



2018 ANNUAL EXAMINATION

BIOLOGY

Form V

STRUCTURE OF PAPER

- Section I: Multiple Choice (18 marks)
Answer all questions on the Multiple-Choice Answer Sheet.
- Section II: Extended Response (87 marks)
Answer all parts of the questions in the spaces provided in the Examination Paper.
- Board approved calculators may be used

EXAMINATION

Date: Tuesday 11th September (AM)
Duration: 2 hours
Marks: 105

CHECKLIST

Each boy should have the following:

- 1 Examination Paper
- 1 Multiple-Choice Answer Sheet

EXAM INSTRUCTIONS

- Remove the centre staple and hand in all parts of the paper in one bundle.
- **WRITE YOUR NAME AND CLASS NUMBER IN THE SPACE PROVIDED AT THE TOP OF EACH SEPARATE SECTION.**

CLASS NUMBER	1	2	3	4	5
Class Code	5BL201	5BL202	5BL203	5BL204	5BL205
Master Initials	ACR	GPW	HCKM	ZI	ACR

Master in charge: ACR

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SECTION I: MULTIPLE CHOICE

Attempt ALL Questions
Use the Multiple-Choice Answer Sheet.

- 1 When organisms are living densely packed in one small area, they are most likely to compete if they belong to one species than if they belong to many different species. Which of the following is the most likely reason for this?
 - (A) Organisms of the same species have similar death rates.
 - (B) Organisms of the same species have similar requirements.
 - (C) Organisms of the same species produce more fertile offspring.
 - (D) Organisms of the same species are less likely to move out of the area.

- 2 What would be the result of resource partitioning (division of resources) within an ecosystem?
 - (A) One species will be excluded.
 - (B) Competition between species would be increased.
 - (C) Competition between the species would be reduced.
 - (D) There would be no effect on the competition between species.

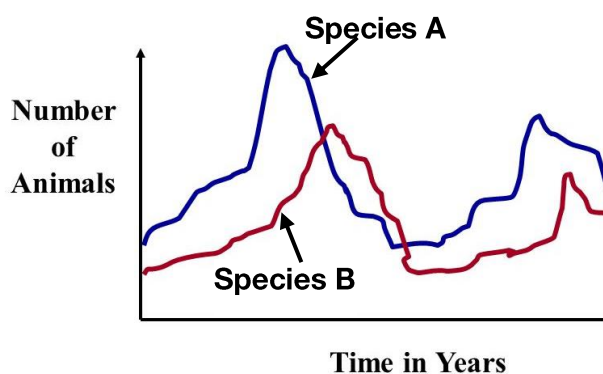
- 3 Choose the best definition for the term 'ecological niche':
 - (A) It is the area in which a species lives.
 - (B) It is the special separation of organisms in an ecosystem.
 - (C) It describes the role and position a species has in its environment.
 - (D) It is the number of individuals of the same species living in a defined area.

- 4 A group of students compared the mass of three identical carrot sticks, cut from a single carrot, before and after they had been immersed in different salt solutions for 30 minutes. Stick X increased in mass by 0.15 g, stick Y decreased in mass by 0.45 g and stick Z decreased in mass by 0.05 g. Which of the following is consistent with their readings?
 - (A) Stick Y was put in the salt solution of lowest concentration.
 - (B) Stick Y was put in salt solution of higher concentration than stick Z.
 - (C) Stick X was put in a salt solution of higher concentration than stick Y.
 - (D) Stick Z was put in a salt solution of a lower concentration than stick X.

- 5** Which of the following is an important advantage of aerobic respiration over anaerobic respiration?
- (A) It produces oxygen as a by-product.
 - (B) It can occur in the absence of oxygen.
 - (C) It can occur over a wider range of temperatures.
 - (D) It produces more ATP for every glucose molecule used.
- 6** Which of the following is an example of active transport?
- (A) osmosis
 - (B) diffusion
 - (C) facilitated diffusion
 - (D) none of the above
- 7** Large molecules that cannot readily cross the cell membrane can be moved into the cell by which of the following processes?
- (A) Diffusion
 - (B) Osmosis
 - (C) Exocytosis
 - (D) Endocytosis
- 8** You would expect a cell with an extensive Golgi apparatus to:
- (A) require little ATP.
 - (B) secrete lots of protein.
 - (C) perform photosynthesis.
 - (D) store large quantities of food.
- 9** The desert-hopping mouse hides away in burrows during the daytime. What type of adaptation is this?
- (A) physical
 - (B) structural
 - (C) behavioural
 - (D) physiological

- 10** Due to the overuse of DDT, some malaria carrying mosquitos have become resistant to this pesticide. What is this an example of?
- (A) gene flow
 - (B) speciation
 - (C) microevolution
 - (D) macroevolution
- 11** “Survival of the fittest” is a phrase used to describe part of the process of natural selection as proposed by Charles Darwin. In this context, the word ‘fittest’ is best described by which of the following statements?
- (A) The ‘fittest’ organism produces the largest number of surviving offspring.
 - (B) The ‘fittest’ organism is able to establish and defend the largest feeding ground.
 - (C) The ‘fittest’ organism is the largest and strongest individual in the population.
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- 12** It is essential that an effective and well-adapted respiratory system will have:
- (A) a large surface area.
 - (B) impermeable surfaces.
 - (C) a supporting framework of bones.
 - (D) a link to the digestive system to obtain oxygen.
- 13** Which of the following statements about the effect of temperature on an enzyme is correct?
- (A) Freezing an enzyme destroys it.
 - (B) All enzymes work best between 0 and 25°C.
 - (C) The higher the temperature the greater the rate of reaction.
 - (D) Enzymes are most efficient within a specific temperature range.
- 14** A heterotroph must consume organic matter in order to:
- (A) recycle energy.
 - (B) continue the food chain.
 - (C) recycle nutrients from autotrophs.
 - (D) provide growth materials and energy for life.

- 15 Spiracles and stomata are structures most likely to be found respectively in which of the following organisms?
- (A) Trout and frog
(B) Frog and trout
(C) Grasshopper and apple tree
(D) Apple tree and grasshopper
- 16 The graph below represents how two populations, A and B, change over time.



Based on the graph above, what can be concluded about the two species?

- (A) Species B is likely to be the predator of species A.
(B) Species B has a greater population than species A.
(C) Both species are competing for the same resource.
(D) As the population of species A increases, species B decreases.
- 17 Which of the following could a scientist see using a light microscope?
- (A) A virus
(B) Ribosomes
(C) Lysosomes
(D) Chloroplasts
- 18 If 30 individuals have been counted in 12 quadrats (each with an area of 5 m²), what is the average density of that species?
- (A) 0.5 individuals per m²
(B) 2 individuals per m²
(C) 6 individuals per m²
(D) 180 individuals per m²

SECTION II: ECOSYSTEM DYNAMICS

NAME

CLASS

Answer the questions in the spaces provided.
Show all relevant working in questions involving calculations.

Question 19 (3 marks)

Marks

Complete the table below to identify the types of symbiotic relationship that can occur between species.

Key

‘+’ indicates the species benefits from the interaction.

‘-’ indicates the species has been harmed from the interaction.

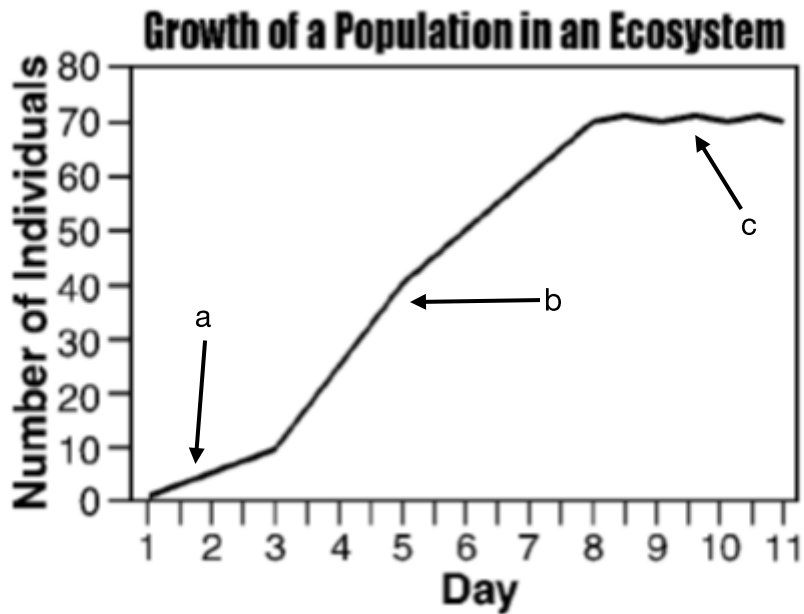
‘0’ indicates no effect on a species.

Type of symbiosis	Species A	Species B
	+	-
	+	0
	+	+

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Question 20 (3 marks)**Marks**

The graph below shows the population growth of a unicellular organism in a pond over an eleven-day period.



Using the information presented, explain the changing shape of this curve at each point (a, b and c).

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Question 21 (4 marks)**Marks**

Give one example of an extinct species of an Australian animal and discuss their evolutionary relationship to a living species. In your answer, specify their similarities and differences.

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Question 22 (9 marks)**Marks**

Read the extract below and then answer the questions that follow.

Biodiversity may prove to be the defining issue of our age (Diversity Today, Scientific blog, published 28 July 2018)

“In June 2016, scientists from the University of Queensland confirmed what had been feared for some time: the Bramble Cay mosaic-tailed rat was no more. This small rodent eked out a lonely existence on Bramble Cay, a tiny dot of land at the northern end of the Great Barrier Reef. When Europeans first landed in 1845, the place was teeming with them. But frequent inundations caused by rising sea level made life increasingly precarious and the creature is now literally a drowned rat...”

“...We are thus in an era where two great environmental anxieties – climate change and biodiversity loss – are converging. Biologists expect many more species to go the way of the rat. If we are not already in the midst of the sixth mass extinction, we soon will be.”

- (a) Evaluate the reliability of this source.

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- (b) Define biodiversity and explain why scientists have concerns regarding biodiversity loss.

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Question 22 continued on next page.

Question 22 continued.**Marks**

- (c) For a named organism, other than the Bramble Cay mosaic-tailed rat, explain the threats to the organism's survival and describe two measures that have been used to conserve or protect this organism.

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Question 23 (4 marks)**Marks**

Numbers of a population of Bush Rats in a woodland ecosystem were estimated using the capture-recapture technique. A non-harmful series of traps were set up containing oats and peanut butter bait. On the first day, 50 Bush Rats were captured, marked and released. Two weeks later, the traps were set again and 80 Bush Rats were trapped. Of the 80 that were recaptured, 30 were marked.

- (a) From the data, calculate the estimated size of the Bush Rat population. Show your working.

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- (b) Some Bush Rats develop a preference for the bait and stay in the area waiting to receive the food again. Assess the validity of using this technique and its effect on the estimate.

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SECTION II: CELLS AS THE BASIS OF LIFE

NAME

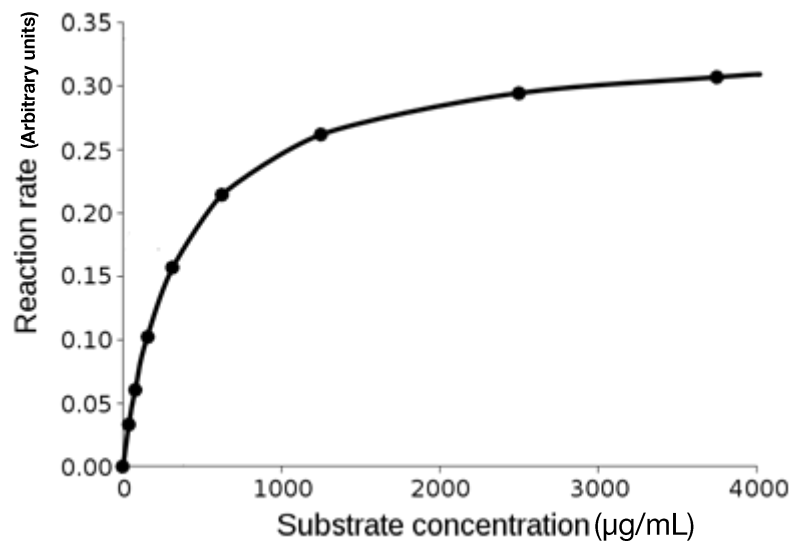
CLASS

Answer the questions in the spaces provided.
Show all relevant working in questions involving calculations.

Question 24 (3 marks)

Marks

The graph below shows the results of the effect of substrate concentration on the rate of an enzyme controlled reaction.



Explain the change in shape of the curve as substrate concentration increases.

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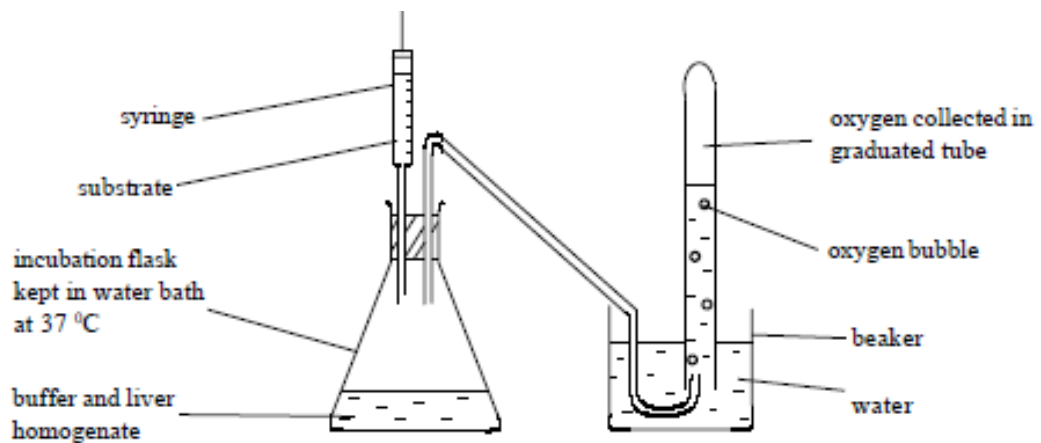
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Question 25 (5 marks)**Marks**

The apparatus illustrated below can be used to investigate the activity of the enzyme catalase which is found in liver. The liver tissue has been ground up and mixed with a buffer solution (which keeps the pH level constant). The substrate for catalase is hydrogen peroxide, which can be added to the homogenate (mixture) via the syringe.



Question 25 continued on next page.

Question 25 continued.**Marks**

Using the apparatus shown, design a safe, valid and reliable experiment to investigate the effect of temperature on the activity of catalase. Identify the dependent and independent variables in your answer and describe an appropriate control for this experiment.

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Question 26 (2 marks)**Marks**

The cell membrane consists of proteins embedded within a phospholipid bilayer. It is estimated that approximately 30% of the different proteins produced in a cell are found within the cell membrane.

Describe one role of a protein within the cell membrane.

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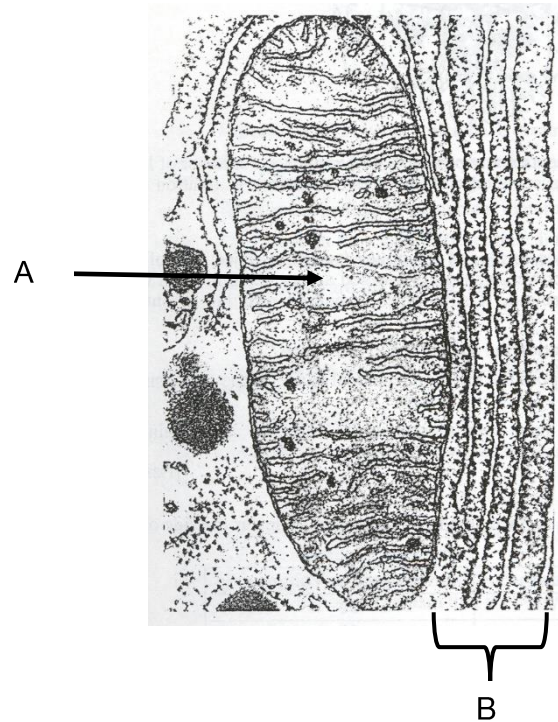
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Question 27 (4 marks)**Marks**

The following diagram shows part of a cell under an electron microscope.



- (a) Identify organelles A and B.

A=

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B=

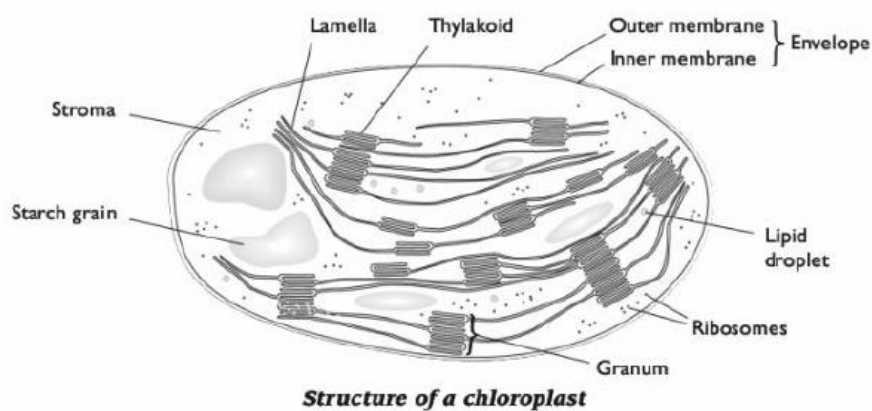
- (b) Explain how the structure of organelle A assists with its respective function in the cell.

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Question 28 (7 marks)**Marks**

The diagram below shows the internal structure of a chloroplast.



- (a) Complete the table below that compares features of the light dependent and light independent reactions of photosynthesis.

Feature	light dependent	light independent
Name of the location within a chloroplast where the reaction occurs		
Product(s) of reaction	1. 2.	1.

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- (b) Describe a technique that could be used to trace the origin of the carbon atoms found in the starch molecules present in chloroplasts.

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SECTION II: BIOLOGICAL DIVERSITY

NAME

CLASS

Answer the questions in the spaces provided.
Show all relevant working in questions involving calculations.

Question 29 (3 marks)

Marks

Explain how allopatric speciation results in the creation of new species.

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Question 30 (3 marks)

Darwin observed differences between closely related species on the Galapagos Islands (e.g. finches, tortoises and iguanas). For one of these groups, what were the observations that he made, and how did he relate them to the selection pressures on the islands?

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Question 31 (3 marks)**Marks**

Leaves of native Australian plants are often specialised to conserve water. Identify TWO features of a leaf and outline how these would help the plant to conserve water in its environment.

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Question 32 (12 marks)**Marks**

Cane toads (figure 1) are extremely hardy animals, voracious predators of insects and other small prey, and poisonous to any predators that might ingest them (figure 2). They were introduced into Australia as a means of controlling pest beetles in the sugar cane industry in 1935, before the use of agricultural chemicals became widespread.



Figure 1



Figure 2

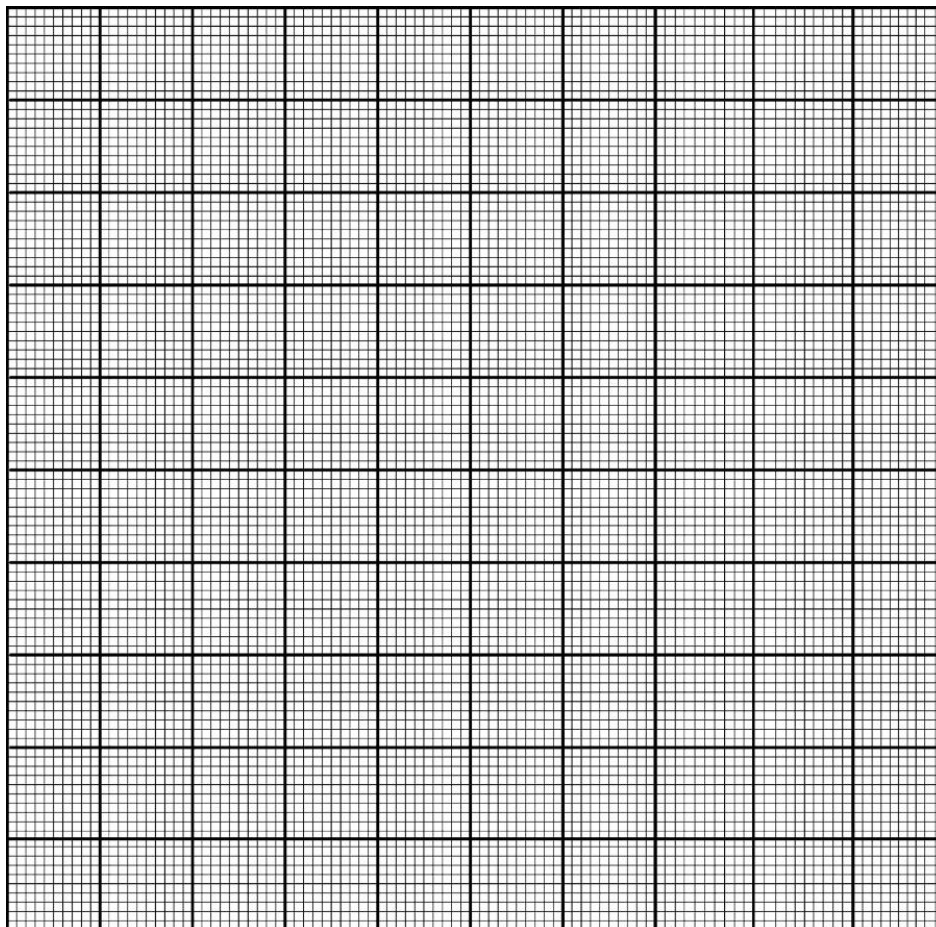
Question 32 continued on next page.

Question 32 continued.**Marks**

The following data records the speed of cane toad invasion in Australia since the year 1950.

Year	Radial increase in range (km/year)
1950	10
1960	12
1970	15
1985	28
2005	56
2015	95

- (a) Plot the above data as a line graph.

**4**

Question 32 continued on next page.

Question 32 continued.**Marks**

- (b) Based on your graph, how fast was the invasion front moving in the year 2000?

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- (c) During the cane toad invasion, changes have been noted in the genetic make-up of the population. Discuss the evolutionary changes that might have contributed to the increasing rate of geographic expansion.

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- (d) Red-bellied black snakes prey on cane toads. In areas where the cane toad has been present for a while, the red-bellied black snakes' jaws have become smaller. Using the Darwin/Wallace theory of natural selection, explain why these structural adaptations might have evolved.

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SECTION II: ORGANISATION OF LIVING THINGS

NAME

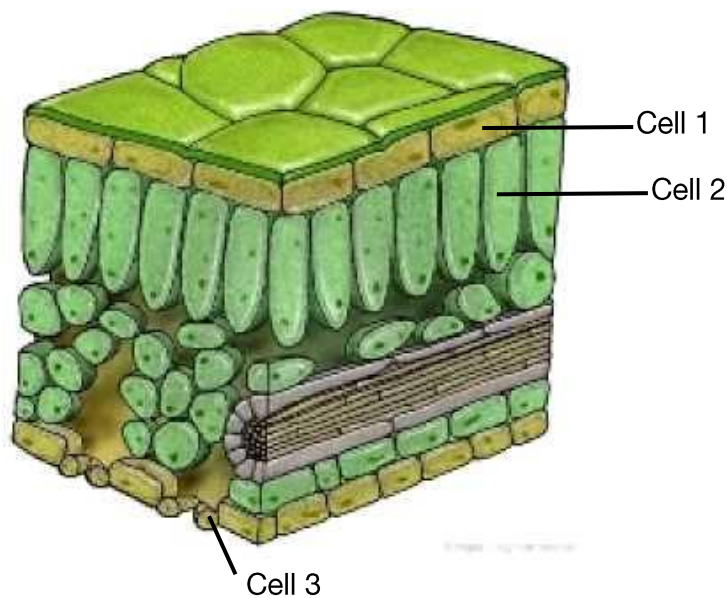
CLASS

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Question 33 (3 marks)

Marks

Study the cross section diagram of the leaf below.



Identify the three cells of the leaf indicated above.

Cell 1

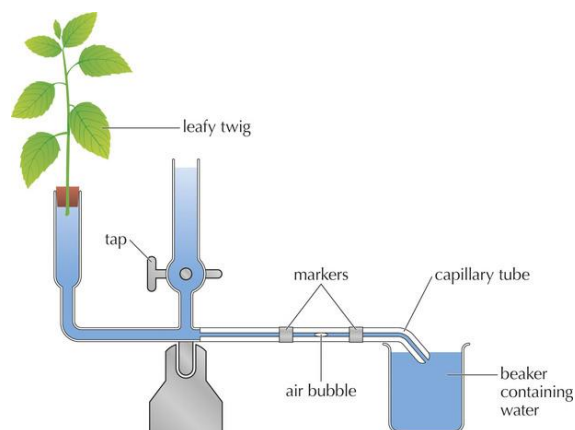
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Cell 2

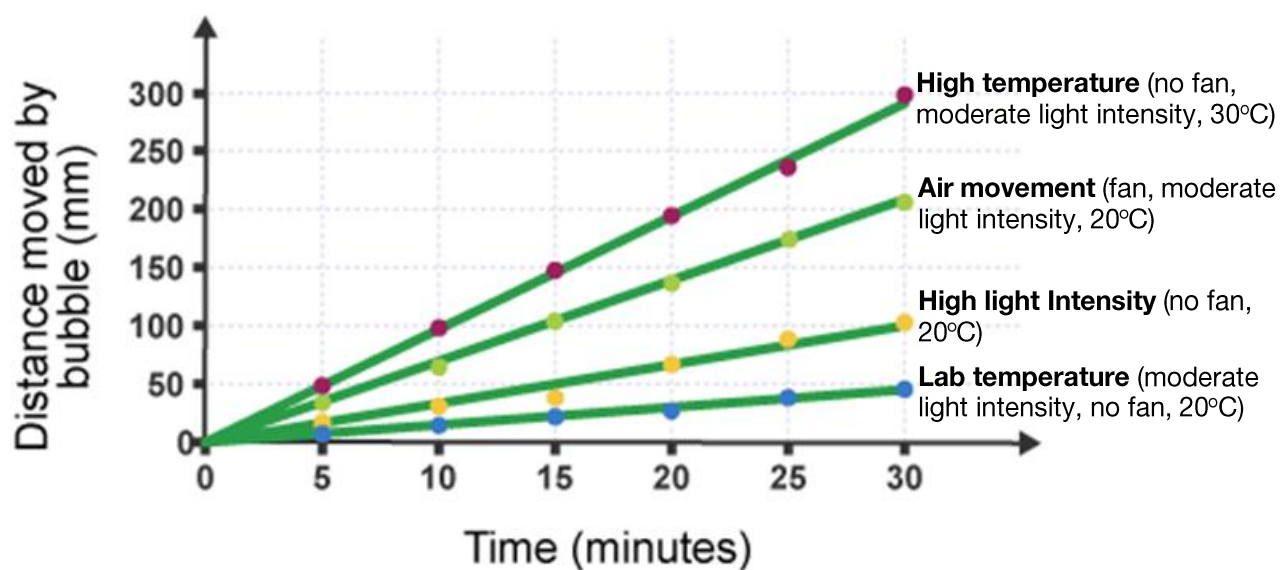
Cell 3

Question 34 (4 marks)**Marks**

A potometer, shown below, was used to investigate the effect of varying external factors on the rate of water loss from a plant.



The results for this experiment are graphed below:



Question 34 continued on next page.

Question 34 continued.**Marks**

Analyse this data and account for the differences in the recorded results for the varied external factors.

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Question 35 (6 marks)**Marks**

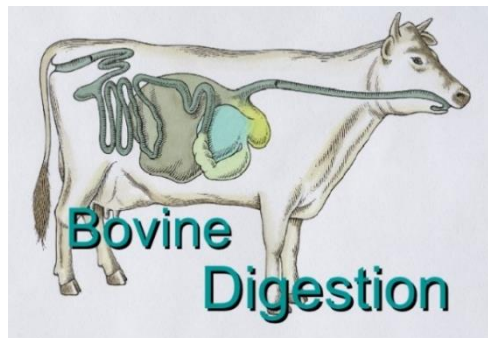
Construct a table to compare the structure and function of vascular systems of flowering plants and mammals, for the movement of sugars.

6

Question 36 (4 marks)**Marks**

Vertebrate digestive systems are highly varied.

Discuss the problems faced by cows in obtaining sufficient nutrients from their diet. In your discussion, include an analysis of how the structure and function of the digestive system of the cow (shown in the diagrams below) is adapted to its diet.



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Question 37 (5 marks)**Marks**

Account for the size limitations of insects based on the design of their circulatory and respiratory systems.

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END OF EXAMINATION



2018 ANNUAL EXAMINATION

BIOLOGY

Form V

STRUCTURE OF PAPER

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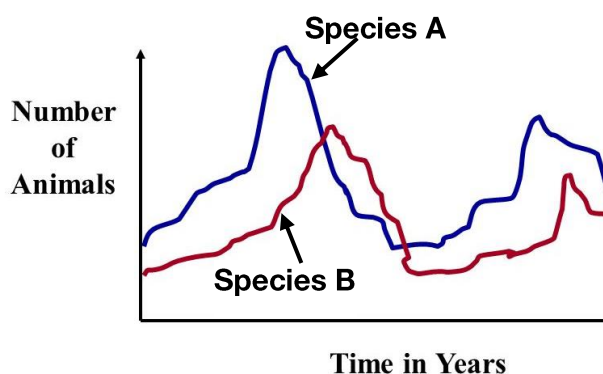
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- 16 The graph below represents how two populations, A and B, change over time.



Based on the graph above, what can be concluded about the two species?

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SECTION II: ECOSYSTEM DYNAMICS

NAME

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Marks

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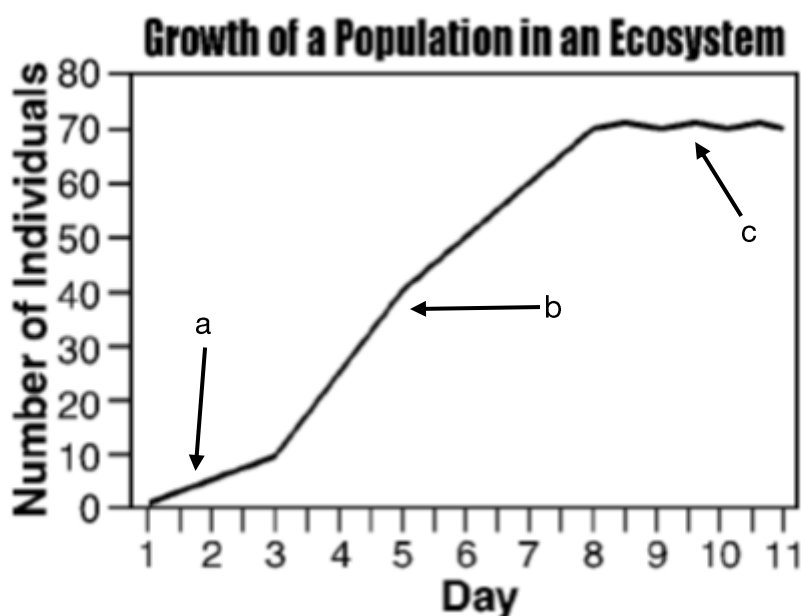
‘0’ indicates no effect on a species.

Type of symbiosis	Species A	Species B
Parasitism / exploitation	+	-
Commensalism	+	0
Mutualism	+	+

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Question 20 (3 marks)**Marks**

The graph below shows the population growth of a unicellular organism in a pond over an eleven-day period.



Using the information presented, explain the changing shape of this curve at each point (a, b and c).

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1 – Point a shows a gradual increase in growth as reproduction starts. Growth is slow at first

1 – point b shows max growth due to lack of competition/ no environmental resistance OR – shows growth is starting to be affected by frndity-dependent factors such as competition for resources

1 – point c shows population reaches equilibrium/ecosystem's carrying capacity as curve plateaus due to e.g birth rate= death rate/ limited food/resource availability / increased competition

Needed to explain, not just describe the curve

Question 21 (4 marks)**Marks**

Give one example of an extinct species of an Australian animal and discuss their evolutionary relationship to a living species. In your answer, specify their similarities and differences.

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- 1 – example of an extinct Australian animal
- 1 – specific similarities between the extinct animal and its modern day equivalent (not just ‘they have similar shapes and structures’)
- 1 – specific differences between the extinct animal and its modern day equivalent
- 1 – discussion of their evolutionary relationship

Eg answers of comparisons on next page:

Giant wombat vs Southern hairy-nosed wombat

Differences - Giant wombat twice as big as modern day wombat. Had sharper incisors than the modern day wombats wider and flatter incisors

Similarities - same numbers of premolars/molars

Evolutionary relationship – smaller wombats were favoured due to environmental changes eg reduced vegetation...

Common name:	<i>Giant Wombat</i>	Southern Hairy-nosed Wombat
Scientific name:	<i>Phascolonus gigas</i>	<i>Lasiorhinus latifrons</i>
Location:	fossil site location: <i>Lake Callabonna, South Australia</i>	Nullarbor Plain, South Australia
Age:	Pleistocene	modern
Describe two similarities between the skulls	various answers including: • they each have 2 large projecting incisors in both the upper jaw and in the lower jaw • they each have the same number of premolars and molars in both the upper and lower jaws (2 premolars + 8 molars in the upper jaw and 2 + 8 in the lower jaw) • the shape of the molars is similar in having a two-lobed structure (somewhat like the figure 8) and low crowns	
Describe one difference between the skulls	various answers including: • size (modern wombat is about half the size) • upper incisors in the Giant Wombat are much wider and flatter (strap-like) • lower incisors in the Giant Wombat have a wide gap between them	

☒ **thylacines** (Note: the following answers apply if the **thylacine** group was selected. Answers for other groups follow over the page.)

1. Provide details on **two** fossils belonging to species from your selected group.

	Fossil 1	Fossil 2
What species? • common name (if available) • scientific name	Powerful Thylacine <i>Thylacinus potens</i>	Tasmanian Tiger <i>Thylacinus cynocephalus</i>
What part(s) of the body?	cast of upper jaw	partial skull and jaw
Where were the fossils found?	Alcoota, Northern Territory	Wellington Caves, New South Wales

2. How have fossils (including those detailed in question 1 **and** other fossils) contributed to our understanding about evolution of these species / groups in Australia? For example:

- What was their **past diversity** (how many different species in the group?). Has this changed over time?
Thylacines first appeared in the fossil record about 28 million years ago, and there may have been as many as 13 different thylacine species over time. The number of species gradually declined over millions of years. They died out on the mainland as recently as 3000 years ago and the last species, the Tasmanian Tiger, is also now extinct.
- What was their **past distribution** (where were they found / how widespread were they?). Has this changed over time?
Thylacines once roamed as far north as New Guinea and all over the Australian mainland.
- What do the fossils tell us about the animals' **sizes, diets** and/or **lifestyles**?
Fossils show different species ranged in size from one to 57 kilograms in weight. The Powerful Thylacine (from 7-8 million years ago) weighed up to 37 kilograms and was one of the largest thylacines to have ever lived. It had a robust jaw, giving it a powerful bite and like other marsupials, it would have had a pouch. It was a predator able to kill relatively large prey.

3. What are the closest **extant (living) relatives** of the species in this extinct group? dasyurid marsupials, such as Tasmanian Devils, quolls, antechinuses and dunnarts

4. Name one species belonging to your chosen group. What happened to it?

The Powerful Thylacine, *Thylacinus potens*. It lived 7-8 million years ago but is now extinct although it's not clear when this happened as there are so few fossils.

OR The Tasmanian Tiger, *Thylacinus cynocephalus*. This species once lived all over Australia and New Guinea but is now extinct, disappearing from mainland Australia about 3000 years ago and more recently from Tasmania.

☒ **diprotodontids** (Note: the following answers apply if the **diprotodontid** group was selected.)

1. Provide details on **two** fossils belonging to species from your selected group.

	(Note: various answers are possible here depending on whether the various fossils are listed individually or paired together.)	
	Fossil 1	Fossil 2
What species? • common name (if available) • scientific name	<i>Diprotodon optatum</i>	<i>Diprotodon optatum</i>
What part(s) of the body?	upper incisor and lower incisor	molar tooth and partial lower jaw
Where were the fossils found?	upper incisor: Bingara, NSW lower incisor: Reddestone Creek (near Glen Innes), NSW	both from Bingara, NSW

2. How have fossils (including those detailed in question 1 **and** other fossils) contributed to our understanding about evolution of these species / groups in Australia? For example:

- What was their **past diversity** (how many different species in the group?). Has this changed over time?
More than 30 different species of diprotodontids lived over many millions of years but this whole family is now extinct.
- What was their **past distribution** (where were they found / how widespread were they?). Has this changed over time?
Diprotodontids once roamed Australia and New Guinea over many millions of years. The diprotodontid, *D. optatum*, was widespread in inland parts of Australia but also lived in some coastal areas
- What do the fossils tell us about the animals' **sizes, diets** and/or **lifestyles**?
Fossils show some diprotodontids weren't much larger than dogs, but others were giants. *D. optatum* was Australia's largest megafauna weighing up to 2700 kilograms. Its teeth tell us it was a herbivore that ate fibrous and tough leaves from a wide range of shrubs and small trees as well as some grasses. Its lower incisors may also have been used to uproot plants from the ground. It was a marsupial with a pouch.

3. What are the closest **extant (living) relatives** of the species in this extinct group? wombats and koalas

4. Name one species belonging to your chosen group. What happened to it? *Diprotodon optatum* became extinct perhaps 30,000 or 25,000 years ago, possibly from a combination of climate change and human impact. Some scientists argue Aboriginal people may have hunted them and possibly changed their habitat with fire management, adding to pressures from climate change.

short-faced kangaroos (Note: the following answers apply if the **short-faced kangaroo** group was selected.)

1. Provide details on **two** fossils belonging to species from your selected group.

	(Note: various answers are possible here. The following four fossils were on display but details were requested for only two.)			
	Fossil 1	Fossil 2	Fossil 3	Fossil 4
What species? • common name • scientific name	short-faced kangaroo <i>Simosthenurus occidentalis</i>	short-faced kangaroo <i>Simosthenurus occidentalis</i>	Giant Short-faced Kangaroo <i>Procoptodon goliah</i>	short-faced kangaroo <i>Simosthenurus occidentalis</i>
What part(s) of the body?	partial skull	half lower jaw	lower jaw	cast of skeleton
Where were the fossils found?	Mount Gambier, South Australia	Mount Gambier, South Australia	Bingara, New South Wales	Green Waterhole Cave (near Tantanoola), S.A.

2. How have fossils contributed to our understanding about evolution of these species / groups in Australia? For example:
- What was their **past diversity** (how many different species in the group?). Has this changed over time?
Short-faced kangaroos (sthenurines) were common and widespread in the last two million years. There were about 30 different species in three main genera – *Sthenurus*, *Simosthenurus* and *Procoptodon* but they are all now extinct.
 - What was their **past distribution** (where were they found / how widespread were they?). Has this changed over time?
Some species were common and widespread. For example, the Giant Short-faced Kangaroo, *Procoptodon goliah*, was widespread in southern and central Australia. *Simosthenurus occidentalis* was common during the last million years. All short-faced kangaroos are now extinct.
 - What do the fossils tell us about the animals' **sizes, diets** and/or **lifestyles**?
Fossils show that short-faced kangaroos had bigger bodies; shorter noses and jaws; and longer, more powerful arms compared with modern kangaroos. The largest was the Giant Short-faced Kangaroo *Procoptodon goliah*, weighing about 230 kilograms and standing up to two metres tall. *Simosthenurus occidentalis* weighed about 120 kilograms. The three main genera, *Sthenurus*, *Simosthenurus* and *Procoptodon*, were each increasingly adapted for chewing dry, tough vegetation. *P. goliah* had the bluntest face, and was the best adapted to a tough, fibrous diet.
 - What are the closest **extant (living) relatives** of the species in this extinct group? modern kangaroos
 - Name one species belonging to your chosen group. What happened to it? *Simosthenurus occidentalis* lived in the last million years. It was extinct by about 30,000 years ago. Being well-adapted to relatively dry environments it's unlikely that the drying climate caused its extinction. Perhaps occasional hunting caused its slow decline.

marsupial lions (Note: the following answers apply if the **marsupial lion** group was selected.)

1. Provide details on **two** fossils belonging to species from your selected group.

	Fossil 1	Fossil 2
What species? • common name (if available) • scientific name	<i>Thylacoleo carnifex</i>	<i>Thylacoleo carnifex</i>
What part(s) of the body?	skull	half lower jaw
Where were the fossils found?	Wellington Caves, NSW	Wellington Caves, NSW

2. How have fossils (including those detailed in question 1 **and** other fossils) contributed to our understanding about evolution of these species / groups in Australia? For example:
- What was their **past diversity** (how many different species in the group?). Has this changed over time?
Eight species of marsupial lion have so far been identified, getting progressively larger over time, but the group is now extinct.
 - What was their **past distribution** (where were they found / how widespread were they?). Has this changed over time?
Fossils show marsupial lions were once widespread across Australia but they are now all extinct.
 - What do the fossils tell us about the animals' **sizes, diets** and/or **lifestyles**?
Fossils show that species in the marsupial lion group became progressively larger over time with *Thylacoleo carnifex* being the largest. It had a heavy, muscular body weighing up to 30 kilograms; opposable thumbs with large curved claws like flick-knives; strong arms for gripping prey; specialised teeth for stabbing and holding prey and for slicing through flesh; a robust, broad skull with a short snout, giving it a powerful bite. It was carnivorous. Its enormous, blade-like premolar teeth – ideal for slicing through flesh, hide, and sinew, indicate it was a meat-eater but not a bone crusher (a predator rather than a scavenger). It has been described as the most specialised meat-eating mammal of all time because of its enormous meat-slicing teeth.
 - What are the closest **extant (living) relatives** of the species in this extinct group? either wombats and koalas or possums
 - Name one species belonging to your chosen group. What happened to it? *Thylacoleo carnifex* lived over the last 1.8 million years but became extinct about 30,000 years ago. It may have become too specialised for its own good. While it was exceptionally good at grabbing, wrestling, biting and tearing, it may have been too bulky to run down fast, agile prey. As the large, slow-moving megafauna died out, so too did their most specialised predator.

Question 22 (9 marks)**Marks**

Read the extract below and then answer the questions that follow.

Biodiversity may prove to be the defining issue of our age (Diversity Today, Scientific blog, published 28 July 2018)

“In June 2016, scientists from the University of Queensland confirmed what had been feared for some time: the Bramble Cay mosaic-tailed rat was no more. This small rodent eked out a lonely existence on Bramble Cay, a tiny dot of land at the northern end of the Great Barrier Reef. When Europeans first landed in 1845, the place was teeming with them. But frequent inundations caused by rising sea level made life increasingly precarious and the creature is now literally a drowned rat...”

“...We are thus in an era where two great environmental anxieties – climate change and biodiversity loss – are converging. Biologists expect many more species to go the way of the rat. If we are not already in the midst of the sixth mass extinction, we soon will be.”

- (a) Evaluate the reliability of this source.

.....

2

1 – NOT reliable (make a definite judgement)

1 – Justification – e.g the source is not reputable, it is not peer-reviewed / just a blog so opinion based...

- (b) Define biodiversity and explain why scientists have concerns regarding biodiversity loss.

.....

3

1 – definition = variety and abundance of living organisms

2 marks for concerns (plural) – eg removing an organism or extinctions destabilises food chains/webs / loss of biodiversity means loss of resources such as food, medicine / loss of biodiversity negatively affects aesthetics and thus can have an impact on the economy...

Question 22 continued on next page.

Question 22 continued.**Marks**

- (c) For a named organism, other than the Bramble Cay mosaic-tailed rat, explain the threats to the organism's survival and describe two measures that have been used to conserve or protect this organism.

.....

4

1 – named organism

1 – explain why it's threatened

2 marks for 2 measures of conservation

e.g answer:

Saltwater crocodile

Threatened by hunting for skins

Laws made to ban hunting + listed as a protected species

OR

Spotted tail quoll

Threatened by habitat loss/hunting/introduced species such as cane toads...

Relocation programs in place + follow-up surveys of populations + Landcare group rehabilitating habitat

Question 23 (4 marks)**Marks**

Numbers of a population of Bush Rats in a woodland ecosystem were estimated using the capture-recapture technique. A non-harmful series of traps were set up containing oats and peanut butter bait. On the first day, 50 Bush Rats were captured, marked and released. Two weeks later, the traps were set again and 80 Bush Rats were trapped. Of the 80 that were recaptured, 30 were marked.

- (a) From the data, calculate the estimated size of the Bush Rat population. Show your working.

.....

2

1 – working

1 – answer

$$\frac{50 \times 80}{30} = 133 \text{ (rounded)}$$

- (b) Some Bush Rats develop a preference for the bait and stay in the area waiting to receive the food again. Assess the validity of using this technique and its effect on the estimate.

.....

2

1 – reduces the validity

1 – the food incentive means the tagged individuals will stay around the trap and so more tagged individuals will be recaptured thus reducing the population estimate from its true value

SECTION II: CELLS AS THE BASIS OF LIFE

NAME

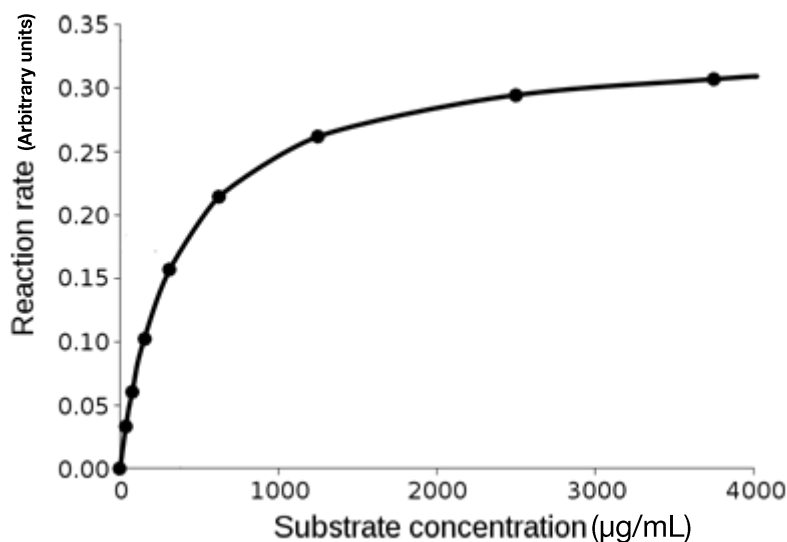
CLASS

Answer the questions in the spaces provided.
Show all relevant working in questions involving calculations.

Question 24 (3 marks)

Marks

The graph below shows the results of the effect of substrate concentration on the rate of an enzyme controlled reaction.



Explain the change in shape of the curve as substrate concentration increases.

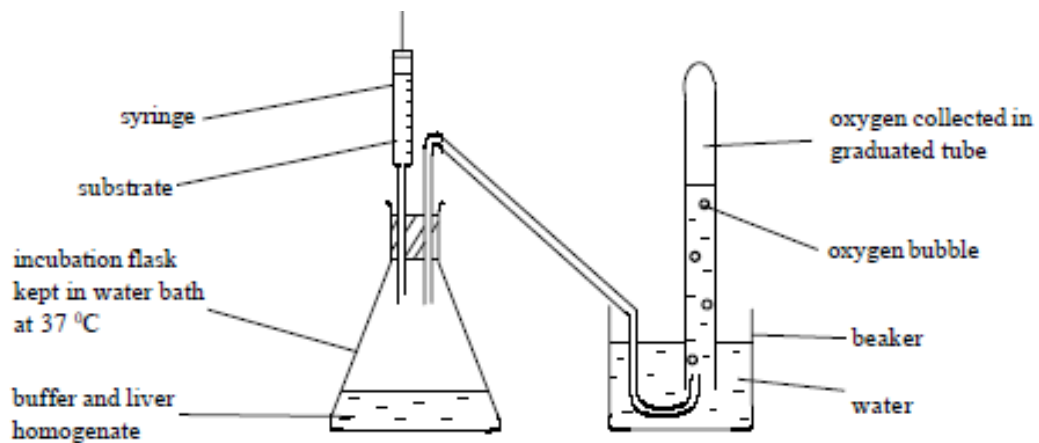
For 3 marks:

- Outlines the difference in the change in the reaction rate as substrate concentration increases (at both low concentrations and at high concentrations of the substrate).
- The initial increase in the reaction rate is steep/rapid as the greater number of substrate molecules made available results in a higher number of collisions with the many unoccupied active sites of the enzymes.
- The rate increase at higher substrate concentrations plateaus/slows down as most of the active sites are already occupied (temporarily bound to the substrate), so supplying extra substrate molecules has little effect on the reaction rate.

NB. Many answers failed to explain the shape of the curve and simply described it instead.

Question 25 (5 marks)**Marks**

The apparatus illustrated below can be used to investigate the activity of the enzyme catalase which is found in liver. The liver tissue has been ground up and mixed with a buffer solution (which keeps the pH level constant). The substrate for catalase is hydrogen peroxide, which can be added to the homogenate (mixture) via the syringe.



Question 25 continued on next page.

Question 25 continued.**Marks**

Using the apparatus shown, design a safe, valid and reliable experiment to investigate the effect of temperature on the activity of catalase. Identify the dependent and independent variables in your answer and describe an appropriate control for this experiment.

For 5 marks should include all of the following:

- Sets out steps/procedure in a logical manner
- Provides a relevant risk assessment
- Identifies the independent variable (temperature) and the dependent variable (amount of oxygen collected)
- Validity – keeping all other variables (other than the independent variable) the same between experimental treatments e.g. volume of buffer/liver homogenate, volume and concentration of hydrogen peroxide, size of glass collecting tube, etc.
- Reliability – repeats the experiment at least 3 times and calculates an average.
- Appropriate control – remove the catalase from the homogenate in the flask and replace with an equal volume of buffer.

4 marks – leaves out 1 of the above

3 marks – leaves out 2 of the above

2 marks – leaves out 3 of the above

Question 25 continued.

Marks

Using the apparatus shown, design a safe, valid and reliable experiment to investigate the effect of temperature on the activity of catalase. Identify the dependent and independent variables in your answer and describe an appropriate control for this experiment.

1. Set up six of the apparatus - five with homogenate in beakers, one with buffer solution plus a volume of water equivalent to that of liver in the other five. This sixth will form the control to make sure it is in fact catalase reacting with the hydrogen peroxide. 5
2. Keep one apparatus* at 37°C, and the others at 42°C, 47°C, 32°C, and 27°C (5 and 10° on either side of body temp).
3. Add a constant amount of substrate to each beaker simultaneously, and leave to react for a period of time e.g. 10 mL of substrate for 5 minutes.
4. Using a ruler, measure the amount of O₂ displacing the water in the graduated tube of each apparatus to see how effectively the enzyme reacted at each temperature.
5. Repeat Steps 1-4 two times to ensure ~~repeatability~~ reliability, and average the results for each apparatus.
- *and the control

Risk Assessment

	Hazard	Danger posed	Mitigation
1	Heat used to regulate temp. of beakers	Burning by the heat source	Wear protective gloves if handling heat source, use care when operating
2	Hydrogen peroxide is toxic to humans	Potential poisoning	Keep syringes away from mouth and eyes, wash hands after
3	Liver could be contaminated with micro organisms	Potential infection with a disease or illness	Wear rubber gloves, eye protection, wash hands after.

Variables : Dependent - amount of O₂ produced

Independent - temperature of the homogenate

Question 26 (2 marks)**Marks**

The cell membrane consists of proteins embedded within a phospholipid bilayer. It is estimated that approximately 30% of the different proteins produced in a cell are found within the cell membrane.

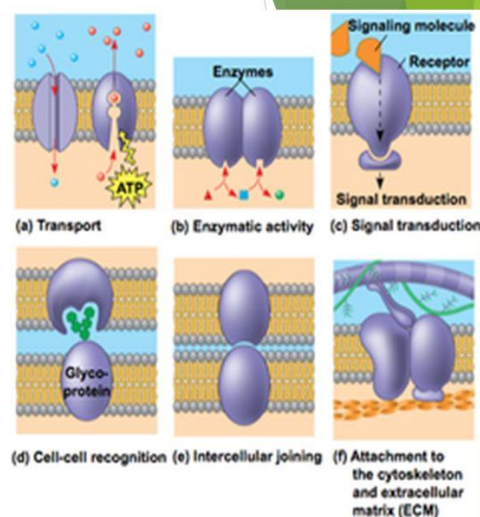
Describe one role of a protein within the cell membrane.

Describes a role of cell membrane protein. 2 marks

Identifies a role of cell membrane protein. 1 mark

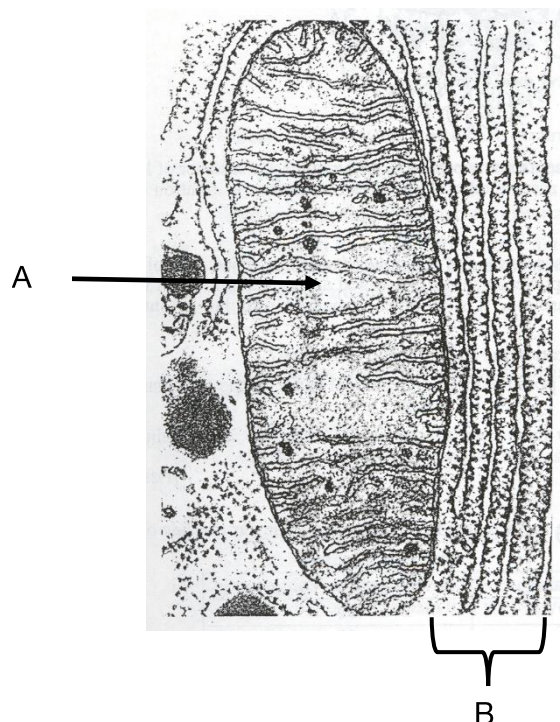
Membrane proteins functions

- ▶ There are six major functions performed by proteins of the plasma membrane:
 1. Transport
 2. Enzymatic activity
 3. Signal transduction
 4. Cell-cell recognition
 5. Intercellular joining
 6. Attachment to the cytoskeleton and extracellular matrix (ECM).



Question 27 (4 marks)**Marks**

The following diagram shows part of a cell under an electron microscope.



- (a) Identify organelles A and B.

A= Mitochondria

2

B= **Rough** Endoplasmic Reticulum.....

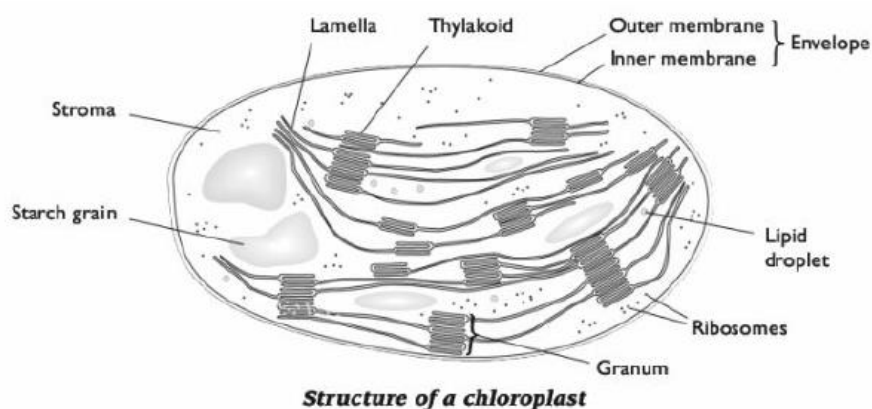
- (b) Explain how the structure of organelle A assists with its respective function in the cell.

For 2 marks:

- The inner membrane is extensively folded to increase the surface area for the attachment of respiratory enzymes
- This maximises the rate of aerobic cellular respiration/rate of ATP production

Question 28 (7 marks)**Marks**

The diagram below shows the internal structure of a chloroplast.



- (a) Complete the table below that compares features of the light dependent and light independent reactions of photosynthesis.

Location: Granum (light dependent) and Stroma (light independent) 1 mark

Products of light dependent: (1) oxygen, (2) ATP or NADPH 2 marks

Products of light independent: (1) glucose 1 mark

Describe a technique that could be used to trace the origin of the carbon atoms found in the starch molecules present in chloroplasts.

For 3 marks must include:

- Use a radioisotope of carbon – ^{14}C to label carbon atoms
- Grow the plant in a sealed chamber containing CO_2 labelled with the ^{14}C (i.e. $^{14}\text{CO}_2$), allowing the plant time to photosynthesise
- Use an identified technology to detect the location of radioactivity inside the plant tissue e.g autoradiography (photographic film) etc

SECTION II: BIOLOGICAL DIVERSITY

NAME

CLASS

Answer the questions in the spaces provided.
Show all relevant working in questions involving calculations.

Question 29 (3 marks)

Marks

Explain how allopatric speciation results in the creation of new species.

- (1 mark) *Involves a geographic barrier which physically isolates two initially identical populations*
- (1 mark) *This **blocks gene flow** between the two populations*
- (1 mark) *These isolated gene pools accumulate genetic differences, and populations diverge to the point where they can no longer interbreed, thereby **adapting to the different environments** over time*

Question 30 (3 marks)

Darwin observed differences between closely related species on the Galapagos Islands (e.g. finches, tortoises and iguanas). For one of these groups, what were the observations that he made, and how did he relate them to the selection pressures on the islands?

- (1 mark) *Example of observations – beak sizes/shape in finches differs on different islands*
- (1 mark) *availability of **different nutrients/food types** (selective pressure) on different islands will select for a particular variant of beak*
- (1 mark) *The best suited to the environmental selective pressure will survive and increase in number (fitness). For example, the large beak finches will predominate on islands with nuts or large seeds as food as they will be able to crack them open, while slim, probing beaks will dominate on islands where insects are the major food source.*
- **NOTE: Must relate the observations in detail to selection pressures on the islands.**

Question 31 (3 marks)**Marks**

Leaves of native Australian plants are often specialised to conserve water. Identify TWO features of a leaf and outline how these would help the plant to conserve water in its environment.

- *(2 marks) for identifying any two features of the leaf that make it specialised to conserve water (eg. sunken stomata, opening/closing of stomata at different periods of day, small surface area)*
- *(1 mark) outlining how they help conserve water. The features reduce transpiration in the plant and therefore water is conserved.*
- **NOTE: can't just say prevent water loss.**

Question 32 (12 marks)**Marks**

Cane toads (figure 1) are extremely hardy animals, voracious predators of insects and other small prey, and poisonous to any predators that might ingest them (figure 2). They were introduced into Australia as a means of controlling pest beetles in the sugar cane industry in 1935, before the use of agricultural chemicals became widespread.



Figure 1



Figure 2

Question 32 continued on next page.

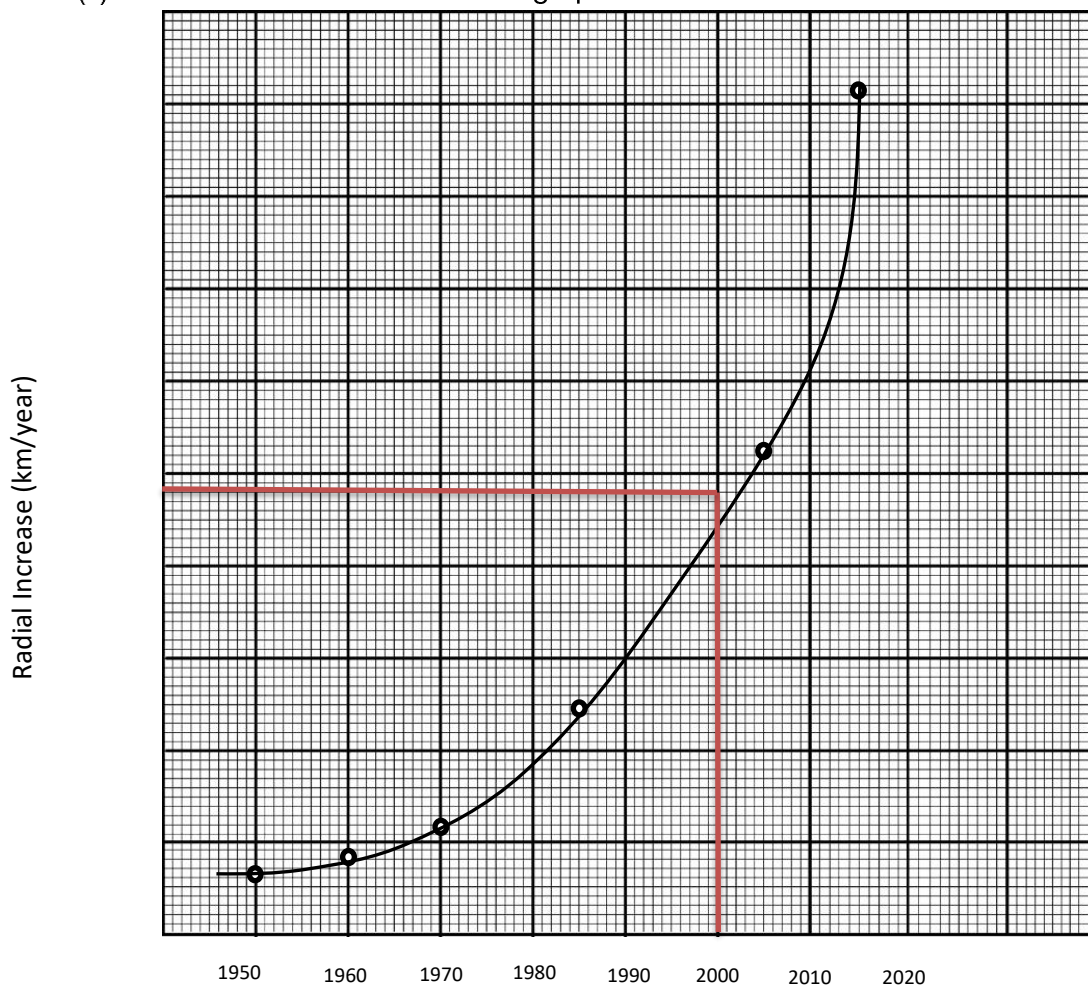
Question 32 continued.**Marks**

The following data records the speed of cane toad invasion in Australia since the year 1950.

Year	Radial increase in range (km/year)
1950	10
1960	12
1970	15
1985	28
2005	56
2015	95

- (1) *Plotted points accurate*
- (2) *Curve of best fit
(can't join dots with ruler and
needs to be continuous free hand)*
- (3) *Axes/units correct*
- (4) *Correct scale
(linear x-axis)*

(a) Plot the above data as a line graph.



Question 32 continued.**Marks**

- (b) Based on your graph, how fast was the invasion front moving in the year 2000?

Note: See red lines on graph (previous page)!

*Needs to be accurate for each graph. In this case it reads as **48km/year**.*

- (c) During the cane toad invasion, changes have been noted in the genetic make-up of the population. Discuss the evolutionary changes that might have contributed to the increasing rate of geographic expansion.

- (1 mark) for mentioning cane toads **at the front line** are stronger, and longer or more muscular legs and are able to move faster and for longer.
- (1 mark) these cane toads are then more likely to **reproduce with each other** (all having similar traits) so the trait is selected for and passed on to the following generations.
- (1 mark) this will increase the numbers of the **fitter** cane toads at the invasion front, contributing to the increasing rate of the geographic expansion.
- **NOTE: Had to mention the changing population of the cane toads at the invasion front compared to the rest of the population, and relate it to the increasing rate of geographic expansion.**

- (d) Red-bellied black snakes prey on cane toads. In areas where the cane toad has been present for a while, the red-bellied black snakes' jaws have become smaller. Using the Darwin/Wallace theory of natural selection, explain why these structural adaptations might have evolved.

- (1 mark) **VARIATION** exists in the snake population. **There are both large and small jaw variants.**
- (1 mark) **ENVIRONMENTAL SELECTIVE PRESSURE** is present. The cane toads are toxic/poisonous when eaten and will kill off snakes that eat them.
- (1 mark) **REPRODUCTION** of fittest takes place. The small jaw snakes are selected for, as they are unlikely to be able to eat the cane toads and therefore will survive. They will **pass on their favourable genes/traits to their offspring**.
- (1 marks) **ADAPTATION** will take place. Here there will be an **increase in small jaw snakes in the population over many generations**, as they will be "resistant" to the cane toads.

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SECTION II: ORGANISATION OF LIVING THINGS

NAME

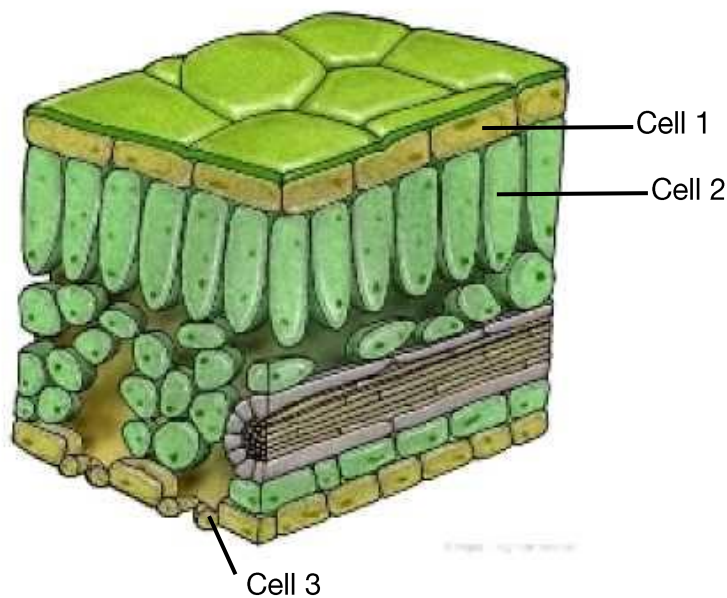
CLASS

Answer the questions in the spaces provided.
Show all relevant working in questions involving calculations.

Question 33 (3 marks)

Marks

Study the cross section diagram of the leaf below.



Identify the three cells of the leaf indicated above.

Cell 1

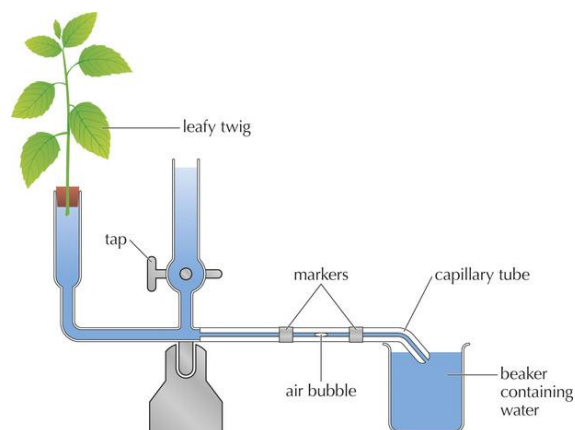
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Cell 2

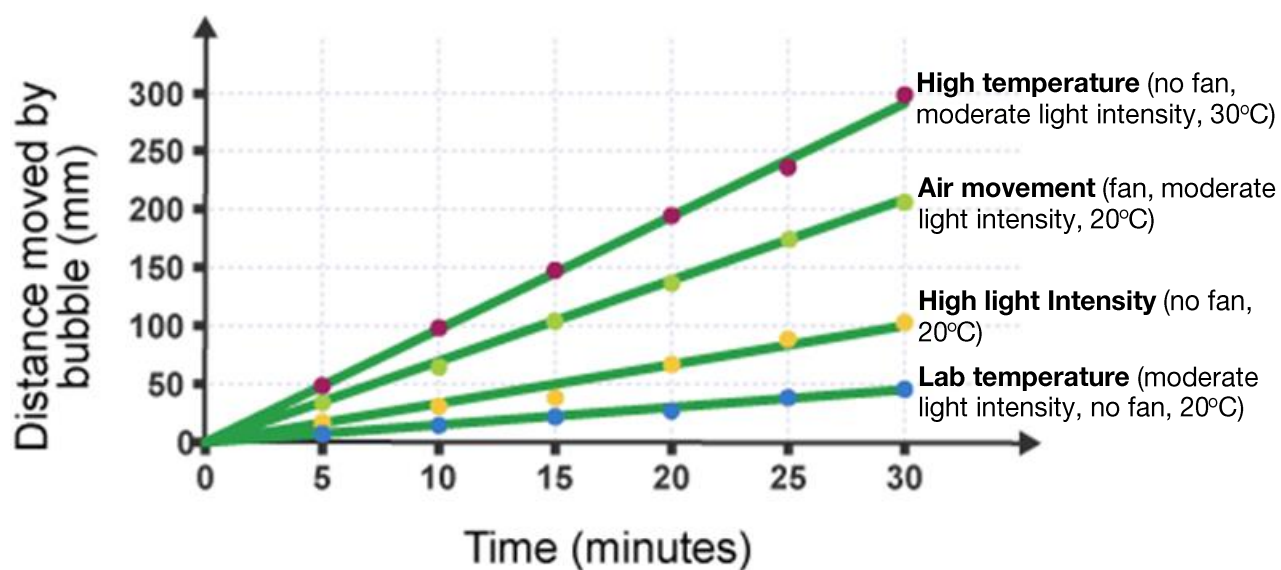
Cell 3

Question 34 (4 marks)**Marks**

A potometer, shown below, was used to investigate the effect of varying external factors on the rate of water loss from a plant.



The results for this experiment are graphed below:



Question 34 continued on next page.

Question 34 continued.**Marks**

Analyse this data and account for the differences in the recorded results for the varied external factors.

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4

Question 35 (6 marks)**Marks**

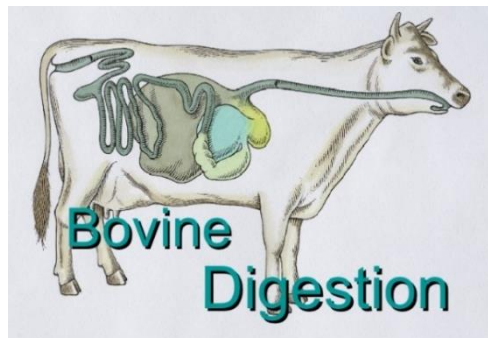
Construct a table to compare the structure and function of vascular systems of flowering plants and mammals, for the movement of sugars.

6

Question 36 (4 marks)**Marks**

Vertebrate digestive systems are highly varied.

Discuss the problems faced by cows in obtaining sufficient nutrients from their diet. In your discussion, include an analysis of how the structure and function of the digestive system of the cow (shown in the diagrams below) is adapted to its diet.



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4

Question 37 (5 marks)**Marks**

Account for the size limitations of insects based on the design of their circulatory and respiratory systems.

5

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END OF EXAMINATION