SCIENCE TEACHERS ASSOCIATION VICTORIA 2023

TRIAL EXAMINATION

QUESTION AND ANSWER BOOK

Total writing time:
1 hours 30 minutes

BIOLOGY
UNIT 1

Student name	

Student ID									**Letter**	

Structure of book

Section	Number of questions	Number of marks
A	25	25
B	6	50
	Total	**75**

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

Materials supplied

- Question and answer book of 20 pages, with a detachable answer sheet for multiple-choice questions inside the front cover.

Instructions

- Detach the answer sheet for multiple-choice questions during reading time.
- Write your name and student ID in the space provided above on this page and on the answer sheet for multiple-choice questions.
- Unless otherwise indicated, the diagrams in this book are not drawn to scale.
- All written responses should be in English.

At the end of the examination

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

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STAV
2023

BIOLOGY
Unit 1 Trial Examination
MULTIPLE CHOICE ANSWER SHEET

STUDENT NAME:	

INSTRUCTIONS: **USE PENCIL ONLY**

- Write your name in the space provided above.
- Use a **PENCIL** for **ALL** entries.
- If you make a mistake, **ERASE** it – **DO NOT** cross it out.
- Marks will **NOT** be deducted for incorrect answers.
- **NO MARK** will be given if more than **ONE** answer is completed for any question.
- Mark your answer by **SHADING** the letter of your choice.

	ONE ANSWER PER LINE		ONE ANSWER PER LINE
1	A B C D	14	A B C D
2	A B C D	15	A B C D
3	A B C D	16	A B C D
4	A B C D	17	A B C D
5	A B C D	18	A B C D
6	A B C D	19	A B C D
7	A B C D	20	A B C D
8	A B C D	21	A B C D
9	A B C D	22	A B C D
10	A B C D	23	A B C D
11	A B C D	24	A B C D
12	A B C D	25	A B C D
13	A B C D		

SECTION A – Multiple Choice Questions

Specific instructions for Section A

This section consists of 25 questions. You should attempt **all** questions.

Each question has four possible correct answers. Only **one** answer for each question is correct. Select the answer that you believe is correct and indicate your choice on the Multiple-Choice Answer Sheet by shading the letter that corresponds with your choice of the correct answer.

If you wish to change an answer, erase it, and shade your new choice of letter.

Each question is worth **one** mark. **No** mark will be given if more than one answer is completed for any question. Marks will **not** be deducted for incorrect answers.

Question 1

A student observed a cell under a light microscope and noted the presence of multiple chloroplasts. The cell the student was observing was most likely a/an

A. plant cell.

B. bacterial cell.

C. fungal cell.

D. animal cell.

Question 2

A solution containing red blood cells was placed in a solution of unknown concentration. After 30 minutes, the cells appeared crenated (shrivelled). What type of solution were the cells placed in?

A. hypertonic.

B. isotonic.

C. hypotonic.

D. supersonic.

Question 3

The plasma membrane encloses the cellular contents, providing a partially permeable barrier between the intracellular and extracellular environments. The plasma membrane is composed of:

A. hydrophilic lipid tails and hydrophobic phosphate heads.

B. hydrophilic lipid tails and phosphate heads.

C. hydrophobic lipid tails and phosphate heads.

D. hydrophilic phosphate heads and hydrophobic lipid tails.

Question 4

A cell within a eukaryote was found to have a high number of mitochondria when compared to other cells. It is reasonable to conclude that the cell

A. has a high surface area to volume ratio.

B. undergoes regular active transport.

C. is from a single celled eukaryote, such as euglena.

D. is the most abundant in the body.

Question 5

The following diagrams are of different organelles found within eukaryotic cells.

I II III IV

It can be stated that

A. organelle IV is found in all plant cells.

B. organelle II is the site of protein synthesis.

C. organelle I is found close to the nucleus.

D. organelle III is found only in animal cells.

Question 6

Intrinsic apoptosis is initiated by

A. damage to the mitochondria.

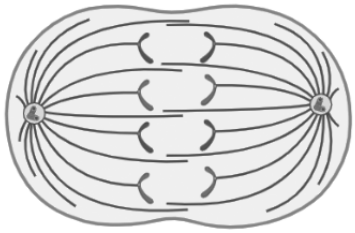
B. a death ligand binding to the nucleus.

C. an increase in the concentration of growth hormone.

D. a signal received from a neighbouring cell.

Question 7

Mitosis is the process by which eukaryotic cells replicate.



The cell shown above is in which stage of mitosis?

A. prophase

B. metaphase

C. anaphase

D. telophase

Question 8

When considering the amount of genetic material present within a cell during the cell cycle, it is true to state that

A. the G1 phase has twice as much genetic material as the G2 phase.

B. the S phase halves the genetic material.

C. the completion of S phase and the G2 phase have the same amount of genetic material.

D. the amount of genetic material within a cell remains constant throughout the cell cycle.

Question 9

The p53 protein plays a crucial role in the cell cycle by acting as a tumour suppressor. It helps to prevent the formation of cancer by regulating the cell cycle and promoting cell death in cells that have DNA damage. The p53 protein works by binding to specific DNA sequences and regulating the expression of genes that control the cell cycle, including genes that promote apoptosis. When DNA damage is detected, p53 is activated and can halt the cell cycle to allow for repair of the damaged DNA.

In a cancerous cell

A. the p53 gene is active.

B. the p53 gene is inactive.

C. the p53 gene is in a resting state.

D. an error has occurred in the p53 gene.

Question 10

Water balance is an essential mechanism in organisms, as many biochemical reactions occur within a water based medium. The primary hormones involved in this process are antidiuretic hormone (ADH) and aldosterone. The role of ADH is to

A. increase the permeability of the collecting ducts.

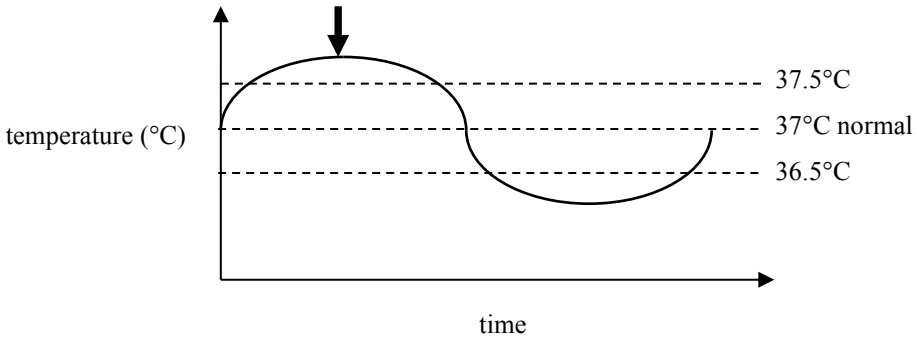
B. decrease the permeability of the collecting ducts.

C. control the length of the Loop of Henle.

D. reduce glucose reabsorption in the glomerulus.

Question 11

The following graph shows the change in temperature over time in a human.



At the peak of the graph, shown by the arrow, a homeostatic mechanism that would **not** occur is

A. sweating.

B. vasodilation.

C. relaxation of muscles.

D. increased metabolic rate.

Question 12

A vascular bundle is a group of specialised, interconnected cells and tissues that transport water, minerals, and sugars throughout a plant. The bundle is made up of two types of tissue: xylem and phloem.

The role of the phloem is to

A. transport water from the roots to the leaves.

B. transport sugars from the site of photosynthesis throughout the plant.

C. maintain water balance by establishing concentration gradients of ions.

D. allow the exchange of oxygen and carbon dioxide.

Question 13

The correct order of structure, from least complex to most complex in human systems is

A. cell, organ, tissue, system.

B. cell, tissue, system, organ.

C. cell, tissue, organ, system.

D. cell, system, tissue, organ.

Question 14

Insulin is secreted by the pancreas in response to an increase in blood glucose levels, such as after a meal.

Insulin

A. promotes an increase in aquaporins in the collecting duct.

B. promotes the breakdown of glucose stored in the liver into glycogen and its release into the bloodstream.

C. promotes the breakdown of glycogen stored in the liver into glucose and its release into the bloodstream.

D. promotes the uptake of glucose by cells, particularly in the liver and muscles, and also promotes the storage of glucose in the form of glycogen.

Question 15

Following telophase in plant cells, a cell plate begins to form. The cell plate will eventually develop into a

A. spindle fibre.

B. cell wall.

C. nucleus.

D. stem cell.

Question 16

Transpiration of water in plants is unidirectional, with water travelling against the force of gravity. The terms used to describe the attraction between water molecules that facilitates this process are

A. cohesion and adhesion.

B. evaporation and transpiration.

C. effector and receptor.

D. ingestion and excretion.

Use the following information to answer questions 17 and 18.

During the process of metamorphosis, tadpoles undergo significant changes in body structure and physiology as they transform into a frog. These changes are driven by hormones such as thyroxin and retinoic acid, which are produced in response to external cues such as temperature and environmental factors. The release of these hormones triggers a cascade of developmental changes, including the formation of new organs, the growth and reshaping of existing structures and the disappearance of others.

Question 17

Each change further triggers the release of more hormones that drive the next set of changes. This is an example of

A. negative feedback.

B. apoptosis.

C. homeostasis.

D. positive feedback.

Question 18

Hormones such as thyroxin and retinoic acid, required for metamorphosis to occur in tadpoles are under the control of which system?

A. the nervous system

B. the digestive system

C. the excretory system

D. the endocrine system

Question 19

Villi in the small intestines have numerous small projections. The primary purpose of these projections is to

A. increase the surface area to digest nutrients.

B. increase the surface area of the bolus, to initiate chemical digestion by enzymes.

C. activate enzymes within the small intestine.

D. secrete enzymes for chemical digestion.

Question 20

A group of students decided to collect some data on the size of potato cells immersed in different concentrations of saline for a 20 minute period. Based on their research, they expected the potato placed in the 0.5% saline solution to have the least change in mass. When they conducted their investigation, they found that the potato in the 2% saline solution showed the least change. They didn't want to get into trouble from their teacher, so they modified their results to match the expected outcome. The students breached the ethical concept of

A. respect.

B. beneficence.

C. integrity.

D. justice.

Question 21

The smallest functional unit within the excretory system is the

A. hypothalamus.

B. nephron.

C. microvilli.

D. pituitary gland.

Question 22

A group of students conducted an experiment to measure the change in skin temperature in a participant when exercising and when at rest. They attached a sensor to the participant's skin and logged the data. They were concerned that, as the participant was sweating during the exercise phase, the accuracy of the data may be compromised. As such, they decided to use a different sensor for the rest phase.

What type of error have the students made?

A. systematic

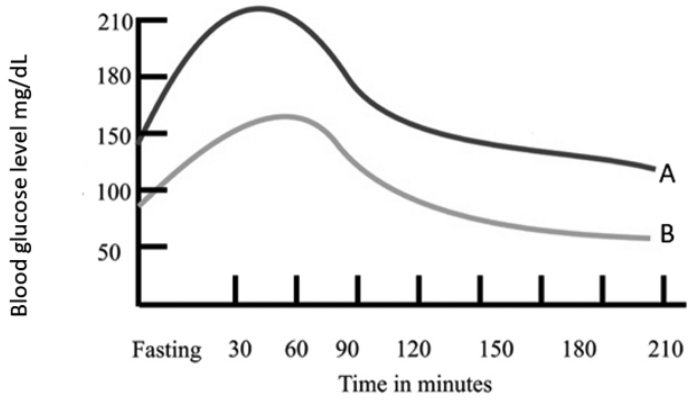
B. random

C. personal

D. none

Question 23

The graph below compares the blood glucose levels of two individuals following a meal, one with type 1 diabetes and one without.



It is fair to state that

A. the person with type 1 diabetes had a peak blood glucose level of approximately 150 mg/dL.

B. the person with type 1 diabetes was able to restore their blood glucose level at a faster rate compared to the person without type 1 diabetes.

C. the person without type 1 diabetes had a peak blood glucose level of 50 mg/dL.

D. the person without type 1 diabetes had a consistently lower blood glucose level than the person with type 1 diabetes.

Question 24

A correlational study

A. investigates the relationship between an independent and a dependent variable.

B. investigates the relationship between variables that have not been manipulated or controlled.

C. creates a model to simulate a system.

D. arranges objects into discrete sets.

Question 25

Unipotent stem cells have the ability to differentiate into

A. a single, specific cell type.

B. a wide range of cells within a specific tissue or organ.

C. a limited number of cell types, but only within a specific cell lineage, such as mesoderm, endoderm and ectoderm.

D. any cell type found in the body, including those found in multiple tissues or organs.

END OF SECTION A

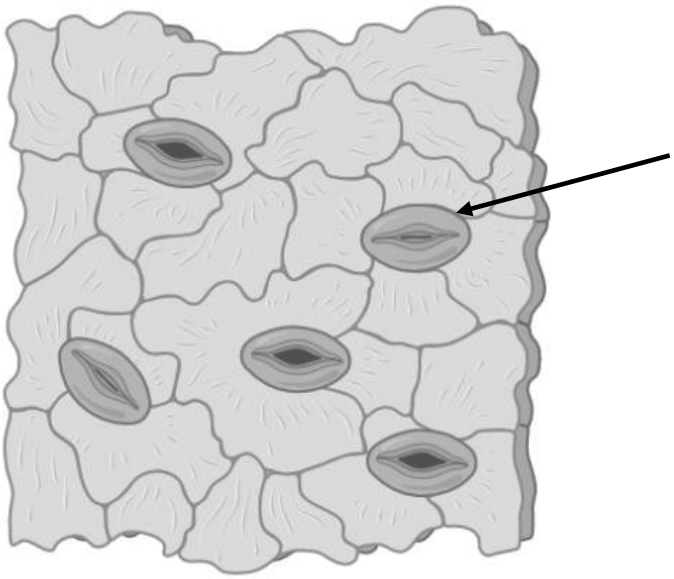
SECTION B

Specific instructions for Section B

This section consists of **6** questions. There are **50** marks in total for this section.
Write your responses in the spaces provided. You should attempt **all** questions. Please write your responses in **blue** or **black ink.**

Question 1

The image below shows the underside of a leaf. This part of a leaf is typically less visible than the upper surface, but it is just as important for the plant's survival. It is often covered with small, hair-like structures called trichomes, which help to reduce water loss and protect the leaf from damage. The structure indicated by the arrow in the image below is usually more densely packed on the underside of a leaf than on the upper surface.



a Identify the structure indicated by the arrow in the image above **and** describe its function.

_____

_____

(2 marks)

b The image shows the same structures both open and closed. What causes these structures to open?

_____

_____

_____

_____

(3 marks)

c State **two** characteristics of the leaf cell that would identify it as a eukaryotic cell rather than a prokaryotic cell.

_____

_____

(2 marks)

d How does the surface area to volume ratio of a leaf facilitate its function?

_____

_____

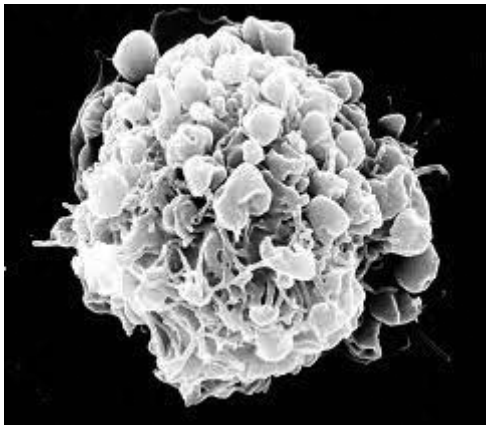
_____

(2 marks)

Total 9 marks

Question 2

Apoptosis, or programmed cell death, regulates the number of cells in multicellular organisms. Apoptosis follows a sequence of steps, with one of these steps shown below in a single cell.



Source: Cotter, T. G., Lennon, S. V., Glynn, J. M. & Green, D. R. Microfilament-disrupting agents prevent the formation of apoptotic bodies in tumor cells undergoing apoptosis. Cancer Res. 52, 997–1005 (1992).

a What step during apoptosis is occurring in the image above **and** what is the cause?

_____

_____

(2 marks)

b Apoptosis can be described as intrinsic or extrinsic. Provide **two** examples of how these two pathways share similarities.

_____

_____

(2 marks)

At one point in time, all humans were composed of only one cell, the zygote. Rapid replication and differentiation of cells occurs creating a multicellular organism, composed of different types of cells, tissues and organs.

c Compare pluripotent and totipotent stem cells.

_____

_____

_____

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(2 marks)

d Which type of stem cell, pluripotent or totipotent, would derive the greatest change to an organism if it was modified and allowed to replicate via mitosis? Explain your choice.

_____

_____

_____

_____

(2 marks)

Total 8 marks

Question 3

Mitosis is a process whereby cells are replaced or additional cells are produced to allow for growth. At times, chemical signals are disrupted and cells can become deviant, causing cancerous growths within the body.

a Multiple checkpoints exist within the cell cycle to ensure that the daughter cells are exact replicas of the parent cell. Identify at which stage in the cell cycle the G1 checkpoint is located **and** describe what it is checking for.

_____

_____

_____

(2 marks)

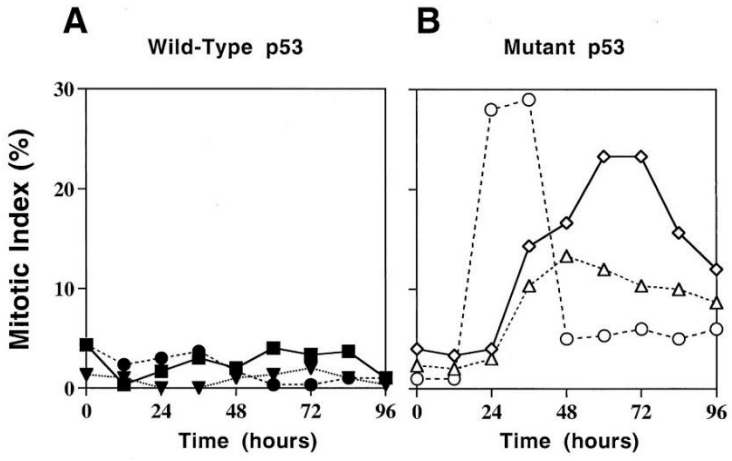
The p53 gene produces a protein that acts as a crucial checkpoint in the cell cycle, ensuring that damaged or abnormal cells do not proliferate. Loss of p53 function can lead to uncontrolled cell growth and the development of cancer.

b Identify a mutagen that can stimulate damage to the DNA within a cell, potentially causing cancer.

_____

(1 mark)

The graphs below show the effect of the p53 gene on the mitotic index in a wild-type cell and a mutant cell. The mitotic index is the ratio of cells undergoing mitosis to those not undergoing mitosis.



*Source: F. Bunz, A. Dutriaux, C. Lengauer, T. Waldman, S. Zhou, J. P. Brown, J. M. Sedivy, K. W. Kinzler, and B. Vogelstein **SCIENCE** 20 Nov 1998 Vol 282, Issue 5393 pp. 1497-1501 DOI: 10.1126/science.282.5393.1497*

c With reference to the data, what evidence is there to support that the p53 gene promotes excessive cell replication?

_____

_____

_____

(2 marks)

Cancerous cells not only rapidly divide, they can become deviant, causing significant illness in the individual and may lead to death if left untreated.

d Describe a characteristic of cancer cells that leads to this deviant behaviour.

_____

_____

_____

_____

(2 marks)

Total 7 marks

Question 4

All plants must obtain water in some form as it is an input for photosynthesis. Plants absorb water via the roots and transport it to cells capable of photosynthesis to convert inorganic carbon dioxide into organic glucose via the xylem. Plants absorb water via the root hair system, with an increased surface area to volume ratio present to facilitate this process.

a Name this process **and** explain how the presence of ions in the root hairs increases the rate of this process.

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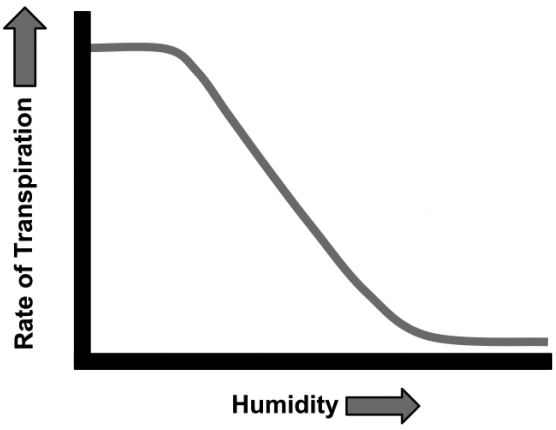
_____

(3 marks)

The rate of transpiration is affected by environmental factors. The graph below shows the effect of humidity on the rate of transpiration in plants.



b Describe the trend in the graph **and** explain the reason for the changes.

_____

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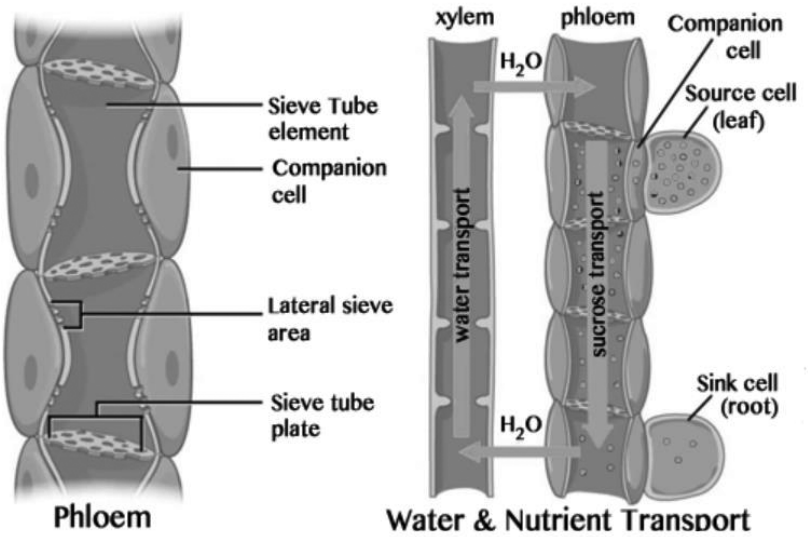
(3 marks)

Plants need to transport the glucose produced in photosynthetic cells to other regions of the plant. This glucose is used in cellular respiration to provide energy for cellular functions and growth, with excess glucose stored in polymers. These polymers can be broken down when the sugar is needed.

The diagram below shows a schematic longitudinal section of parts of the vascular bundle, the xylem and phloem.



Source: https://www.bio.miami.edu/dana/160/160S19_15.html

c. What is the role of the sieve cells in phloem?

_____

_____

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(2 marks)

Total 8 marks

Question 5

Many specialised systems exist within the human body, each with distinct roles yet reliant on each other for efficient functioning that sustains life in an organism with over 100 trillion cells.

a With reference to insulin, briefly outline how the endocrine and digestive systems work together to regulate blood glucose levels.

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(3 marks)

Two students were discussing the accessory organs of the digestive system in class. When they reached the gall bladder, they were unable to reach agreement on the role of bile. Student 1 believed that bile aids chemical digestion, whilst student 2 believed that bile is involved in mechanical digestion.

b Which student is correct? Justify your response with reference to the action of bile.

_____

_____

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_____

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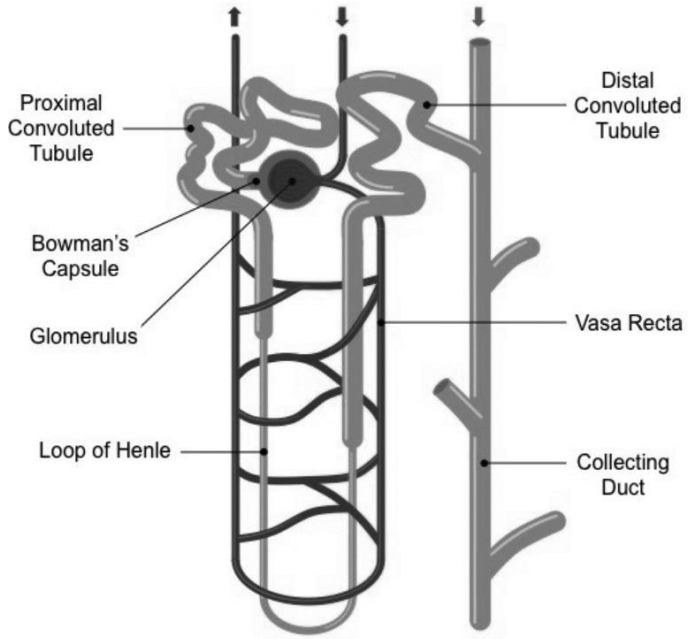
(2 marks)

Within the functional unit of the kidney is the Loop of Henle.



c On the diagram above, label the region of the Loop of Henle that is permeable to water **and** the region that is not permeable to water.

(1 mark)

d Discuss how the permeability of the ascending and descending loop of Henle facilitates the functional unit of the kidney to maintain water balance in the body.

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(4 marks)

Total 10 marks

Question 6

Hyperthyroidism is a condition characterised by an overactive thyroid gland that produces too much thyroid hormone. The thyroid gland is a butterfly-shaped gland located in the neck that produces hormones that regulate many bodily functions, including metabolism. The most common cause of hyperthyroidism is an autoimmune disorder called Graves' disease, in which the body produces antibodies that stimulate the thyroid gland to produce excess thyroid hormone. The excess thyroid stimulating hormone (TSH) leads to symptoms including muscle weakness and irregular heartbeat.

a Describe why hyperthyroidism is considered to be a homeostatic malfunction.

_____

_____

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_____

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(3 marks)

Thyroid stimulating hormone (TSH) is released from the pituitary gland, following the release of thyroid releasing hormone (TRH).

b Explain why these glands are not blocked from releasing hormones as a way to treat hyperthyroidism.

_____

_____

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_____

(2 marks)

A group of 100 individuals was split into two groups suffering from hyperthyroidism for a drug trial. The first group had fifty individuals that were given a new active drug each morning and monitored for 3 months. A blood sample was analysed weekly to measure levels of TSH in the bloodstream. The second group was given a sugar pill each morning and also monitored for 3 months. A blood sample was analysed weekly to measure levels of TSH in the bloodstream.

c What name is given to the second group of individuals in the drug trial?

_____

(1 mark)

d What results would be expected if the drug trial was shown to be successful? Explain your response.

_____

_____

_____

_____

_____

(2 marks)
Total 8 marks

END OF TRIAL EXAMINATION