ALL SAINTS' COLLEGE

Semester 2 Examination 2020

Question/Answer Booklet

BIOLOGY

Year 11 ATAR
Units 1 & 2

Student Number: In figures | | | | | | | | |

In words _____

_____

Time allowed for this paper
Reading time before commencing work: ten minutes
Working time: three hours

Materials required/recommended for this paper
To be provided by the supervisor
This Question/Answer booklet
Multiple-choice answer sheet

To be provided by the candidate
Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: non-programmable calculators approved for use in this examination

Important note to candidates
No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised material. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Structure of this paper

Section	Number of questions available	Number of questions to be answered	Suggested working time (minutes)	Marks available	Percentage of examination
Section One Multiple-choice	30	30	40	30	30
Section Two Short answer	5	5	90	100	50
Section Three Extended answer Unit 1	2	1	50	40	20
Unit 2	2	1			
				Total	100

Instructions to candidates

1. The rules for the conduct of the Western Australian external examinations are detailed in the *Year 12 Information Handbook 2020*. Sitting this examination implies that you agree to abide by these rules.

2. Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.

3. Answer the questions according to the following instructions.

   Section One: Answer all questions on the separate Multiple-choice answer sheet provided. For each question, shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. Do not use erasable or gel pens. If you make a mistake, place a cross through that square, then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

   Section Two: Write your answers in this Question/Answer booklet. Wherever possible, confine your answers to the line spaces provided.

   Section Three: Consists of two parts each with two questions. You must answer one question from each part. Tick the box next to the question you are answering. Write your answers in this Question/Answer booklet.

4. You must be careful to confine your answers to the specific questions asked and to follow any instructions that are specific to a particular question.

5. Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Section One: Multiple-choice **30% (30 Marks)**

This section has **30** questions. Answer **all** questions on the separate Multiple-choice answer sheet provided. For each question, shade a box to indicate your answer. Use only a blue or black pen to shade the boxes. Do not use erasable or gel pens. If you make a mistake, place a cross through that square, then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Suggested working time: 40 minutes.

---

1. Two different species of parrot belong to the order Psittaformes but are classified into different families. Based on this information, these parrots are likely to

   (a) have very similar morphology.
   (b) inhabit the same ecosystem.
   (c) have identical DNA.
   (d) share a recent common ancestor.

2. Which of the following statements best defines biodiversity?

   (a) A method of classification that uses genetic similarity to determine relatedness.
   (b) A community of different species that interact with each other and their environment.
   (c) The genetic variation within the individuals of a particular species.
   (d) The variety of living organisms within different ecosystems.

3. Which of the following is a genetic strategy that can be employed to conserve threatened species?

   (a) Creating a National Park.
   (b) Baiting for introduced species.
   (c) A captive breeding program.
   (d) Fencing as a barrier against feral animals.

4. Photosynthesis provides a food web with

   (a) solar energy.
   (b) chemical energy.
   (c) heat energy.
   (d) light energy.

5. Which of the following best describes an enzyme's effect on activation energy?

   (a) Increasing the energy required to start the reaction.
   (b) Decreasing the energy required to start the reaction.
   (c) Stimulating the active site to receive molecules.
   (d) Increasing the rate of cellular respiration.

6. Which of the following factors is **not** density-independent?

   (a) Competition

(b) Floods
(c) Drought
(d) Salinity

The diagram below relates to question 7 and 8.

7. The distribution pattern shown in the diagram above is

(a) clumped.
(b) random.
(c) uniform.
(d) even.

8. Which of the following organisms most likely displays this type of distribution?

(a) Wedge-tailed eagle
(b) Penguin
(c) Fox
(d) Tuna

9. The laughing Kookaburra, *Dacelo novaeguineae*, was introduced into the ecosystems of Western Australia's south west in the late 1800's. Kookaburras are carnivores and are known to steal chicks of other bird species from their nests. This is an example of

(a) competition.
(b) parasitism.
(c) predation.
(d) mutualism.

10. Which of the following chemical equations **best** represents the process of cellular respiration?

(a) $H_2O + CO_2 \longrightarrow O_2 + C_6H_{12}O_6 + ATP$
(b) $C_6H_{12}O_6 + O_2 \longrightarrow CO_2 + H_2O + ATP$
(c) $ADP + Pi + O_2 \longrightarrow ATP$
(d) $C_6H_{12}O_6 + CO_2 \longrightarrow H_2O + O_2 + ATP$

11. Which of the following taxonomic groups would include the greatest number of species?

(a) Family
(b) Species

(c) Genus
(d) Phylum

12. The ability of any cell to carry out metabolic processes is limited by the availability of factors specific to each reaction. For example, aerobic respiration cannot take place in the absence of

(a) water and glucose.
(b) oxygen and glucose.
(c) glucose and carbon dioxide.
(d) water and carbon dioxide.

13. In a terrestrial community, the group of organisms **generally** exhibiting the greatest biomass are the

(a) decomposers.
(b) producers.
(c) first order consumers.
(d) second order consumers.

14. A biology student was designing an experiment with the aim to make plants grow faster. For a period of two weeks, lettuce seedlings were exposed to red and violet light every day for either 6, 10 or 18 hours. In order to determine any effect the light may have on lettuce growth, the student should measure

(a) average leaf diameter.
(b) rate of transpiration.
(c) rate of photosynthesis.
(d) average cellular chlorophyll content.

15. Which of the following variables affect photosynthesis and should have been controlled in the lettuce growth experiment?

(a) water, nutrients and non-experimental light sources.
(b) carbon dioxide, temperature and water.
(c) carbon dioxide, water and time exposed to different coloured light.
(d) oxygen, water and temperature.

16. Arthropods, like insects and spiders, have an open circulatory system, meaning that

(a) blood and nutrients are carried around their bodies in vessels linked to one another through a simplified heart.
(b) haemolymph circulates freely as they do not have a heart.
(c) the haemolymph bathes the cells in nutrients directly before being returning to the head via a tubular heart.
(d) oxygen is readily available to cells from the haemolymph.

17. Which of the following is **not** an example of primary succession?

(a) Post-fire seed germination.
(b) Coastal scrubland growing on a newly formed volcanic island.
(c) Plants establishing an area of glacial retreat.
(d) Spinifex growing on newly formed sand dunes.

18. The leaf epidermis is an example of a tissue because

(a) the cells all have a waxy cuticle.
(b) light can penetrate through to the cells underneath.
(c) cell structure and function are the same.
(d) every cell has the same genetic material.

19. Which of the following statements best reflects the main difference between the 'lock and key' model and 'induced fit' model of enzyme function?

(a) The lock and key model involves catabolic reactions, while the induced fit model involves anabolic reactions.
(b) The lock and key model states that only one enzyme can bind with one specific substrate, while the induced fit model states that one enzyme can bind with many different substrates.
(c) The lock and key model involves the formation of an enzyme-substrate complex, while the induced fit model does not.
(d) The lock and key model describes the active site of an enzyme as fixed, while the induced fit model states that the active site can modify its shape to strengthen binding.

The image below relates to question 20.

20. How does the broad bean in the image above obtain nitrogen from the atmosphere?

(a) Nitrogen, as nitrites in the soil, is dissolved in water and absorbed into the roots.
(b) Nitrogen-fixing bacteria within the root nodules convert N_2 into ammonia.
(c) Nitrogen is converted into ammonia in the soil before uptake by root nodules.
(d) Nitrogen-fixing fungi in the root nodules convert N_2 into amino acids during cellular respiration.

The image below relates to question 21.

21. The trees and shrubs that grow in arid regions, such as those pictured above, are much smaller than their counterparts in a rainforest ecosystem. Photosynthetic reactions are reduced due to

(a) stomata closing during the day, reducing the amount of CO_2 exchanged and water being carried from the roots to the leaves.
(b) the absence of rainfall affecting transpiration.
(c) overexposure to sunlight.
(d) stomata opening only at night when CO_2 levels in the atmosphere are low.

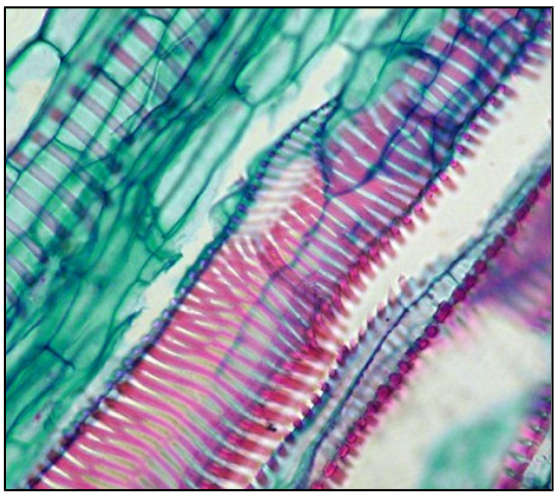
22. A spiracle is

(a) the term used to describe the hairs on plant root cells.
(b) a microscopic pore on the leaves of plants that allows gas exchange.
(c) a specialised cell in fish gills that actively absorbs oxygen from the surrounding water.
(d) an external opening for gas exchange in some arthropods.

23. When conducting an experiment, the variable that is deliberately altered is the

(a) dependent variable.
(b) independent variable.
(c) resultant variable.
(d) control.

The image below relates to question 24.



24. A biology student was asked to classify the structure shown in the image above. He suggested that the structure represented xylem tissue because it

(a) stained pink due to the presence of cellulose.
(b) has adjacent companion cells.
(c) contains many sieve plates.
(d) contains lignified rings.

25. The diversity of terrestrial organisms on Antarctica is considerably lower than land masses closer to the equator. The most likely reasons for this include

(a) sub-zero temperatures and high rainfall.
(b) less exposure to light and high salt levels.
(c) low rainfall and reduced exposure to light.
(d) low oxygen levels and sub-zero temperatures.

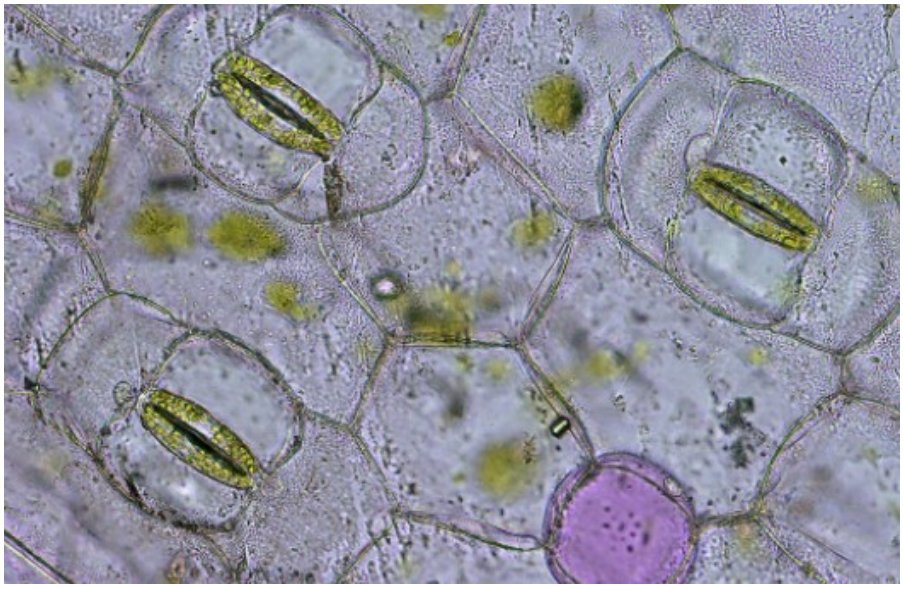
26. Which of the following statements is **true** of vertebrate circulation?

(a) All vertebrates have double-circulation and a four-chambered heart.
(b) Only mammals and birds have double circulation and a four-chambered heart.
(c) Amphibians, mammals and birds have double circulation but only mammals and amphibians have four-chambered hearts.
(d) All vertebrates except fish and amphibians have double circulation.

27. Lysosomes are said to be the digestive system of the cell because they

(a) contain enzymes, digest cellular waste and break down molecules.
(b) convert glucose and amino acids into simpler forms that can be metabolised in the cell.
(c) engulf cellular waste products and excrete them via vesicle formation.
(d) produce enzymes that are crucial to chemical digestion.

The image below relates to questions 28 and 29.



28. The image above shows guard cells surrounding stomata in a leaf epidermis. In order for the stomata to open, the guard cells must

(a) become more turgid through the loss of water via osmosis.
(b) become more turgid through the uptake of water via osmosis.
(c) become less turgid through the loss of water via osmosis.
(d) become less turgid through the uptake of water via osmosis.

29. Many Australian plants from arid ecosystems possess adaptations to reduce water loss. Which of the following is **not true** of adaptations involving stomata in arid plants? Stomata

(a) are located on the underside of leaves.
(b) can be sunken in epidermal pits.
(c) are always opened during the day.
(d) are few in number.

30. A structure involved in digestion contains a number of different cell types that carry out different functions. This structure is considered to be a/an

(a) tissue.
(b) organ.
(c) system.
(d) cellular mass.

End of Section One

Section Two: Short answer **50% (100 Marks)**

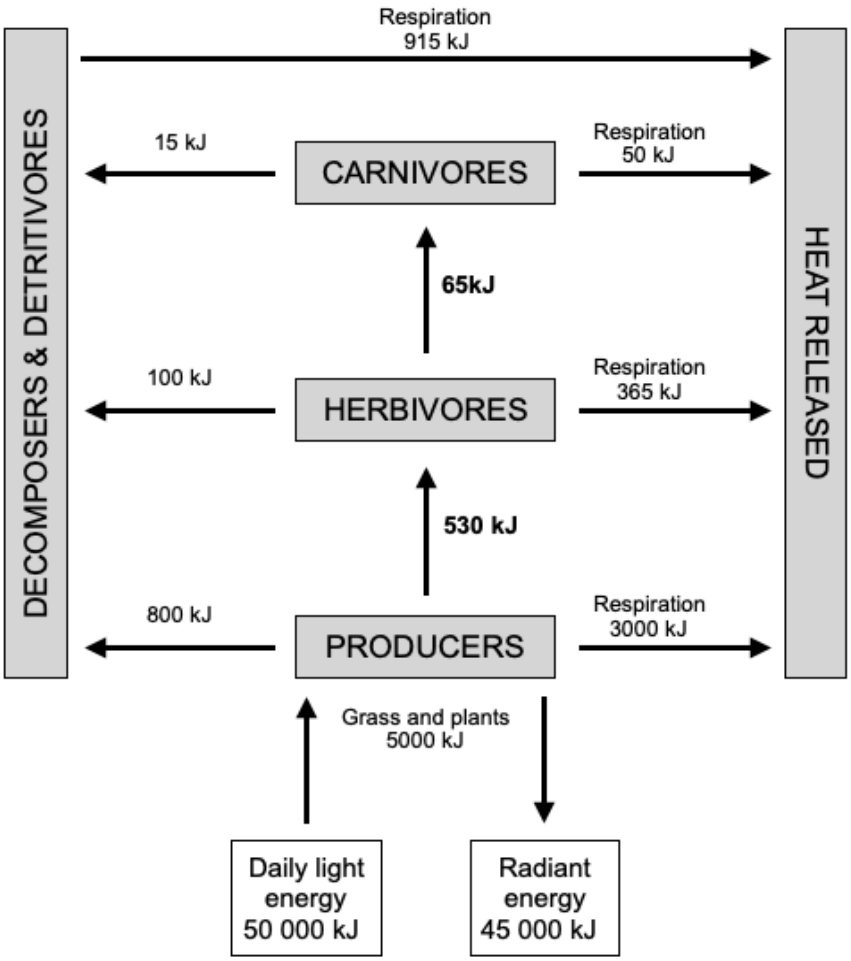
This section has **five** questions. Answer **all** questions. Write your answers in the spaces provided.

Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 90 minutes.

Question 31 **(20 marks)**

Below is a simplified energy flow diagram of the food web from a backyard ecosystem.



(a) Calculate the percentage heat loss to the nearest whole number for; (3 marks)

(b)

Description	Marks
(i) Producers - 3000/5000 x 100 = 60%	1
(ii) Herbivores - 365/530 x 100 = 69%	1
(iii) Carnivores - 50/65 x 100 = 77%	1
TOTAL	**3**

Explain the difference in heat loss between producers and carnivores. (2 marks)

(c)

Description	Marks
Carnivores have a greater rate of cellular respiration which produces and releases more heat. OR Carnivores have a higher metabolic rate per kilogram of body weight so more biomass will be converted to heat.	1
Producers photosynthesise and produce more energy (in daylight) than is lost as heat during respiration (night-time).	1
TOTAL	**2**

Explain the role of the decomposer in an ecosystem.

(2 marks)

Description	Marks
Decomposers break down organic matter into inorganic matter	1
So that it can be recycled / used by producers	1
TOTAL	**2**

In some ecosystems, particular species can play a pivotal role in maintaining the structure of the community in which it lives.

(d) State the term used to describe these particular species. (1 mark)

Description	Marks
Keystone species	1
TOTAL	**1**

(e) Describe **two** ways in which these species influence an ecosystem. (4 marks)

Description	Marks
• Controlling the population size of species that could otherwise become dominant. • A predator species will control the numbers of a prey species that could damage the environment or outcompete other species for resources.	1 - 2
• Maintaining biodiversity and ecosystem integrity/resilience. • Presence/action of the keystone species ensures biodiversity and ecosystem resilience are maintained should environmental conditions change.	1 - 2
TOTAL	**4**

(f) Many conservation scientists believe that effective ecosystem management begins with ensuring the survival of these species. Explain. (2 marks)

Description	Marks
Two points, worth **one** mark each. Examples include;	
• A keystone species has a disproportionate effect on its environment relative to its abundance. • If a keystone species is removed or declines, the nature of the ecosystem will change dramatically. • A keystone species has a critical role in determining and maintaining the overall relationship of plants and animals within an ecosystem. • A keystone species might maintain a particular abiotic factor that in turn influences the presence of biotic factors in an ecosystem.	1 - 2
TOTAL	**2**

(g) Complete the table below by identifying **three** environmental issues caused by humans. Explain how each environmental issue has affected the biodiversity of Australian ecosystems. (6 marks)

Description	Marks
One mark for identifying impact and **one** mark for a description, for a total of **six** marks. Examples include, but are not restricted to;	
1. Habitat fragmentation Excessive clearing of native bushland has led to the formation of small, isolated populations of species with lowered genetic diversity. **2. Mining/overuse of natural resources** Causing habitat destruction, soil erosion, salinity, loss of species and biodiversity through removal of habitat. **3. Salinity** Clearing of too many deep-rooted trees causing water table to rise. This brings salts to the soil surface and makes the land unsuitable for plant growth. **4. Biomagnification** Overuse of pesticides and pollution with heavy metals has led to accumulation of non-degradable toxins up the food chain, affecting health and reproduction of higher order consumers. **5. Deforestation** Removal of large areas of native forest for agriculture and urban development and for the timber industry has caused the loss of species through extinction. **6. Introduced pest species/feral animals** Introduced species (fox, cat, cane toad, weeds) have outcompeted or predated on native species, resulting in species extinctions and loss of biodiversity. **7. Eutrophication** Overuse of inorganic fertilisers (containing phosphorus and nitrogen) has caused toxic algal blooms in aquatic ecosystems, leading to depletion of dissolved oxygen, disrupted food webs, decrease in diversity and fish kills.	1 - 2
TOTAL	**6**

Question 32 **(20 marks)**

(a) In the table below, identify **three** biological macromolecules essential to the structure and function of all living organisms. For each molecule, provide **one** example and explain how it is vital to cellular structure and function. (6 marks)

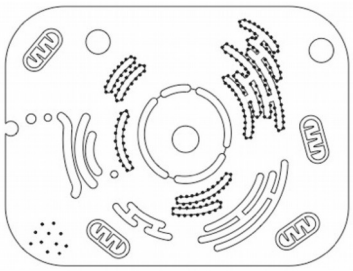
Name of macromolecule	Example and explanation of how it is vital to cellular structure and/or function
Carbohydrates	e.g. glucose/starch/sucrose source of fuel for cellular respiration
Proteins	e.g. enzymes/glycoproteins/hormones molecules to increase rate of chemical reactions/building blocks for cellular membranes/molecular transport.
Lipids	e.g. cholesterol/fatty acids/myelin cellular membranes/strength/insulation

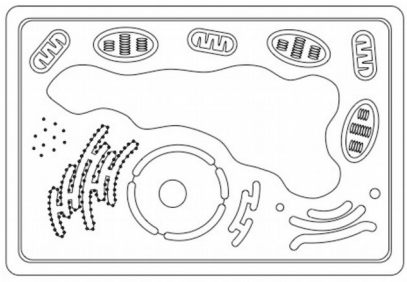
All cells, and many of their cellular components, are enclosed by a membrane.

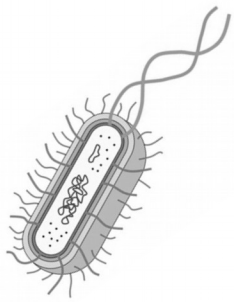
(b) Identify **two** functions of a cell membrane. (2 marks)

Description	Marks
Two points from below, **one** mark each. Examples may include;	
• Protective boundary from external environment. • Control movement of materials in and out of the cell. • Separates different chemicals to control chemical reactions. • Can create a surface for chemical reactions to occur. • Contains imbedded proteins for cell signalling.	1 - 2
TOTAL	**2**

Use the images below to answer part (c).







Eukaryotic cells **Prokaryotic cell**

(c) Identify **three** major differences between prokaryotic and eukaryotic cells. (6 marks)

Description	Marks
Three comparisons between cell types for **two** marks each. Examples include;	
• Eukaryotes - membrane bound nucleus; Prokaryotes - no nucleus with free floating DNA. • Eukaryotes - membrane-bound organelles; Prokaryotes - no membrane-bound organelles. • Eukaryotes - large and complex; Prokaryotes - small and simple. • Eukaryotes - no plasmid DNA; Prokaryotes - often contain plasmids. • Eukaryotes - can have cell specialisation based on function; Prokaryotes - no cell specialisation.	1 - 6
TOTAL	**6**

(d) Identify and name the structures found in eukaryotic cells that are responsible for; (4 marks)

Description	Marks
(i) protein synthesis - ribosomes	1
(ii) respiration - mitochondria	1
(iii) photosynthesis - chloroplasts	1
(iv) processing and packaging proteins - Golgi apparatus/body	1
TOTAL	**4**

(e) Two important organelles within eukaryotic cells, associated with metabolism, have double membranes. Explain how these membranes improve the biochemical function of these structures. (2 marks)

Description	Marks
Membranes are heavily folded which increases the surface area.	1
A large surface area increases the rate of the associated biochemical reactions.	1
TOTAL	**2**

This page has been left blank intentionally

See Next Page

Question 33 **(20 marks)**

A survey of the 'little red kaluta', a small, carnivorous marsupial (*Dasykaluta rosamondae*) was carried out in Western Australia's Pilbara region over a period of six months. Sampling took place on the first two days of every month, with one hundred traps randomly placed in a 2 km^2 quadrat in terrain dominated by spinifex and sand. Captured animals were marked with nail polish on the claws of their front, right-hand paw. The gender, health and weight were recorded for each animal captured. The relative population size of the kaluta was calculated after each survey period using the following formula;

$$N = \frac{M \times n}{m}$$

where M = marked animals,
n = total number of animals captured,
m = number of recaptured animals (marked).

The data from the six-month population survey are shown in the table below.

	June	July	Aug	Sept	Oct	Nov
MALE						
New individuals	26	18	8	3	1	2
Marked (M)	26	44	52	55	56	58
Recaptured (m)		19	36	42	0	0
Total caught (n)	26	37	44	45	1	2
Mean weight (g)	31	35	32	37	21	23
FEMALE						
New individuals	22	14	11	9	4	5
Marked (M)	22	36	47	56	60	65
Recaptured (m)	-	16	21	40	48	55
Total caught (n)	22	30	32	49	52	60
Mean weight (g)	24	26	28	28	29	30
Pouched young	0	0	0	0	3	19
N males		**86**	**64**	**59**		**0**
N females		**68**	**72**	**69**		**71**
N total		**154**	**136**	**128**		**71**

See Next Page

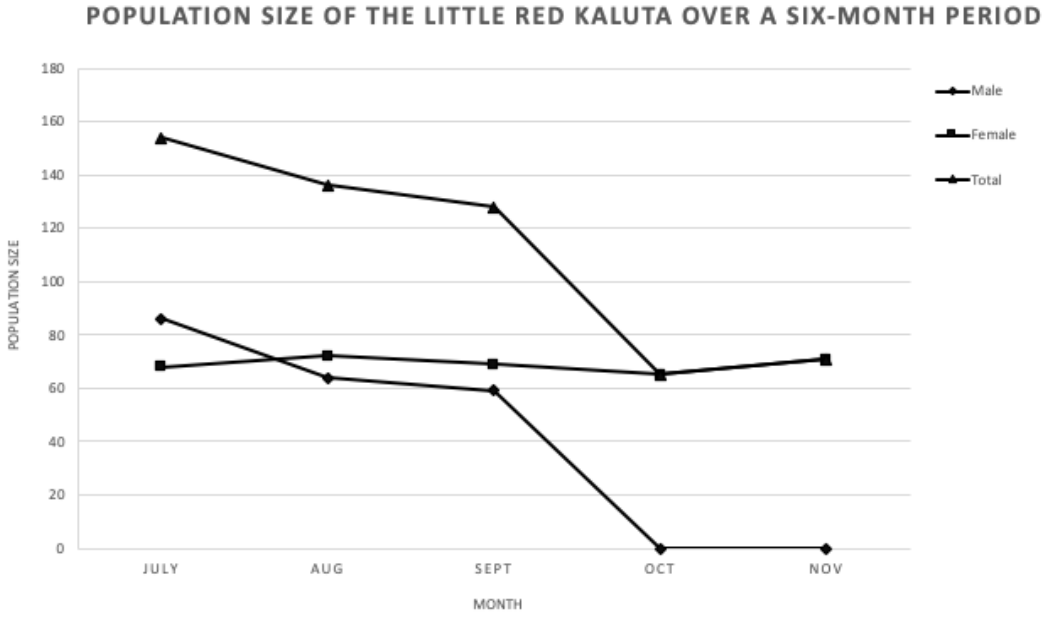
(a) Calculate the following population sizes (N) for the October survey period. Show your working and round your answers to the nearest whole number. (3 marks)

Description	Marks
Males - 58 x 1 / 0 = 0	1
Females - 60 x 52 / 48 = 65	1
Total - 0 + 65 = 65	1
TOTAL	**3**

(b) On the grid provided, construct an appropriate graph showing the population size of male, female and total kalutas from July to November. (6 marks)

A spare grid is provided at the end of this Question/Answer booklet. If you need to use it, cross out this attempt and indicate clearly that you have redrawn it on the spare page.

Description	Marks
Title	1
Axes correct - time on x-axis; population size on y-axis.	1
Axes labelled	1
Line graph	1
Three separate lines - one for male, female and total.	1
Legend	1
TOTAL	**6**



(c) Describe any trends in the graphed data. (3 marks)

Description	Marks
Female population is relatively stable for the whole survey period.	1
Male population is slightly higher than females until the October period where numbers drop dramatically to zero (0).	1
Male population size remains at zero for the remainder of the study.	1
TOTAL	**3**

(d) Explain **one** problem with the marking technique used by the researchers. (2 marks)

Description	Marks
Nail polish may get scratched off while the animal is digging and feeding.	1
It could be recorded as a new individual if recaptured, distorting the data.	1
TOTAL	**2**

(e) Provide **two** possible reasons to explain the declining male kaluta numbers as shown in the data collected in the October and November surveys. (2 marks)

Description	Marks
Two points from below, **one** mark each.	
• Most male kalutas died following mating season. • Small number recorded were not yet sexually mature so still alive. • Males were not active while traps were set so females are overrepresented in the data.	1 - 2
TOTAL	**2**

(f) The little red kaluta is nocturnal and rests in burrows during the day. Identify **one** advantage of this behaviour. (1 mark)

Description	Marks
Examples include, but are not restricted to;	
• predator avoidance • desert heat avoidance	1
TOTAL	**1**

While relatively little is known about the kaluta, it is not considered a threatened species.

(g) Explain the importance of collecting ongoing data on the kaluta, despite its current status. (3 marks)

Description	Marks
• Establish its role in the ecosystem - could be a keystone species or an indicator of ecosystem health. • Monitor any change in population size or structure. • Determine impacts of climate change/predators/invasive species/human activity.	1 - 3
TOTAL	**3**

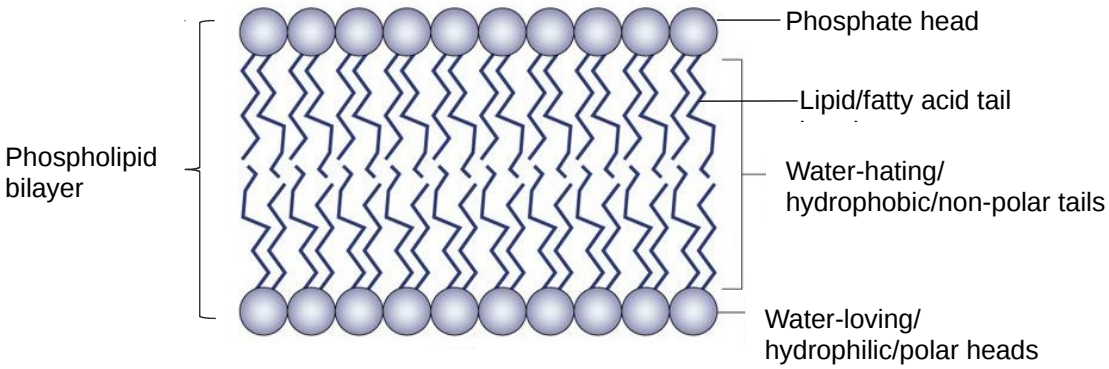
Question 34 **(20 marks)**

(a) With the aid of a labelled diagram, describe the structure of the fluid mosaic model of cellular membranes. (6 marks)

Description	Marks
Diagram should include at least **six** of the following structures and/or have labelled;	
• Phospholipid bilayer (label) • Phosphate head • Lipid/fatty acid tail • Tails inward and heads outward in two layers • Water-loving/hydrophilic/polar end (outside) • Water-hating/hydrophobic/non-polar end (inside) • Cholesterol molecule	1 - 6
TOTAL	**6**

**The question does not ask specifically for protein structures. No marks are allocated for transport or integral proteins.*

Example;



(b) Explain why the model is called a 'fluid mosaic'. (2 marks)

Description	Marks
Two points for **two** marks each. Each point should include a valid factor (**one** mark) and explanation (**one** mark). Examples include, but are not restricted to;	
• Phospholipids are not joined and are able to move making the membrane fluid	1
• Proteins are studded throughout the membrane giving it a mosaic effect	1
TOTAL	**2**

(c) Explain the importance of membrane fluidity to cellular function. (2 marks)

Description	Marks
One points for **two** marks each. Each point should include a valid factor (**one** mark) and explanation (**one** mark). Examples include, but are not restricted to;	
• Allows fusion of membranes together for effective transport of materials into and out of the cell via endocytosis and exocytosis. • Can affect the distribution and positioning of proteins within the membrane, which influences the transport of molecules vital to metabolic processes. • Allows the membrane to move and change shape without rupturing. A ruptured membrane would lead to the loss cell contents and death. • Enables cytokinesis (cell division) to occur (by even cleaving) which is important for growth and repair of cells.	1 - 2
TOTAL	**2**

Consider the **three** images below of different gas exchange surfaces from a mammal (**W**), a fish (**X**) and an amphibian (**Y**).

(d) Identify **two** features common to all three structures. (2 marks)

W

X

Y

Description	Marks
Large surface area.	1
Thin/single cell surface.	1
TOTAL	**2**

(e) Explain the importance of these **two** features to an organism's metabolic activity.
(4 marks)

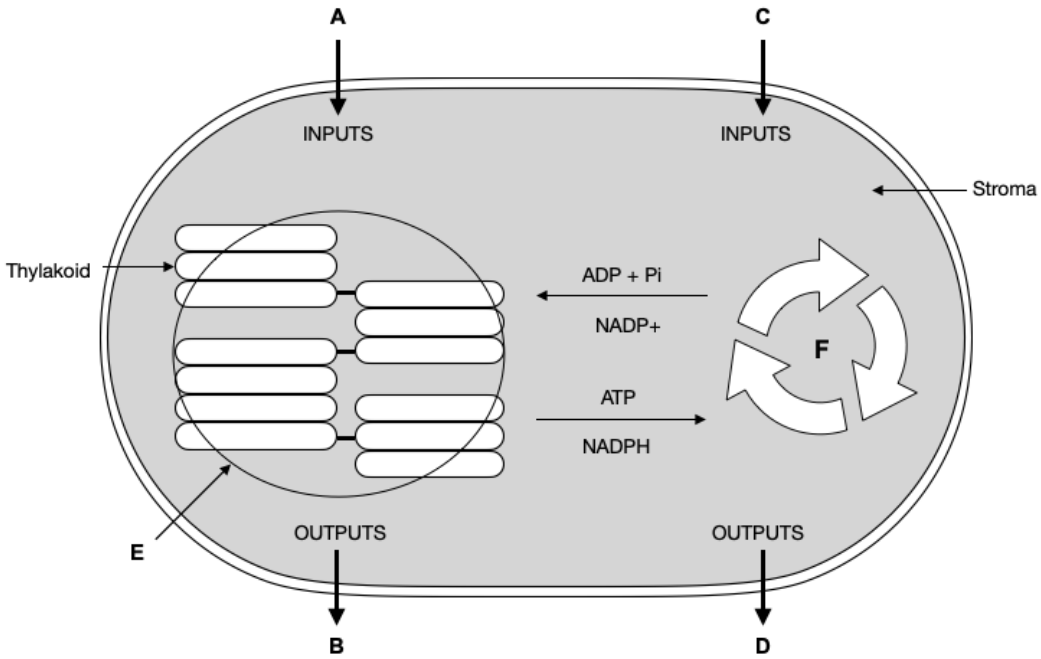
(f)

Description	Marks
One mark for reason and **one** mark for effect. Examples include, but are not restricted to;	
• Sufficient oxygen can be obtained from the external environment, transported to the cells and used to synthesise enough energy through cellular respiration. • Oxygen can be transported very rapidly through a thin surface (one cell thick) into the bloodstream and be rapidly delivered to the cells for cellular respiration. • Carbon dioxide can be removed/lost easily from the blood to the external environment, allowing cellular concentration gradients to be maintained. • The highly vascularised structures allow maintenance of a constant concentration gradient for both oxygen and carbon dioxide - ensures continued, rapid diffusion of gases into and out of bloodstream.	1 - 2
TOTAL	**4**

Explain why structures '**W**' and '**X**' differ in shape despite having a similar function.
(4 marks)

Description	Marks
Structure **W** is an alveolus from a vertebrate lung which takes in air. Air has a high oxygen content and millions of alveoli comprise the lungs, allowing for efficient gas exchange.	1 - 2
Structure **X** is a part of a gill from a fish which is submerged in water. Less oxygen is dissolved in water than air so the surface area must be much greater to obtain enough oxygen. *Counter-current exchange occurs in gill lamellae.	1 - 2
TOTAL	**4**

35 **Question (20 marks)**



(a) Identify the chemical inputs, **A** and **C**, and outputs, **B** and **D** of photosynthesis as shown in the diagram above. (2 marks)

(b)

Description	Marks
Inputs A - H_2O (water) and sunlight C - CO_2 (carbon dioxide) and H^+	1
Outputs B - O_2 (oxygen) D - sugar ($C_6H_{12}O_6$ or CH_2O)	1
TOTAL	**2**

Name the substance present in the thylakoid membranes essential for photosynthesis. (1 mark)

(c)

Description	Marks
Chlorophyll	1
TOTAL	**1**

Name and describe the reactions/process occurring in the area labelled '**E**'. (3 marks)

(d)

Description	Marks
Light-dependent reactions of photosynthesis.	1
Light energy is absorbed by the pigment chlorophyll found in the thylakoid membranes.	1
This energy is used to split water (H_2O) into oxygen (O_2) and hydrogen ions (H^+).	1
TOTAL	**3**

Name and describe the reactions/process occurring in the area labelled '**F**'. (3 marks)

Description	Marks
Light-independent reactions - Calvin cycle.	1
In the stroma the H^+ from thylakoids (delivered by NADPH) and input CO_2 react to form sugar molecules. (Calvin cycle)	1
Requires energy (ATP) created in light-dependent reactions.	1
TOTAL	**3**

Many enzymes are involved in biochemical reactions that occur within all organisms, including photosynthesis.

(e) Define 'enzyme'. (2 marks)

Description	Marks
A specialised protein molecule that acts as a biological catalyst.	1
Speeds up the rate of chemical reactions/reduces activation energy.	1
TOTAL	**2**

The stroma is a fluid-filled space within a chloroplast that contains DNA, ribosomes and many different enzymes. The fluid is maintained at a pH of 8.

A gardener added a strong, nitrate-based fertiliser to his indoor plants without realising it would decrease the pH of the soil.

(f) Explain the effect of a reduced soil pH on the enzymes and chemical reactions within the stroma. (3 marks)

Description	Marks
Enzymes are sensitive to and function best at a specific pH.	1
Enzymes in the stroma would likely denature at a lower pH/more acidic environment.	1
The light-independent reactions could not take place without enzymes. (No sugar synthesised and build-up of CO_2)	1
TOTAL	**3**

Many types of medicines, pesticides and toxins are enzyme inhibitors.

(g) Explain how an enzyme inhibitor affects enzyme function. (2 marks)

(h)

Description	Marks
One mark for cause and **one** mark for effect, for a total of **two** marks. Example;	
• Blocks active site, preventing the formation of the enzyme-substrate complex. • New substances cannot be formed as a result of the reactions being prevented.	1 - 2
TOTAL	**2**

Describe **two** other factors besides pH and enzyme inhibitors that can affect the rate at which enzymes function. (4 marks)

Description	Marks
Two marks per factor, for a total of **four** marks; **one** mark for identifying a factor and **one** mark for its description. Examples include, but are not restricted to;	
• **Temperature** - enzymes function best at an optimum temperature. Excess heat will result in enzymes denaturing. Low temperatures cause reactions to cease - not enough energy to help activate. • **Substrate concentration** - increasing the concentration of substrate will increase the reaction rate of enzymes until the concentration of enzymes becomes a limiting factor. • **Enzyme concentration** - More enzymes that are available = more reactions occurring at the same time and a greater volume of products formed.	1 - 2
TOTAL	**4**

End of Section Two

Section Three: Extended answer 20% (40 marks)

Unit 1

Choose **either** Question 36 **or** Question 37.

Question 36 (20 marks)

(a) Explain the dynamics of the predator-prey relationship and outline the various strategies used by prey species to avoid predation.

(10 marks)

Description	Marks
Students must provide **seven** points from below for **one** mark each.	
• A carnivorous animal (predator) kills another consumer (prey) for food. • A predator usually has more than one prey species on which feeds and a prey species can have more than one predator it needs to avoid. • The relationship between predator and prey is dynamic, balanced and cyclical in nature. • Abundant food and optimal environmental conditions lead to an increase in prey population numbers. • The predator population increases in response to the increase in prey. • With an increase in predation or unfavourable environmental conditions, prey numbers decline. • With decreasing numbers of (favoured) prey, the predators source other prey species and intraspecies competition increases. • Predator population starts to decline in response to competition and reduced food resources. • The decline in predator population and alternative food sources allows the recovery of the favoured prey species.	1 - 7
Students must include **three** different strategies with a description in their response worth **one** mark each. Examples include, but are not restricted to;	
Mimicry Some animals and plant have evolved structures/morphology or behaviours that mimic other species in order to avoid predation. **Camouflage** Structural characteristics like hair and skin patterns help organisms to 'blend' into their surroundings and avoid being detected by predators. **Nocturnal behaviour** Small herbivorous animals feed at night (heat avoidance) to reduce probability of attack from overhead and terrestrial predators. **Herding** Grazing prey feed in large herds to reduce the likelihood of capture. **Speed/agility** Many prey species are very fast runners/hoppers and can escape from predatory attack with a burst of speed and endurance.	1 - 3
TOTAL	**10**

(b) Outline the concept of carrying capacity. Explain how the effects of climate change could influence the carrying capacity of any given species population.

(10 marks)

Description	Marks
Carrying capacity is the maximum population size of a species that can be supported indefinitely in a given environment.	1
Carrying capacity is determined/limited by abiotic and biotic factors of the environment - limiting factors.	1
Limiting factors can be density-dependent - the population density of a species influences these factors - competition, disease, predation, food, shelter/nests.	1
Limiting factors can be density-independent - factors that affect the population despite density - rainfall, salinity, temperature, humidity, pH, fire, drought, other catastrophic events.	1
Climate change directly affects abiotic/density-independent factors - changes in rainfall patterns, increased temperatures, bushfire frequency, extreme weather events.	1
Climate change indirectly affects density-dependent factors as a result of changes to abiotic/density-independent factors. This in turn can have a dramatic effect on the carrying capacity.	1
Environmental changes affecting carrying capacity. Students must provide at least **four** examples worth **one** mark each. Examples include, but are not restricted to;	
• lower rainfall affects primary productivity as a result of decreased rate of photosynthesis; leads to a decrease in plant diversity, less food for herbivores and therefore more competition. • Lower productivity of autotrophs has a flow on effect up the food chain/web. Higher order consumers cannot be supported by a reduced biomass at lower levels and may become threatened. • Reduced annual rainfall results in less recharge of the water table. Large, deep-rooted trees become water stressed and susceptible to disease. • Lower than normal water table from lower rainfall will increase plant deaths and reduce food and shelter for many animal species, increasing competition and susceptibility to disease and parasites. • Extreme weather events like drought and flooding increase mortality of plant and animal species less adapted to cope with change. Reduction in biodiversity may occur over time. • Increased average temperatures over summer months results in an increase in the frequency and intensity of bushfires, exacerbated by low rainfall and strong winds. Causes removal of food and shelter and increases likelihood of predation and disease.	1 - 4
TOTAL	**10**

Question 37 **(20 marks)**

(a) Discuss the biological species concept and its limitations in defining 'species'. Explain how an understanding of the concept of 'species' is important to ecosystem conservation and management.

(10 marks)

Description	Marks
According to the biological species concept, a species is a group of organisms whose members can breed with each other and produce viable offspring.	1
Individuals in a species are reproductively isolated from individuals belonging to different species.	1
Biological species concept explains how reproductive isolation leads to speciation/evolution.	1
Cannot apply the biological species concept to fossilised remains as there is no evidence of reproductive strategies.	1
Without the ability to classify fossilised remains, phylogenetic studies are not possible.	1
Cannot be applied to hybrid organisms as they 'belong' to two different species.	1
Students must provide **four** points regarding ecosystem conservation and management, worth **one** mark each. Examples include, but are not restricted to;	
• Allows for correct taxonomic identification in surveys. • Allows for measurement of species diversity/richness. • Improves our understanding of species habitat requirements. • Provides information regarding interaction of different species. • Provides information about ecosystem health using diversity as an indicator. • Provides information regarding population dynamics. • Allows conservation scientists to determine human impacts on species diversity and status.	1 - 4
TOTAL	**10**

(b) Discuss the adaptations Australian plants possess in order to regenerate and reproduce following wildfire.

(10 marks)

Description	Marks
Students must provide at least **five** examples from below, worth **two** marks each. **One** mark for adaptation and **one** mark for discussion of adaptation.	
• Epicormic buds/growth - buds are located under protective bark and sprout to form new branches and leaves following fire. *Eucalyptus* and *Banksia* species produce epicormic sprouts. • Heat-induced fruits/nuts/cones opening - many native plants, such as *Banksia* sp., have resin sealed nuts/cones that can only release seeds once heat from fire has melted resin. • Thick bark/retaining dead leaves on trunk - thick bark or retained leaves (grasstrees) insulates the vascular tissues underneath and protects any epicormic buds. • Large, woody lignotubers - Trees such as *Banksia* sp. and mallees possess large, underground lignotubers that store starch and can produce regenerative shoots after a fire has destroyed the aboveground part of the plant. • Dry, dormant tubers - some herbaceous species of orchids lay dormant as dried tubers below ground, protected from fire. They regenerate/reshoot in post-fire, nutrient-rich soil bed. • Fleshy bulbs and rhizomes - herbaceous plants have underground stems which rapidly reshoot following fire that destroys the plant. • Smoke-induced germination - chemical compound in bushfire smoke (cyanohydrin and karrikinolide) breaks seed dormancy and stimulates the germination of seeds in the soil. The seeds of some species cannot germinate without exposure to these compounds. • Fire-activated flowering - some species, such as grasstrees, take advantage of the increased nutrient load in the soil and flower post-fire. This increases the chance of species survival by promoting reproduction.	1 - 2
TOTAL	**10**

Unit 2

Choose **either** Question 38 **or** Question 39.

Indicate the question you will answer by ticking the box next to the question. Write your answer on the pages provided.

☐ **Question 38** **(20 marks)**

(a) Discuss the process of cellular respiration in the presence and absence of oxygen.
(10 marks)

Description	Marks
Aerobic cellular respiration requires oxygen and occurs within the mitochondria of all cells.	1
Glucose (from digestion of carbohydrates) and oxygen are required to 'fuel' aerobic respiration, which produces carbon dioxide, water and energy in the form of ATP (adenosine triphosphate). $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_20 +$ energy (36 ATP)	1
Aerobic respiration can be broken down into three distinct stages - Glycolysis, Krebs Cycle and Electron Transport.	1
Glycolysis occurs in the cytoplasm of the cell and yields 2 ATP. Glucose is converted into 2 pyruvate molecules in the absence of oxygen.	1
The pyruvate molecules enter the mitochondrial matrix (in the presence of oxygen). The Krebs Cycle occurs within the matrix - two rounds of the cycle yield 2 ATP and carbon dioxide.	1
Hydrogen ions (H^+) and electrons (released) from the Krebs Cycle are carried to the highly folded inner membranes (cristae) of the mitochondria where electron transport takes place.	1
As the H^+ and electrons move through the inner membranes they provide the energy for the synthesis of 32 ATP (phosphorylation).	1
Anaerobic respiration occurs in the absence of oxygen and only yields 2 ATP. The mitochondria are not involved in this process which occurs in the cytoplasm.	1
As with aerobic respiration, glycolysis is the first stage of anaerobic respiration. In the absence of oxygen, the pyruvate is converted into lactic acid (lactate fermentation).	1
In bacteria, yeast and plants, the pyruvate molecules are converted into ethanol and carbon dioxide (via alcoholic fermentation).	1
TOTAL	**10**

(b) Explain how materials are transported throughout a plant by contrasting the structure and function of the xylem and phloem.

(10 marks)

Description	Marks
Structure - phloem vs xylem. **One** mark per point for a total of **five** marks.	
• Xylem comprised of dead cells; phloem comprised of living cells. • Xylem cell walls contain thick lignin (for strength); phloem walls contain thin cellulose. • Xylem cells include tracheids, parenchyma and vessel elements; phloem cells include sieve tube cells, companion cells and phloem parenchyma. • Xylem vessels are located deep within (the centre) of the vascular bundle/stem tissues; phloem vessels are located on the outer edges of the vascular bundle. • Xylem cells are impermeable - no osmotic movement; phloem cells are permeable to water and solutes. • Xylem cells do not have a cytoplasm and are hollow; phloem cells possess cytoplasm and line the cavity of the phloem. • Xylem cells are arranged end to end with no end walls; phloem cells are connected end to end but end walls are sieve plates. • In older plants and tree trunks, xylem is located within the stem, while phloem is found within the inner soft bark. • Conducting elements of xylem are tracheids and vessels; phloem conducting elements are sieve tubes.	1 - 5
Function - xylem vs phloem. **One** mark per point for a total of **five** marks.	
• Xylem transports water containing dissolved inorganic ions; phloem transports sugar/sucrose (products of photosynthesis) and amino acids. • Xylem flow is unidirectional from root to leaf; phloem transport is multidirectional, delivering 'food' to growth areas and storage organs (roots and tubers). • Xylem offers mechanical strength to the plant; phloem does not provide any mechanical support. • Water transport through xylem is passive and requires not energy expenditure; phloem transport is active and uses energy in the form of ATP. • Xylem transports water in an unbroken stream through capillary action using the forces of cohesion and adhesion, transpirational pull and root pressure; phloem transports nutrients around the plant through the plant via translocation. • Water moves into and out of the xylem through tracheid pits in the cell walls; materials enter and leave the phloem through osmosis, diffusion and active transport (no pits - living cells). • Water movement through/up the xylem is influenced by opening and closing of stomata/evaporation from leaves; phloem transport is influenced by diffusion gradients - pressure flow hypothesis.	1 - 5
TOTAL	**10**

Question 39 **(20 marks)**

(a) Explain how molecules are transported across cellular membranes through passive and active transport.

(10 marks)

Description	Marks
Passive transport - osmosis, diffusion, facilitated diffusion. Active transport - active transport, endocytosis (pinocytosis and phagocytosis) and exocytosis.	1
Passive transport does not require energy as molecules move down a concentration gradient (high to low). Active transport uses energy as ATP to move molecules against the concentration gradient (low to high), expel materials/waste from the cell or ingest materials into the cell via vesicles.	1
Simple diffusion across a membrane (semi-permeable) involves the movement of small, hydrophobic (non-polar) molecules like oxygen and carbon dioxide down a concentration gradient. No protein channels are required as the inside of the bilayer is non-polar.	1
Osmosis is the movement of water across a semi-permeable membrane from low solute to high solute concentration, in response to osmotic pressure. Water is polar so travels through special channels called aquaporins.	1
The movement of large, polar or ionic/charged molecules requires the assistance of protein channels and carriers that are imbedded within the phospholipid bilayer. These are specific to the molecules they transport.	1
Facilitated diffusion involves the movement of large, polar and charges molecules such as glucose, amino acids and ethylene. These molecules are transported through protein channels down a concentration gradient, without expending ATP.	1
Active transport is the movement of molecules through protein carriers, against the concentration gradient. The proteins must be supplied with energy/ATP before they can function, e.g. when a molecule is needed in greater concentrations or a waste needs to be expelled beyond passive diffusion amounts, e.g. sodium-potassium pump in nerve cells.	1
Very large particles cannot be transported across/through the membrane and must be moved via vesicles - endocytosis and exocytosis. Vesicle formation and 'bulk' transport of material is an active process requiring energy/ATP.	1
There are two types of endocytosis - phagocytosis and pinocytosis. Phagocytosis is the process by which solid particles (food, bacteria) are engulfed by the cell. Pinocytosis involves engulfing liquids.	1
Exocytosis (opposite of endocytosis) occurs when large molecules/substances produced by the cell need to be transported to other parts of the organism (hormones, enzymes, proteins). These molecules are delivered to the cell membrane in vesicles and released to the exterior.	1
TOTAL	**10**

(b) Discuss the function of the digestive system and differentiate between the alimentary structures of a herbivore and a carnivore.

(10 marks)

Description	Marks
The digestive system is responsible for the mechanical and chemical breakdown of food into small molecules that can be absorbed into the bloodstream and delivered to cells for metabolic processes.	1
Mechanical digestion occurs in the mouth, using teeth to macerate food; in the stomach by muscular churning, and in the small intestines via peristaltic waves. This helps to break up food into smaller pieces that have a larger surface area.	1
Chemical digestion occurs in the mouth by enzymes released by salivary glands (amylase), in the stomach by gastric juices and enzymes (protease) and in the small intestines by bile from gall bladder and enzymes from pancreas.	1
Enzymes are grouped according to the molecules they react with; Proteases break down proteins into polypeptides/amino acids. Amylases break down carbohydrates into sugars/glucose. Lipases break down fats into fatty acids and glycerol.	1
Products of chemical digestion are absorbed through the inner lining of the small intestines. The surface area of the lining is increased by the presence of villi and microvilli. Absorbed products/nutrients are then carried through the bloodstream and made available to cells.	1
The diet of animals can be determined by their alimentary structures for mechanical and chemical digestion. Carnivores possess adaptations for digesting meat, while herbivores are adapted to a diet of plant matter.	1
Carnivores have large canines for tearing flesh and molars crunch and grind bones. Herbivores have reduced or no canines. Incisors are prominent at front of jaw and flattened molars for grinding fibrous material.	1
Carnivore gut is adapted for digesting meat - possess own enzymes. Large stomach capacity to cater for infrequent large meals. Short small intestine and caecum usually absent because no fermentation of fibrous material needed/protein and fat are easily digested.	1
Herbivores can have hindgut or foregut digestion for processing fibrous material and cellulose - no enzymes for this process. Foregut digesters have a large stomach, long intestine and medium caecum. Fermentation uses microbes (bacteria) to break down cellulose. Digestion is relatively quick.	1
Hindgut digestion involves a small stomach and small intestine but a large, expanded caecum. This allows microbial fermentation of cellulose and maintains food particles for longer to extract as much nutrition as possible.	1
TOTAL	**10**

End of questions