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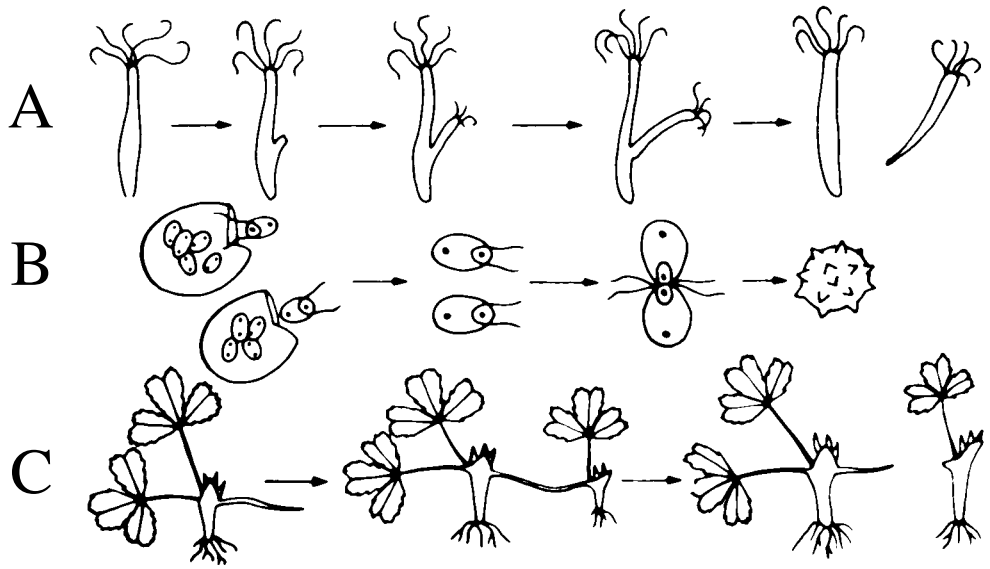
Total Question 8: /4

Question 9

The following sketches illustrate three different organisms reproducing:



Explain which of the above will produce offspring with the greatest genetic variation. (3 marks)

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Total Question 9: /3

Question 10

In mice (*Mus musculus*) a condition known as 'waltzing' affects the behaviour of some individuals. In one particular group of 'waltzing' mice, known as Nijmegan waltzers, affected mice shake their heads, circle rapidly and are very irritable.

Studies have shown this type of behaviour to be genetically based.

Consider the following information relating to the inheritance patterns of 'waltzing':

Cross 1	Parents	Waltzer x Waltzer	
	Offspring	Waltzers	314
		Non-Waltzers	0
			Total = 314
Cross 2	Parents	Waltzer x Non Waltzer	
	Offspring	Waltzers	0
		Non-Waltzers	254
			Total = 254
Cross 3	Parents	F1 cross from Cross 2	
	Offspring	Waltzers	47
		Non-Waltzers	124
			Total = 171

Question 10 continues opposite.

Question 10 (continued)

Suggest a likely pattern of inheritance based on these observations. Explain your answer fully by referring to each of the crosses. Indicate the genotypes of all parents and offspring in the table.

(6 marks)

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Total Question 10: /6

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Question 11

(a) Complete the table below to show any significant changes in the blood concentration of materials after the blood has passed through the following tissues 2 hours after food was eaten.

(3 marks)

Use the key: **less = –** **same = 0** **more = +**

Blood concentration	**Liver**	**Small intestine**	**Active Muscle**
Carbon dioxide			
Glucose			
Urea			

(b) Explain the changes you have chosen for the liver. (4 marks)

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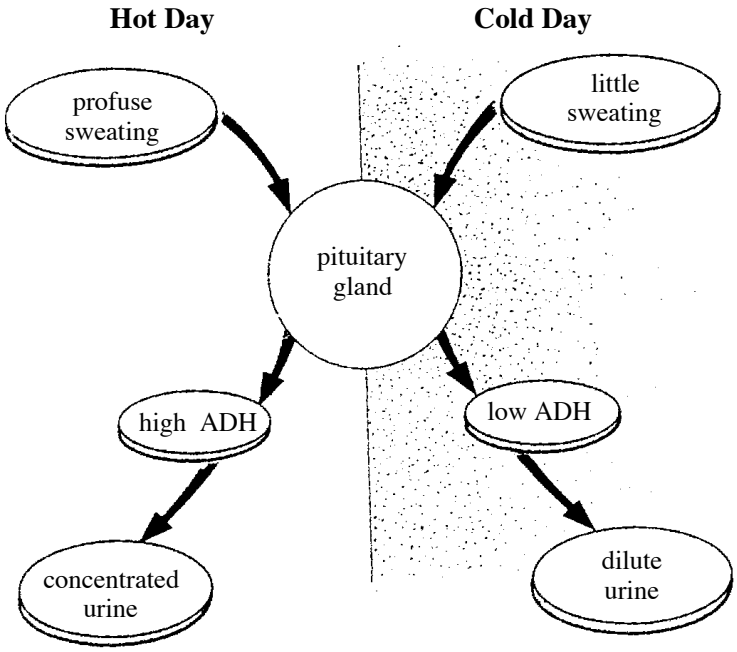
Total Question 11: /7

Question 12

Reabsorption of water occurs in the kidney tubules. The amount reabsorbed into the blood depends on the permeability of the tubules which is in turn controlled by the pituitary gland. Use the diagram in answering the following questions.



(a) Explain why larger urine volumes tend to be produced on a cold day. (3 marks)

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Question 12 continues opposite.

Question 12 (continued)

(b) Explain how the above diagram does/does not fit the model of homeostasis. (4 marks)

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(c) Many people suffering diabetes insipidus have a deficiency of ADH. Suggest **two** consequences of this ADH deficiency. (2 marks)

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Total Question 12: /9

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Tasmanian Secondary Assessment Board

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SECTION C

Time: 35 minutes

On the basis of your performance in this examination, the examiners will provide a rating of A, B, C or D on the following criterion taken from the syllabus statement:

Criterion 5 Demonstrate understanding and knowledge of biological principles and how they apply to the interrelationships between organism and environments.

Pages: 7
Questions: 5

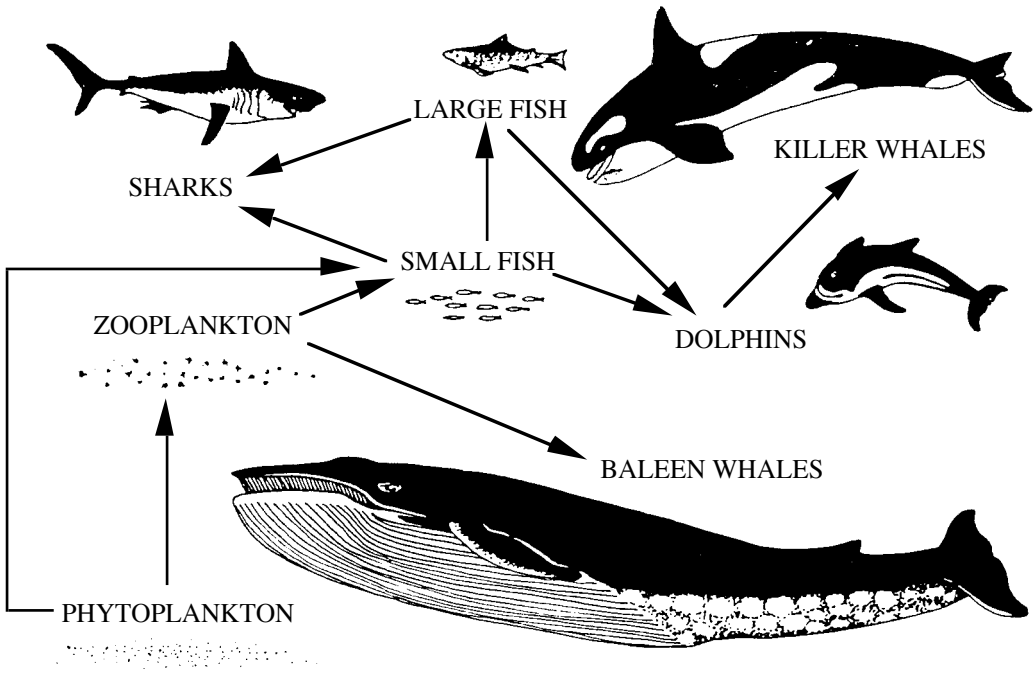
CANDIDATE INSTRUCTIONS

Answer **ALL** questions. Answers must be written in the spaces provided on the examination paper.

Candidates are reminded that spelling and expression which make it difficult for the examiner to understand what candidates mean, will result in loss of marks.

Question 13

The following questions refer to the partial food web below.



(a) Write the name of an organism from this food web which is: (2 marks)

- a primary producer.....
- a first order consumer.....
- a second order consumer .....
- an omnivore .....

Question 13 continues opposite.

Question 13 (continued)

(b) If an insecticide such as DDT was introduced into the food web, in which organisms would it be found in the highest concentration? Explain the process taking place. (3 marks)

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(c) Most of the biomass of the system is eventually broken down to inorganic materials by decomposer organisms. Are these inorganic breakdown products lost to the ecosystem? Explain your answer. (3 marks)

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Total Question 13: /8

Question 14

Rabbits are serious environmental pests. Rabbit calici disease (RCD) is caused by a virus that has been introduced in many parts of Australia to control rabbit numbers. Following the introduction of the disease, infected rabbits die quickly and population numbers fall sharply. Even though there is no danger of RCD infecting other species, some biologists are concerned that the sudden removal of rabbits from an area may cause reduction in the size of populations of native animals. Explain how this could happen. (3 marks)

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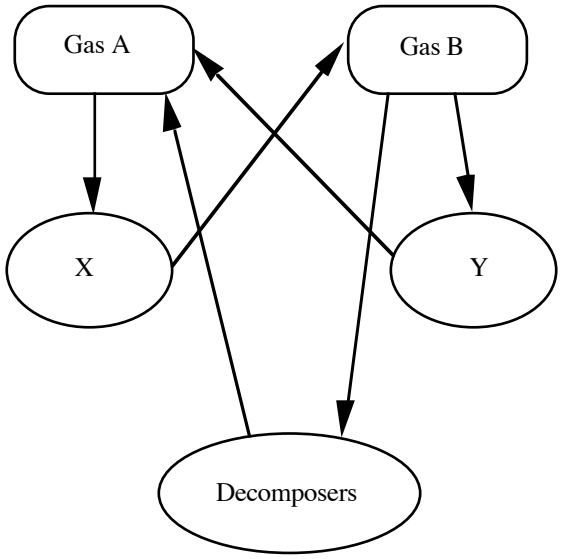
Total Question 14: /3

Question 15

In the figure below the labelled shapes represent different gases in the atmosphere and living organisms of different types. Arrows show the direction of some of the movements of gases between the atmosphere and living organisms.



Identify Gas **A** and Organisms **X**. Give a brief explanation for your choices, naming the process involved in each case. (4 marks)

Gas **A**: .....

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Organism **X**: .....

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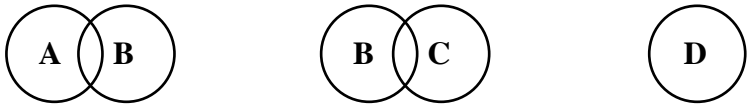
Total Question 15: /4

Question 16

(a) The letters **A**, **B**, **C** and **D** refer to four populations of frogs. These populations are represented diagrammatically by circles, and the overlapping circles indicate interbreeding of the populations concerned. Where the circles do not overlap, no interbreeding of these populations occurs.



(i) Give **two** possible explanations as to why population **D** is reproductively isolated from the other populations. (2 marks)

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(ii) If conditions in the environment change rapidly which population would be least likely to survive? Explain your answer. (3 marks)

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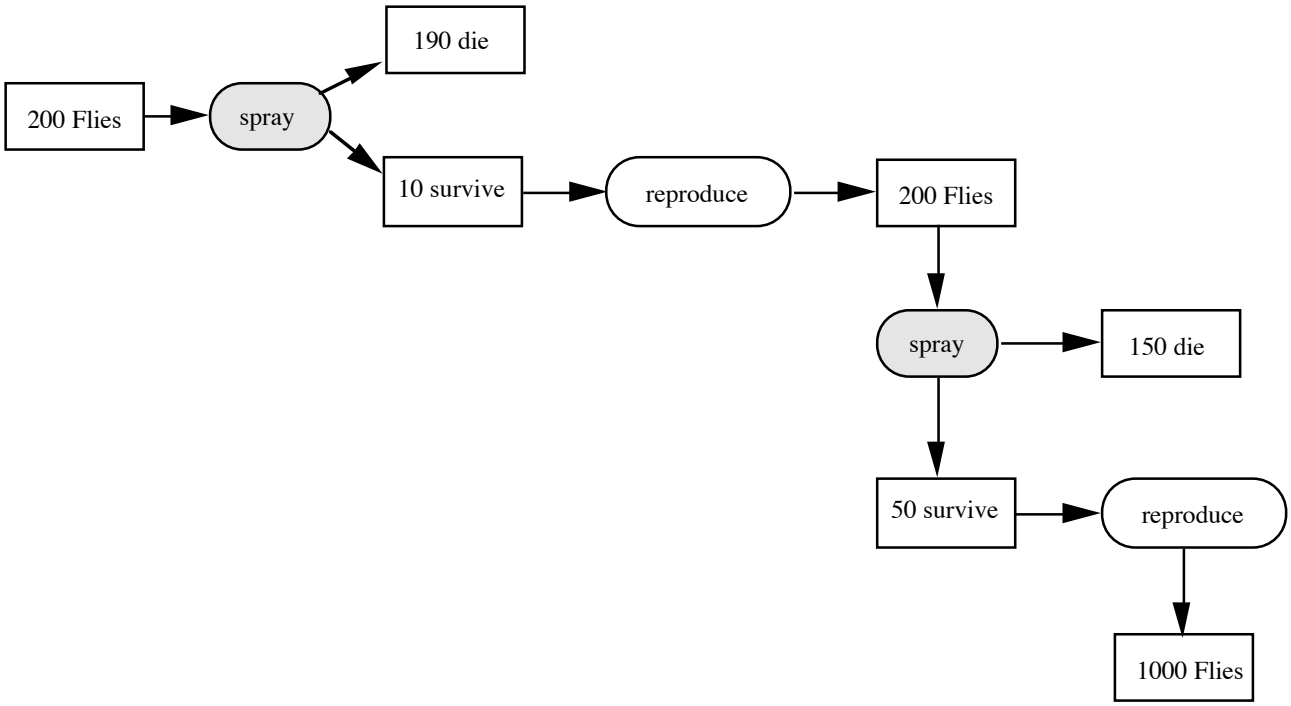
Question 16 continues over the page.

Question 16 (continued)

(b) The diagram below was found in a student's science notebook.



Explain the process illustrated above. (4 marks)

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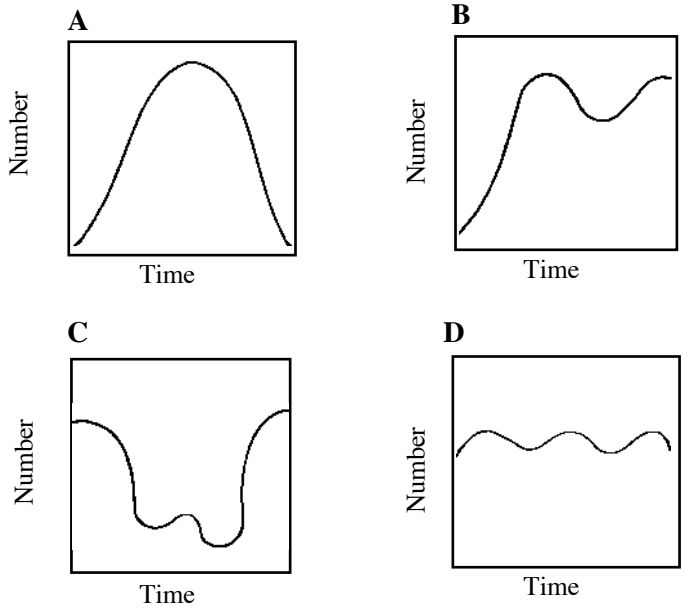
Total Question 16: /9

Question 17

Types of population growth curves



(a) Which graph represents a population of a species of lizard which was introduced onto a small oceanic island, established itself, and came to equilibrium? Suggest what might have caused these changes in lizard numbers. (4 marks)

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(b) Sometimes newly established populations increase rapidly and then crash. Which graph represents this situation? Suggest **two** reasons why a crash may have occurred. (3 marks)

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Total Question 17: /7

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SECTION D

Time: 35 minutes

On the basis of your performance in this examination, the examiners will provide a rating of A, B, C or D on the following criterion taken from the syllabus statement:

Criterion 8 Develop feasible hypotheses and design controlled experiments to test hypotheses.

Pages: 7
Questions: 4

CANDIDATE INSTRUCTIONS

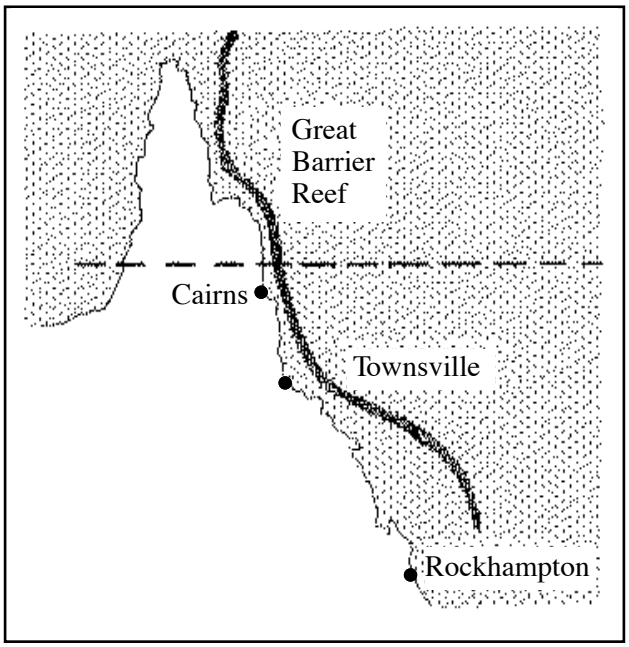
Answer **ALL** questions. Answers must be written in the spaces provided on the examination paper.

Candidates are reminded that spelling and expression which make it difficult for the examiner to understand what candidates mean, will result in loss of marks.

Question 18

(a) The 'crown of thorns' starfish feeds on coral. It is inturn, preyed upon by the giant triton, a marine gastropod with a large trumpet shaped shell, much prized by collectors.

In recent years the crown of thorns has developed in plague proportions in the region below the broken line on the map, and has become a serious threat to the Great Barrier Reef. Above the line the starfish is present but not in plague proportions.



Suggest an hypothesis to account for the sudden increase in starfish numbers. (3 marks)

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(b) The common garden snail, *Helix aspersa*, secretes mucus from the lower surface of its foot to lubricate its passage over the ground. It has been observed that the migration of snails often follows existing mucus trails. Formulate one hypothesis to account for this observation.
(3 marks)

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Total Question 18: /6

Question 19

The following is an excerpt from a magazine article:

> **'Folklore or fact? *Tight undies can make you infertile*.'**
>
> The best temperature for sperm production is 35°C, which is 2°C below core body temperature. It is widely accepted by experts that a rise in scrotal temperature (seen mainly in boys and men with undescended testes), can affect sperm quality.'

From the information given:

(a) Identify the independent variable. (1 mark)

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(b) Identify the dependent variable. (1 mark)

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An experiment to investigate if this holds true in normal adults was designed to use 100 healthy young males at a college. The young males would volunteer for whether they would wear tight jeans for a week or normal clothing for a week. Those wearing normal clothing would be the control group.

(c) Identify **four** limitations of this method. (4 marks)

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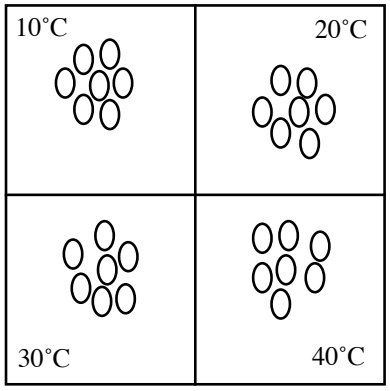
Total Question 19: /6

Question 20

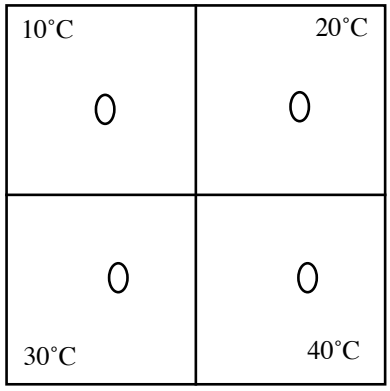
A student wished to determine the best temperature to incubate chicken eggs so that they hatch in the shortest possible time. Three possible designs were considered as shown below.

A



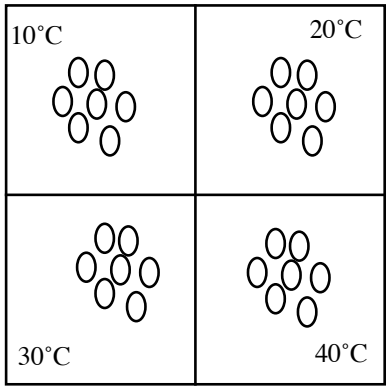
The time recorded is the time the first egg hatches at each temperature

B



The time recorded is the time for each egg to hatch

C



The time recorded is the average time the eggs hatch at each temperature

Comment on how valid the results would be in each case, **A**, **B** and **C**. (6 marks)

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B: .....

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C: .....

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Total Question 20: /6

Question 21

Denis Summers–Smith has been studying sparrows for more than half a century in England. He has observed that a major decline in sparrows in the big cities occurred in the late 1970's and early 1980's. This coincides with a huge environmental change: the conversion from leaded to unleaded petrol.

The scientist suggests that the culprit is a chemical called methyl tertiary butyl ether (MTBE), which is added to unleaded petrol as an 'anti-knocking' agent.

He believes that this chemical belching out from millions of car exhausts is **killing off the small insects** that house sparrow chicks require during the first three days of their life.

One possible hypothesis is:

'The decline in house sparrows is due to increased levels of MTBE which is an effective **insecticide**.'

(a) Design an experiment to test the above hypothesis and include in your answer what results would support this hypothesis. (10 marks)

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Question 21 continues opposite.

Question 21 (continued)

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(b) Explain how such results might indicate that there would be a greater loss of sparrows in larger cities than rural areas. (2 marks)

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Total Question 21: /12

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Tasmanian Secondary Assessment Board

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SECTION E

Time: 35 minutes

On the basis of your performance in this examination, the examiners will provide a rating of A, B, C or D on the following criterion taken from the syllabus statement:

Criterion 9 Analyse, interpret and evaluate information and data gained (from individual investigations and the investigations of others) and to evaluate the methods used and conclusions drawn from these investigations.

Pages: 10
Questions: 5

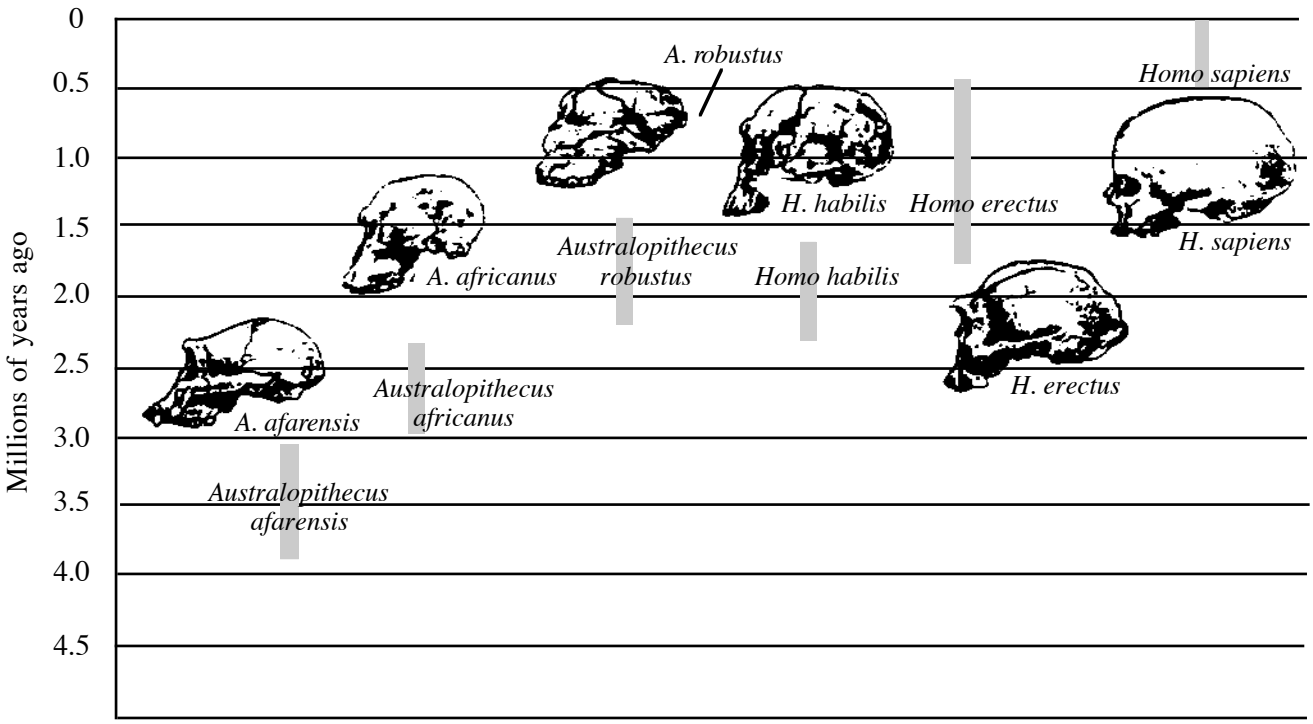
CANDIDATE INSTRUCTIONS

Answer **ALL** questions. Answers must be written in the spaces provided on the examination paper.

Candidates are reminded that spelling and expression which make it difficult for the examiner to understand what candidates mean, will result in loss of marks.

Question 22

The diagram below shows the skull shapes of some hominids and the period of time during which they existed.



(a) Which of these hominids existed for the longest period of time? Include the length of time in your answer. (2 marks)

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(b) Which **three** species existed at the same time? (1 mark)

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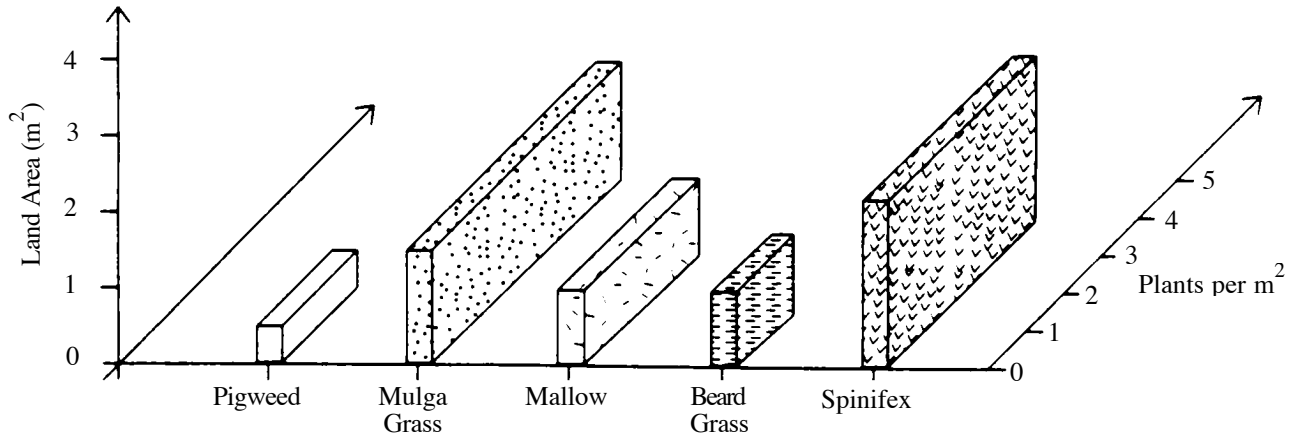
Total Question 22: /3

Question 23

An ecologist graphed the number of plants and the area covered by several plant species in an ecosystem.



Identify which plant species:

(a) covers the largest land area. (1 mark)

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(b) has the greatest density. (1 mark)

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(c) has the largest population. (1 mark)

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Total Question 23: /3

Question 24

Populations of two species of insects (which look almost identical) were maintained in culture bottles for long periods of time. Ten insects of each species were placed together in each bottle. The percentage of individuals of each species present in each of the six bottles after six months is recorded in the table.

Culture No.	**1**	**2**	**3**	**4**	**5**	**6**
% after 6 months						
Species X	100	10	75	15	40	0
Species Y	0	90	25	85	60	100
Conditions						
Temperature ℃	30	30	22	22	15	15
Relative Humidity %	80	20	80	20	80	20

On the basis of these results, which species would survive in the widest range of environmental conditions? Justify your choice. (5 marks)

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Total Question 24: /5

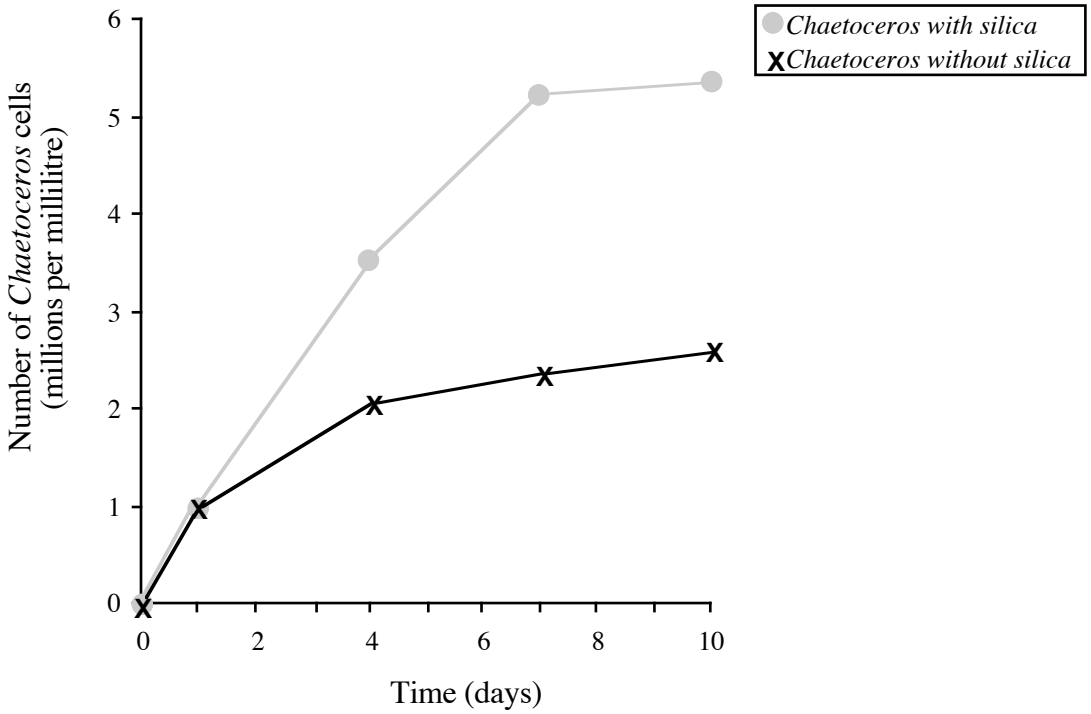
Question 25

Chaetoceros sp is a single celled alga. In a study of the effect of silica on the growth of *Chaetoceros sp* cultures were set up with and without silica in the culture medium. On **Day 0** each culture had 400,000 *Chaetoceros* cells per millilitre. The table below shows the cell numbers in each culture at intervals during the following eight days.

Table: Number of *Chaetoceros* cells (millions per millilitre)

	Day 0	**Day 1**	**Day 4**	**Day 7**	**Day 10**
Chaetoceros with silica	0.400	1.105	3.510	5.200	5.210
Chaetoceros without silica	0.400	1.005	2.050	2.250	2.300

Number of *Chaetoceros* cells



(a) Comment on the similarities and differences shown by the results of this experiment. (4 marks)

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Question 25 continues opposite.

Question 25 (continued)

(b) Give **two** ways the reliability of the data in work such as this could be increased. Justify your choice. (4 marks)

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(c) A student looking at these results concluded that adding more silica increases the growth of single celled algae.

What additional information would you like to have before accepting or rejecting this conclusion? (4 marks)

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Total Question 25: /12

Question 26

Figure 1 below shows the average metabolic rates (MR) of inactive adult lizards from seven different species, all measured at 25°C.

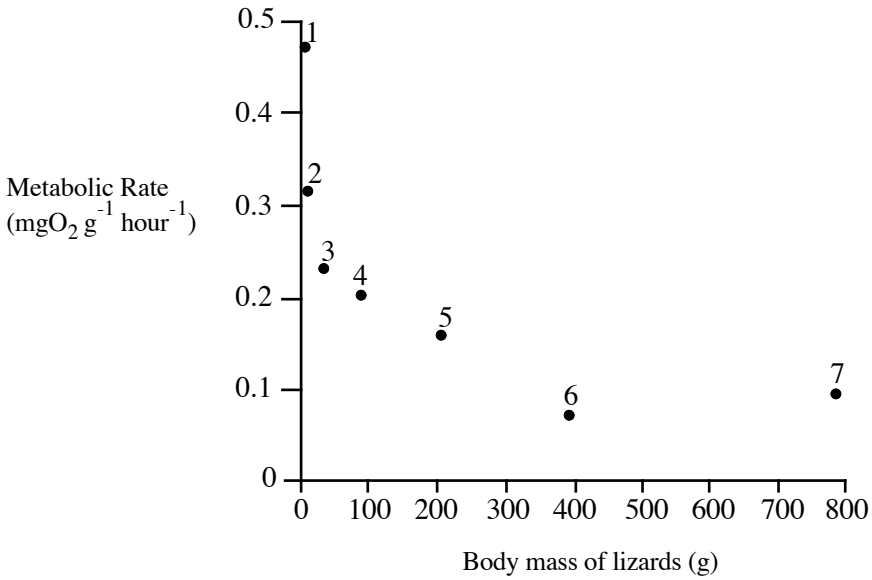

Figure 1

(a) Give a statement about the metabolic rate of the lizards in relation to their body mass. (2 marks)

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(b) The Y axis (vertical axis) of the graph is labelled Metabolic Rate, ($mgO_2\ g^{-1}\ hour^{-1}$). Both of the following could be used as an alternative measure of metabolic rate. Compare the relative strength and weakness of each.

(i) water loss ($mgH_2O\ g^{-1}\ hour^{-1}$).
(ii) carbon dioxide output ($mgCO_2\ g^{-1}\ hour^{-1}$). (4 marks)

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Question 26 continues opposite.

Question 26 (continued)

(c) **Figure 2** shows the metabolic rate (MR) of a lizard (species 7) when kept at different temperatures. MR was measured first at 30˚C and then at lower temperatures.

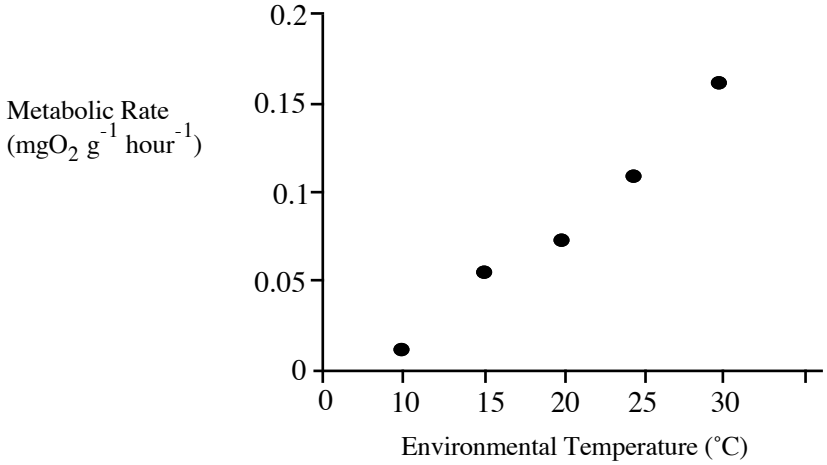

Figure 2

Explain if it is valid to state that 30˚C is the optimum temperature for the lizard because at this temperature the MR is highest. (3 marks)

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Total Question 26: /9

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