Neap

Trial Examination 2023

VCE Biology Units 1&2

Written Examination

Question and Answer Booklet

Reading time: 15 minutes
Writing time: 2 hours 30 minutes

Student's Name: _____

Teacher's Name: _____

Structure of booklet

Section	*Number of questions*	*Number of questions to be answered*	*Number of marks*
A	40	40	40
B	9	9	80
			Total 120

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 correction fluid/tape.

No calculator is allowed in this examination.

Materials supplied

Question and answer booklet of 34 pages

Answer sheet for multiple-choice questions

Instructions

Write your **name** and your **teacher's name** in the space provided above on this page, and on the answer sheet for multiple-choice questions.

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

All written responses must be in English.

At the end of the examination

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

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

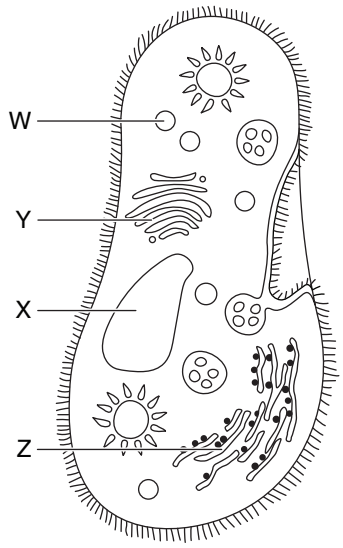
SECTION A – MULTIPLE-CHOICE QUESTIONS

Instructions for Section A

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.
Choose the response that is **correct** or that **best answers** the question.
A correct answer scores 1; an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.
Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

Use the following information to answer Questions 1–5.

The diagram below shows an organism called *Paramecium* that is commonly found in freshwater lakes, rivers and ponds. Various organelles within Paramecium are indicated by labels W–Z.



Question 1

Which one of the following is the correct classification of the *Paramecium*?

A. unicellular plant
B. prokaryotic plant
C. eukaryotic animal
D. multicellular eukaryotic

Question 2

Which one of the following structures provides evidence for the correct classification of the *Paramecium*?

A. nuclear material
B. Golgi apparatus
C. ribosomes
D. cell wall

Question 3

The *Paramecium* can synthesise proteins for cell structure and function.

Which organelle is responsible for this process?

A. organelle W

B. organelle X

C. organelle Y

D. organelle Z

Question 4

As the *Paramecium* lives in freshwater, it must absorb oxygen via

A. diffusion.

B. osmosis.

C. active uptake.

D. facilitated diffusion.

Question 5

During favourable conditions of temperature and adequate food availability, the *Paramecium* will carry out the same method of asexual reproduction as that used by prokaryotic cells.

This method is called

A. binary fission.

B. transverse fusion.

C. budding.

D. blebbing.

Question 6

Root hair cells absorb mineral ions through the process of active transport.

For active transport to occur, the root hair cells must have a

A. large volume to surface area ratio.

B. selectively impermeable plasma membrane.

C. source of energy from cellular respiration.

D. phospholipid bilayer for the mineral ions to pass through.

Question 7

Which one of the following is a cause of apoptosis?

A. exposure of cells to very high temperatures

B. internal DNA damage

C. cells absorbing toxins

D. low environmental oxygen levels

Use the following information to answer Questions 8–10.

In 1995, an Australian umbilical cord blood bank was established. The bank allows parents to voluntarily store a sample of their baby's umbilical cord blood to be used if problems arise with their children's health in the future. The stored umbilical cord blood can also be used for other children if required.

Question 8

The potency of the cells in the stored umbilical cord blood is

A. multipotent.

B. pluripotent.

C. totipotent.

D. superpotent.

Question 9

The stored umbilical cord blood could be used to treat a number of different health issues.

The umbilical cord blood would **not** be useful for

A. bone marrow transplants.

B. serious blood disorders.

C. some forms of cancer.

D. hypoglycaemia.

Question 10

Which one of the following ethical principles is demonstrated by parents agreeing to store their baby's umbilical cord blood for future use?

A. integrity

B. beneficence

C. justice

D. respect

Question 11

The formation of cancerous cells results from changes in the genes controlling normal body cell growth and division.

If a stomach cell becomes cancerous, the resulting tumour cells will

A. divide more rapidly than normal cells as they spend longer in interphase.

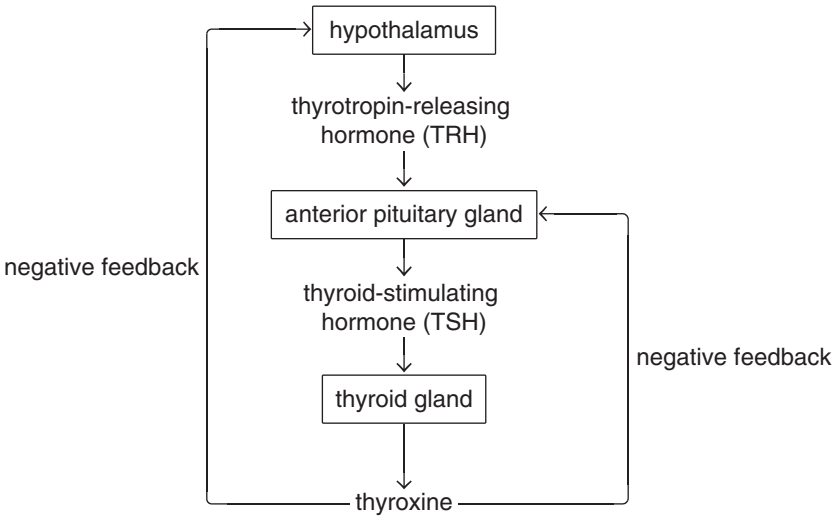
B. divide indefinitely if they have a continual supply of nutrients.

C. respond to signals that tell them to self-destruct by apoptosis.

D. always have the same appearance and chromosome number as unaffected stomach cells.

Use the following information to answer Questions 12–15.

The diagram below illustrates the regulation of thyroxine secretion. The thyroid gland can be stimulated in several different ways, one of them being during thermoregulation when the body's core temperature decreases.



Question 12

Which one of the following statements about the diagram is correct?

A. The hypothalamus is the effector.

B. The thyroid gland is the receptor.

C. There are only two hormones involved.

D. The final stage is thyroxine production.

Question 13

During thermoregulation, more thyroxine is released when the body's core temperature decreases, which results in negative feedback.

This negative feedback will result in

A. decreased stimulation of the hypothalamus.

B. less thyrotropin-releasing hormone (TRH) in the blood.

C. less thyroid-stimulating hormone (TSH) in the blood.

D. variable stimulation of the thyroid gland.

Question 14

A thyroid function test measures the levels of TSH and thyroxine (T4) in the blood. A normal TSH range is 0.4–4.0 mU/L. A high TSH level of more than 4.0 mU/L and a low T4 blood concentration indicates hypothyroidism.

Which one the following could be true for a person with hyperthyroidism?

A. a TSH reading of 6.0 mU/L

B. a low T4 blood concentration

C. an overactive thyroid gland

D. a TSH reading of 3.0 mU/L

Question 15

An individual goes for a walk when the weather is cold and windy.

Their body is most likely to respond to the cold by

A. releasing more thyroxine from the thyroid gland.

B. dilating the blood vessels in the individual's skin.

C. relaxing the body muscles to stop shivering.

D. decreasing the metabolic rate.

Question 16

Some of the organs in the digestive system, such as the salivary glands, liver and pancreas, are referred to as accessory organs.

Accessory organs are

A. required for digestion, but are not part of the digestive tract.

B. essential for chemical digestion in the digestive system only.

C. the sites where food is chemically digested by enzymes.

D. necessary for the absorption of digested food.

Question 17

Which one of the following links an accessory organ with its function?

	Accessory organ	Function
A.	salivary glands	secreting enzymes and mucus that are essential for chemical digestion in the mouth
B.	pancreas	producing insulin and enzymes to aid in digestion in the duodenum
C.	liver	producing bile that is activated by the stomach contents when the pH is 1–2
D.	pancreas	releasing bicarbonate ions that are required for enzyme action in the duodenum

Question 18

Which row of the table best describes a substance passing through the stomatal pores of a leaf on a healthy, green plant growing in a moderate climate?

	Substance	Time of substance movement in a 24-hour period	Direction of substance movement	Process used for substance movement in the leaf
A.	carbon dioxide	mainly during the night	into the plant	photosynthesis
B.	oxygen	mainly during the night	into the plant	cellular respiration
C.	water	during the day	into the plant	photosynthesis
D.	nitrogen	during both day and night	into the plant	cellular respiration

Question 19

Which one of the following statements about osmoregulation is correct?

A. It is the process involved in controlling body temperature to reduce water loss in hot conditions.

B. It involves a stimulus–response mechanism as no feedback is necessary in water balance control.

C. In humans, it is under the direct control of an enzyme called antidiuretic hormone (ADH).

D. It involves several structures in the human body including the skin, digestive tract and kidneys.

Question 20

The body temperature of a human is typically 37°C, but may raise to 38°C or higher if a person is unwell. If a person's body temperature rises greatly above 37°C, they are affected by a condition called hyperthermia; if their temperature rises above 41.1°C, they are affected by a condition called hyperpyrexia, which is considered a medical emergency.

Hyperpyrexia could be caused by

A. negative feedback reversing the stimulus and producing excessive responses to increase body heat.

B. bleeding in the brain, which would raise the set point of the hypothalamus, the internal thermostat of the body.

C. the shut down of heat-regulating mechanisms in the body, which decreases the heat production by cell metabolism.

D. a fever that results from a bacterial infection, which resets the body's thermostat to a lower temperature and thus causes the person to shiver and feel chilled.

Use the following information to answer Questions 21–25.

DNA is the molecule that makes up the chromosomes in cells. The number of chromosomes and, thus, the amount of DNA in a cell varies between species. The amount of DNA in a cell can be measured by mass, in picograms (1 pg = 10^{-12} g), or length, in centimetres. The following table shows the total number of chromosomes in one somatic (body) cell of four species and the amount and length of DNA in one somatic cell.

Species	Total number of chromosomes in one somatic cell	Amount of DNA in one somatic cell (pg)	Length of DNA in one somatic cell (cm)
lily plant (*Lilium*)	24	344.0	100 000
human (*Homo sapiens*)	46	6.4	188
house mouse (*Mus musculus*)	40	5.0	148
vinegar fly (*Drosophila*)	8	0.4	12

Question 21

A lily plant has a greater length and mass of DNA than a vinegar fly in each of its somatic cells.

This indicates that a lily plant

A. is more advanced in evolutionary terms than a vinegar fly.

B. has fewer chromosomes per somatic cell than a vinegar fly.

C. has DNA that consists of many more alleles per gene than a vinegar fly.

D. has more genes in its genome than a vinegar fly.

Question 22

Which one of the following statements is correct?

A. There are 4 chromosomes in a zygote of a vinegar fly.

B. There are 20 chromosomes in a sperm cell of a house mouse.

C. There are 23 chromosomes in a testes cell of a human.

D. There are 24 chromosomes in a pollen grain of a lily plant.

Question 23

The amount of DNA in the egg of a house mouse is

A. 1.25 pg

B. 2.5 pg

C. 5.0 pg

D. 10.0 pg

Question 24

House mice and humans have the same sex-determining chromosomes.

In a liver cell of a male house mouse, there would be

A. no X or Y sex chromosomes.

B. 38 autosomes and zero sex chromosomes.

C. 38 autosomes and two sex chromosomes.

D. 40 autosomes.

Question 25

All humans, male or female, have

A. the same amount of DNA in all their somatic cells.

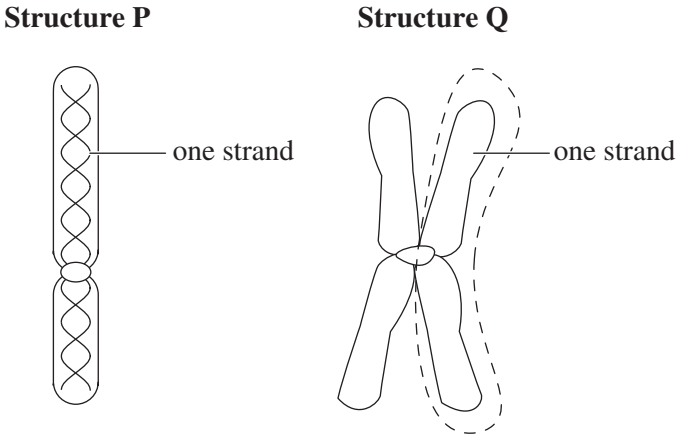
B. different numbers of chromosomes in their gamete cells.

C. the same genes on their homologous chromosomes.

D. the same alleles of the genes on their homologous chromosomes.

Question 26

The following diagram shows two structures, P and Q.



The label 'one strand' is used to describe one part of each structure.

Which of the following provides a more precise label for this part of each structure?

	Structure P	Structure Q
A.	simple helix	chromatid
B.	one DNA molecule	chromatid
C.	two DNA molecules	chromosome
D.	double helix	chromatin

Use the following information to answer Questions 27–32.

Shona, a Year 11 Biology student, compared two healthy plants of the same species that were growing in her backyard. One plant had dark green leaves, and the other plant had pale green leaves. She determined that the plant with dark green leaves should be allocated the abbreviation 'Gg'.

Shona gave her Biology teacher a plant of the same species as a gift. The plant had dark green leaves. Her teacher asked whether the plant was Gg or GG. Shona decided to use the quickest method of performing a cross to answer her teacher's question.

Question 27

The abbreviation Gg refers to

A. the genome of the plant.

B. the entire gene make-up of the plant.

C. a specific genotype of the plant.

D. the phenotype of the plant.

Question 28

For a plant that is determined to be Gg,

A. G is the dominant allele.

B. dark green is the dominant characteristic.

C. G is the recessive allele.

D. GG is the dominant trait.

Question 29

A plant that is determined to be Gg could **not** be described as

A. heterozygous.

B. a carrier.

C. homozygous.

D. hemizygous.

Question 30

Which one of the following statements about the cross Shona will perform is correct?

A. The quickest method would be a cross between the gifted plant and a dark green (GG) plant.

B. The quickest method would be a cross between the gifted plant and a dark green (Gg) plant.

C. The quickest method would be a cross between the gifted plant and a pale green (gg) plant.

D. Any cross between the gifted plant and another plant type would provide the answer in the same amount of time.

Question 31

The cross that would determine whether the gifted plant was Gg or GG the quickest is a

A. reciprocal cross.

B. test cross.

C. dihybrid cross.

D. functional cross.

Question 32

Shona studied another plant species and used the abbreviations C^G and C^Y to describe different types of the plant.

For a plant that is C^GC^Y, which one of the following statements is correct?

A. The leaves of the plant could be dark green only.

B. The pattern of inheritance was not codominance.

C. The pattern of inheritance was not complete dominance.

D. The alleles are not equally expressed.

Question 33

Being overweight, being obese, and having a sedentary lifestyle are recognised as risk factors for several diseases, including cancer, type 2 diabetes and cardiovascular disease.

Since weight is regulated by the genes that control energy homeostasis, it may be possible that macronutrients in the diet

A. affect DNA methylation and therefore contribute to the development of obesity.

B. switch on epigenetic mechanisms that alter the DNA structure of the genes.

C. modify the genes by changing their positions on the chromosomes.

D. alter the environment, which then impacts the expression of the genes.

Question 34

First Nations peoples, such as the Anangu, who live in extremely dry areas of Australia can identify the potential locations of underground chambers containing water-holding frogs. They do this by recognising markings made by the frogs in the surface soil or by using a stick to tap on the soil to detect a change in sound.

When the Anangu collect the frogs, they gently squeeze them to obtain

A. water.

B. food.

C. eggs.

D. medicine.

Use the following information to answer Questions 35 and 36.

Aphids have an XO sex-determination system and reproduce asexually by parthenogenesis in spring and summer. However, in late autumn, male and female aphids reproduce sexually, which results in fertilised eggs for overwintering. During overwintering, the fertilised eggs remain in the egg stage during winter so that the eggs can withstand the cold conditions.

Question 35

Based on the information provided, the type of reproduction used by aphids in spring and summer is most likely determined by

A. the environmental factors of day length and temperature.

B. epigenetic factors such as DNA methylation.

C. the genetic factors of dominant and recessive genes.

D. the short days and lower temperatures experienced during these seasons.

Question 36

Which of the following identifies the sex chromosomes of the male and female aphids that reproduce sexually in autumn?

	Male aphids	Female aphids
A.	XY	XX
B.	XO	XX
C.	X	XO
D.	XX	XO

Question 37

There are basic principles accepted in our cultural tradition that are relevant to the ethics of research on human subjects.

Which of the following is **not** a principle related to the ethics of research on human subjects?

A. precision

B. beneficence

C. respect

D. justice

Use the following information to answer Questions 38–40.

The water-holding frog (*Ranoidea platycephala*) lives near billabongs, swamps and claypans in Australia and is well adapted to very long dry periods. As the upper surface of the soil dries up, the frog burrows into an underground chamber, which is kept waterproof by the frog's shed skin. While in the chamber, the frog stores water in its bladder and in pockets under its skin; the water can be up to 60% of the frog's weight. The frog can be dormant with a markedly decreased metabolic rate for several years. Once heavy rain occurs, the frogs emerge, mate and lay eggs that rapidly develop into tadpoles and then adult frogs.

Question 38

The water-holding frog can stay in underground chambers for several years and reduce its metabolic rate during this time.

Which of the following identifies the type of each adaptation?

	Staying in underground chambers for several years	**Reducing its metabolic rate**
A.	structural adaptation	physiological adaptation
B.	functional adaptation	behavioural adaptation
C.	behavioural adaptation	physiological adaptation
D.	physiological adaptation	structural adaptation

Question 39

The adaptive benefit of the frog staying in an underground chamber for a long period would be

A. waiting for a mate of the same species.

B. avoiding predators on the surface.

C. allowing time for growth to maturity.

D. remaining dormant during droughts.

Question 40

In moderate climates, eggs from other frog species hatch into tadpoles that take about 14 weeks to grow into breeding frogs. However, for water-holding frogs that live in dry climates, this stage of their life cycle can occur in approximately 14 days.

The main factor responsible for this difference is the

A. humidity of the air.

B. availability of water.

C. presence of predators that eat tadpoles.

D. lack of depressions for water accumulation.

END OF SECTION A

SECTION B

Instructions for Section B

Answer **all** questions in the spaces provided.

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

Question 1 (12 marks)

Hamelin Pool is a marine reserve located on the coast of Western Australia. It is home to communities of cyanobacteria that have population densities of three billion individuals per square metre. Cyanobacteria are prokaryotes, which were one of the first living organisms on Earth, appearing over 3.5 billion years ago. These single-celled organisms are very small (1–2 μm) compared to eukaryotic cells (8–80 μm or greater).

a. i. Describe the main difference between the structure of prokaryotic cells such as cyanobacteria and the structure of eukaryotic cells. 1 mark

ii. After eukaryotic cells developed, all future life forms consisted of eukaryotic cells.

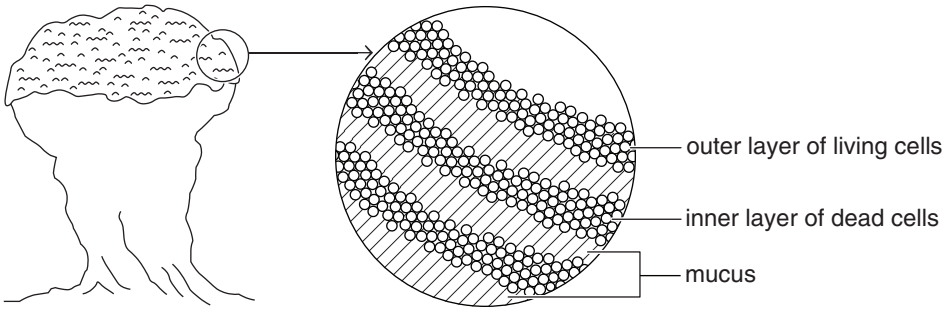
How does the difference described in **part a.** provide eukaryotic cells with an evolutionary advantage? 1 mark

iii. In terms of cell functioning and survival, describe the advantage of the very small size of prokaryotic cells. 1 mark

b. i. What structure encloses the cytoplasm of both prokaryotes and eukaryotes? 1 mark

ii. Other than enclosing the cytoplasm, what is the main function of the structure named in **part b.i.**? 1 mark

Cyanobacteria build rock-like structures known as stromatolites, which are layered mounds of mucus, dead cells and living cells. A stromatolite and its cross-section are shown in the following diagram.



Stromatolite **Cross-section of a stromatolite**

Stromatolite cyanobacteria contain blue-green pigments, while green eucalyptus gum leaves contain green pigments. Both pigments are capable of absorbing the energy necessary for maintaining life.

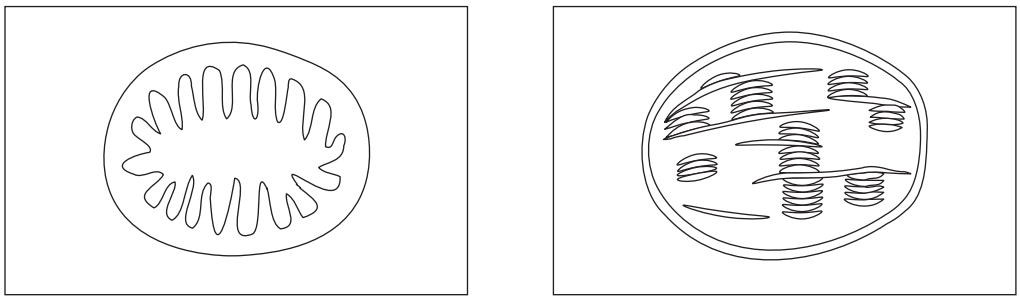
c. **i.** Identify the type of energy absorbed by these pigments in cyanobacteria and gum tree leaves. 1 mark

_____

ii. What process do both organisms carry out using the energy absorbed? 1 mark

_____

Consider the two organelles shown in the following diagram.



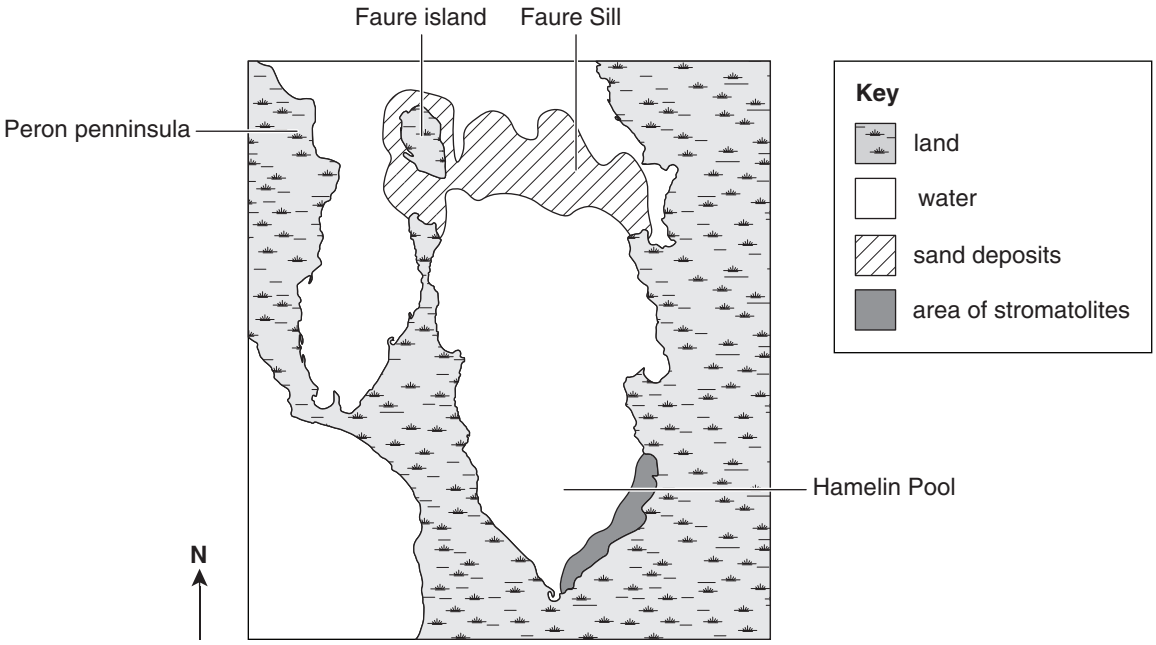
Organelle 1 **Organelle 2**

iii. Identify the organelle from the diagram above that carries out the process named in **part c.ii.** 1 mark

_____

iv. On organelle 1 **or** organelle 2, label the structure that contains the green pigment in the organelle. 1 mark

d. At the entrance to Hamelin Pool, there is a large sand bar called the Faure Sill, as shown in the diagram below. The Faure Sill has been building up for over 6000 years and restricts the tide flow into Hamelin Pool. The shallow water of the pool evaporates quickly, creating extremely salty water. In such harsh conditions, many organisms, such as sea snails, are unable to survive and graze on algae and stromatolites. Hamelin Pool is therefore a safe place for the cyanobacteria to build stromatolites of various shapes and sizes at different water depths.



Using the information provided, suggest the reason for the lack of sea snails in Hamelin Pool. In your response, refer to the appropriate terms for the concentration of the seawater compared to the body cells of the sea snails and the process that would have caused their death. 3 marks

Question 2 (8 marks)

Liam was growing sunflowers on his balcony. He noticed that the sunflowers would start to wilt if he did not water them every few days. Liam was not sure if the flowers wilted because they were in the hot sun, because it was too windy on the balcony, or because the soil was too dry.

He set up an experiment in his garden to find out the cause of the wilting. As he had limited space, he used bean plants instead of the larger sunflower plants. Liam set up three pots of identical bean plants with five seedlings in each pot. He placed the pots in different conditions, used different types of soil, and watered the plants at different times.

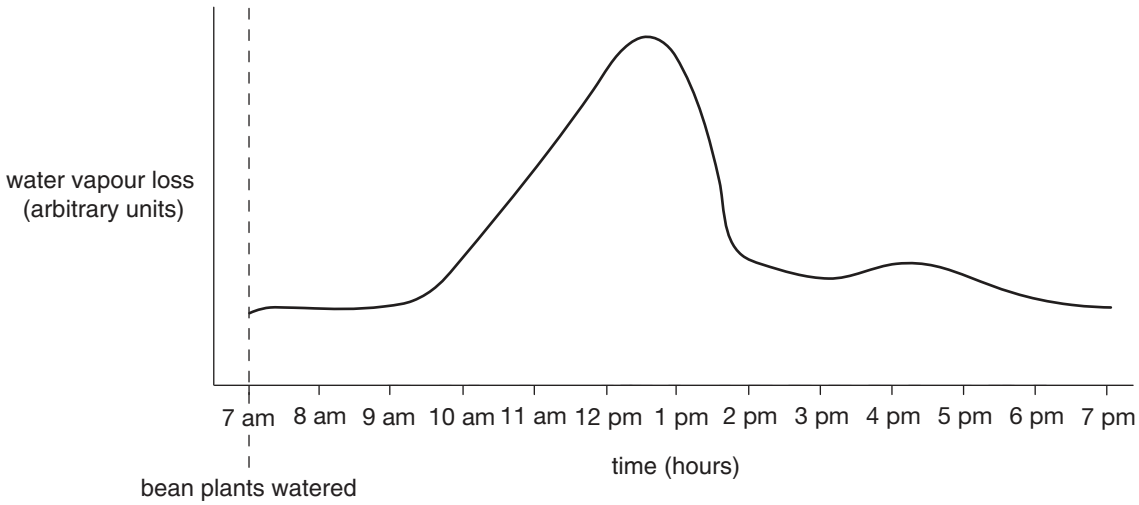
The three pots were treated as follows.

- Pot 1 contained sandy soil left in the hot sun and was watered every morning at 7 am with 20 ml of water.
- Pot 2 contained clay soil left in the shade and was watered only every third day.
- Pot 3 contained sandy soil left in the hot sun and was watered only once a week.

a. **i.** State the term used for the loss of water vapour from plants. 1 mark

ii. Through which tissue in the plant does water movement occur to replace the water loss? 1 mark

The following graph shows the water loss in pot 1, which Liam measured on the second day of the experiment.



b. In terms of the watering schedule and environmental conditions in which pot 1 was kept, explain why each of the changes in the graph line occurred. 3 marks

c. **i.** Describe the ways in which the bean plants should be similar or identical. 1 mark

ii. Explain the necessity of very similar bean plants being used in the experiment. 1 mark

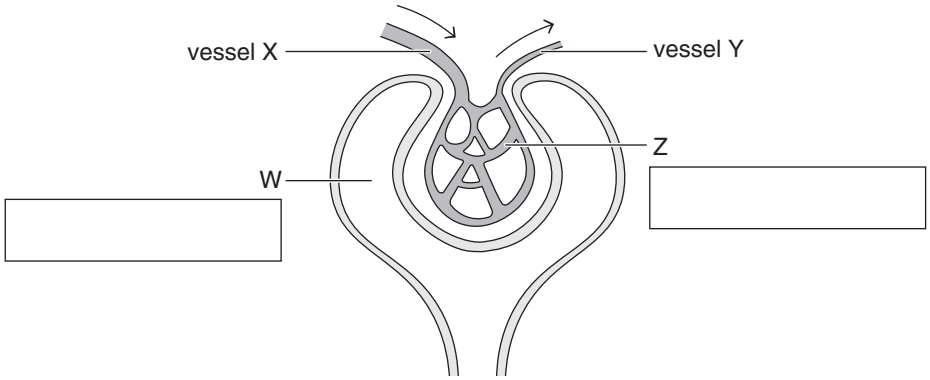
d. Could Liam's experiment be considered valid? Justify your response. 1 mark

Question 3 (8 marks)
In each of the human kidneys, there are approximately 1 000 000 filtering units.

a. **i.** State the name of a single filtering unit. 1 mark

ii. Suggest the advantage of a human kidney having approximately 1 000 000 filtering units when compared with a cat kidney having only 200 000 filtering units. 1 mark

The following diagram shows one part of a filtering unit in a human kidney.



b. On the diagram, label the structures of which W and Z are components. 2 marks

c. Describe the advantages of the following.

i. the width of vessel X being greater than the width of vessel Y 1 mark

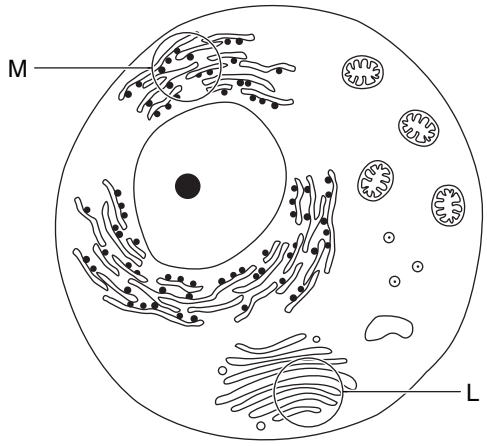
ii. the walls of the structures labelled in **part b.** being one cell thick 1 mark

d. **i.** A person was struck in their lower back, which resulted in damage to the region shown in the diagram.
What might be present in the person's urine as a result? 1 mark

ii. Name a part of the kidney that would be malfunctioning due to the lack of anti-diuretic hormone (ADH) in regulating water reabsorption. 1 mark

Question 4 (12 marks)

Regulation of blood glucose concentration relies upon insulin production by specific cells in the Islet of Langerhans, which is located in the pancreas. An Islet of Langerhans cell is shown in the diagram below.



a. Identify organelles M and L and explain why a high concentration of these organelles is necessary for the functioning of the cell. 2 marks

The hormone insulin, which aids in the regulation of blood glucose concentration, increases intracellular glucose concentration via facilitated diffusion.

b. **i.** Why is facilitated diffusion a more advantageous process for glucose uptake by cells than simple diffusion? 1 mark

ii. Describe how insulin increases the rate of glucose uptake by facilitated diffusion. 1 mark

c. Some individuals cannot make enough insulin on their own and must receive it in regular injections to treat one of the two main types of diabetes. Different forms of insulin have been produced by pharmaceutical companies. The data in the following table gives information about three different types of insulin.

Type of insulin	Onset of action (minutes)	Peak action (hours)	Duration (hours)
X	15	0.5–1.5	3–5
Y	30	2–4	6–8
Z	240–480	12–18	24–28

An individual with diabetes requires the insulin they inject to last for the entire day.

Using the data in the table above, state whether it would be better for this individual to use the X, Y or Z type of insulin. Justify your response. 1 mark

One of the possible long-term effects of diabetes is damage to the kidneys. A group of scientists carried out studies on the kidneys of rabbits with induced diabetes to determine if regular insulin injections could reverse the effect. Eighteen rabbits were raised in standard laboratory conditions and assigned to one of the following three groups.

- Group 1 received no treatment.
- Group 2 were injected with 100 mg/kg of alloxan, which damages the cells of the pancreas so they can no longer produce insulin (causing induced diabetes) and had no further treatment.
- Group 3 were injected with 100 mg/kg of alloxan and then received daily injections of insulin for two months.

At the end of the experimental period, the kidneys of the rabbits were dissected to determine their mean mass and volume. Sections of the kidney tissue were also examined under an electron microscope to observe any change and allow photos of the tissue to be taken.

The following table shows the mean kidney masses and volumes of the three groups.

	Group 1	Group 2	Group 3
Mean kidney mass (g)	7.57 ± 0.31	9.09 ± 0.66	8.12 ± 0.12
Mean kidney volume (mm^3)	7.02 ± 0.38	9.02 ± 0.51	7.13 ± 0.13

d. Explain whether the results collected are quantitative, qualitative or both. 1 mark

e. Eighteen rabbits were used in the experiment, with six in each group.
Why did the scientists use more than one rabbit in each group? 1 mark

f. Referring to the table on page 21, identify the group that has results with the greatest precision. Justify your response. 2 marks

g. Referring to the table on page 21, give possible conclusions for the following.

i. whether diabetes affects kidney volume and weight 1 mark

ii. whether daily injections of insulin could be beneficial in reducing kidney damage 1 mark

h. Describe **one** bioethical principle that needs to be considered in this research study. 1 mark

Question 5 (6 marks)

Bobby wants to take his learner permit test so he can learn to drive a car. He has a number of genetic disorders that affect his vision, including red–green colour blindness; this condition means that he finds it difficult to differentiate between red and green. The pattern of inheritance for red–green colour blindness is sex-linked/X-linked recessive. Bobby's mother, father and four sisters do not have this disorder.

a. State the allele symbols that could be used for this condition. 1 mark

b. Draw a pedigree diagram to show the inheritance of red–green colour blindness in Bobby's family. Include the genotype(s) that each family member could possess. 2 marks

c. If Bobby had a brother and a fifth sister, why would the condition be more likely to appear in the brother? 1 mark

d. Although his red–green colour blindness does not preclude Bobby from obtaining a learner permit, he has other genetic disorders that affect his vision more severely and will progress over time. Before booking his learner permit test, Bobby consults an optometrist to ask about whether he should proceed with applying for his learner permit.

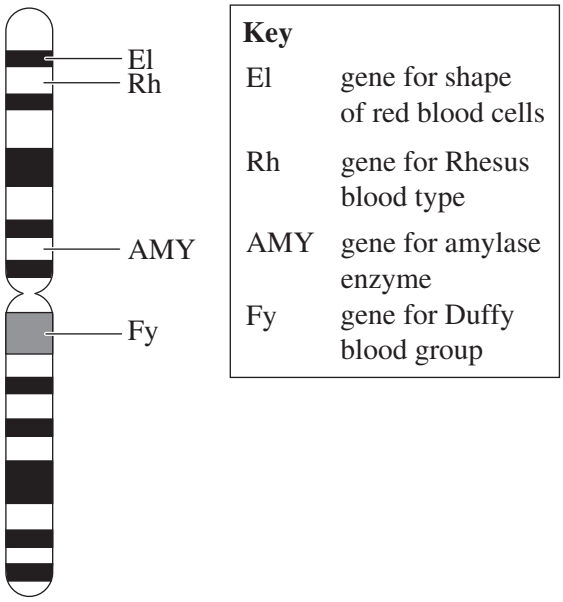
Explain how the optometrist should apply the bioethical principle of non-maleficence when advising Bobby. 2 marks

Question 6 (11 marks)

In humans, the gene for hair colour and the gene for eye colour are linked. As an example, people with blue eyes will often have blonde hair.

a. Explain the term 'linked genes' and why linked genes are more likely to be inherited together. 2 marks

The following diagram illustrates chromosome 1 in the human genome and indicates some of the genes located on the chromosome.



b. **i.** What term is given to the position of a gene on a chromosome? 1 mark

ii. Propose which **two** genes of those shown on chromosome 1 are most likely to be inherited together and explain why. 1 mark

c. The following table shows the allele symbols associated with some of the genes on chromosome 1.

Phenotype expressed	Allele symbol
can produce amylase	A
cannot produce amylase	a
Rhesus positive (Rh positive)	R
Rhesus negative (Rh negative)	r

A woman is Rh positive and heterozygous for the gene that produces amylase. Her mother is Rh negative and cannot produce amylase.

i. Using the correct notation for the position of the two genes on chromosome 1, state the woman's genotype. 2 marks

The woman has biological children with a man who is Rh negative and cannot produce amylase.

ii. Write the parental genotypes. 2 marks

iii. Using your answer to **part c.ii.**, complete the table below with the possible genotypes of the children and the expected ratio of each genotype. 3 marks

	Possible genotypes of children	Expected ratio
1		
2		
3		
4		

Question 7 (11 marks)

Couch grass (*Cynodon dactylon*) is a spreading, mat-forming, wiry-stemmed grass with small, flat, soft leaves. It also has stolons, which are stems that grow horizontally along the ground, and rhizomes, which are stems that grow horizontally underground. It germinates during summer and autumn and flowers during late winter and spring. Couch grass is an effective soil stabiliser and is often used for sports fields and gardens. However, due to its creeping growth pattern, it excludes other species, reduces crop yields as it competes with them for soil minerals, and even releases chemicals that reduce the germination and growth of other crops, such as wheat, maize and rye.

a. i. What type of adaptation are the stolons and rhizomes? 1 mark

ii. What type of adaptation is the release of chemicals that reduces the germination and growth of other crops? 1 mark

iii. Why are the stolons, rhizomes and release of chemicals considered adaptations? 1 mark

The following diagrams show different parts of a couch grass plant at different points in its life cycle.

Diagram 1

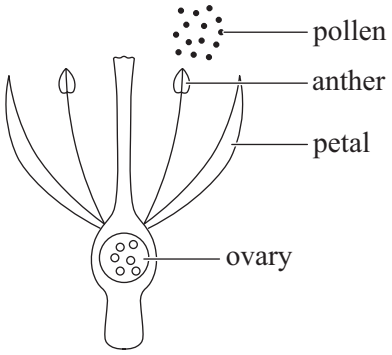
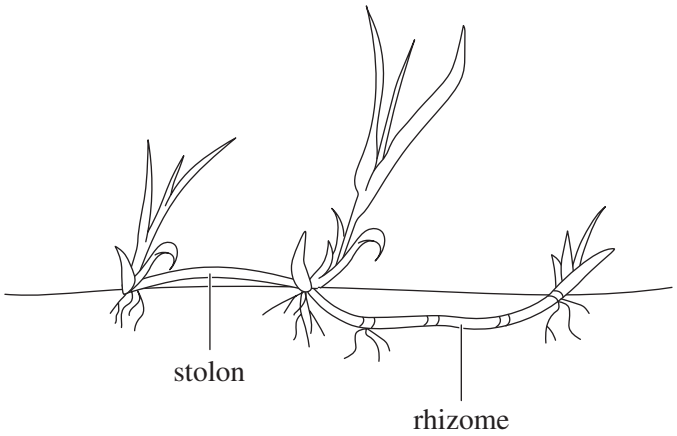


Diagram 2



b. Considering the information and diagrams provided on page 26, complete the following table. 4 marks

	Diagram 1	**Diagram 2**
Type of reproduction illustrated		
One advantage of the type of reproduction illustrated		

c. When it matures, the anther in diagram 1 releases pollen grains.

i. State the biological term that describes the role of pollen grains and ovules/egg cells in reproduction. 1 mark

_____

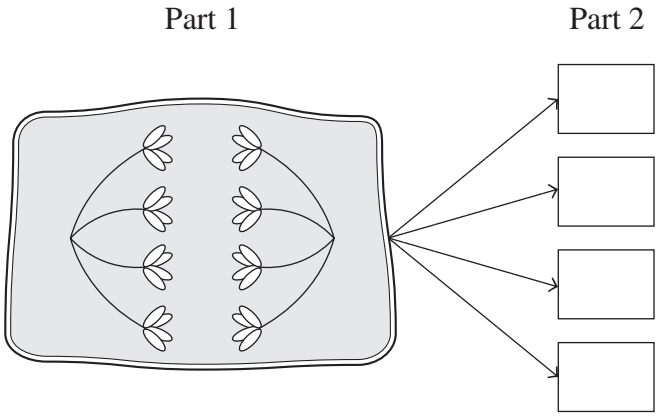
ii. Outline whether the pollen grains are haploid or diploid. 1 mark

_____

_____

d. Diagram 3 illustrates a cell in the ovary of a couch grass plant. Part 1 shows the cell undergoing cell division and part 2 shows the cells produced from the division.

Diagram 3



During the type of cell division shown in diagram 3, two important processes take place: crossing over and recombination, and independent assortment. These processes play significant roles in the survival of the couch grass plant species.

Describe how the following would be affected if these two processes did not take place.

i. the genetic diversity of the species 1 mark

ii. the survival of the species in a changing environment 1 mark

Question 8 (5 marks)

Reproductive technologies for cattle, including IVF, embryo transfer and somatic cell nuclear transfer (SCNT), have been widely studied. The use of SCNT is most advanced in cattle, and the first calves produced using SCNT were born in 1998. Since then, over 1500 calves have been produced via SCNT by different research groups and companies.

To perform a SCNT procedure, one group of researchers collected ovaries from female cows at an abattoir. They then extracted egg cells from the ovaries.

a. What treatment would the researchers have applied to the extracted egg cells so that the cells could be used in the next step of the SCNT procedure? 1 mark

Fibroplasts are somatic cells that contribute to the formation of connective tissue in many tissues and organs in the body. The researchers collected fibroplasts from the embryos of cattle with desirable features and fused them together with the treated egg cells.

b. Suggest why the resulting fused cells were diploid, not haploid. 1 mark

The researchers placed the fused cells into a culture medium. After undergoing cell division for seven days, 67 of the resulting blastocysts (developing embryos) were put into 34 surrogate mothers. After development, six cloned calves were born.

Parentage DNA analysis was carried out on the cloned calves, the surrogate cows and the fibroplast donor cells to compare the genetic identity of the calves.

c. State what the DNA analysis results would have shown when comparing the following.

i. the DNA of the six calves 1 mark

ii. the DNA of the six calves with the DNA of the surrogate mothers, the original egg cells and the fibroplast donor cells 1 mark

d. Reproductive SCNT has been achieved in animals, but not in humans as it is legally prohibited in many countries. In 2004 and 2005, a researcher in South Korea published articles in a scientific journal in which they claimed they had cloned human embryos. This raised controversy and concerns about ethical violations. A short time after, the researcher's claims were found to be fraudulent.

Based on the information provided, outline how the researcher did **not** uphold the bioethical principle of integrity. 1 mark

Question 9 (7 marks)

The grey nurse shark (*Carcharias taurus*), also known as the sand tiger shark, is a top order predator that has a calm nature. The following photograph shows a grey nurse shark.

Source: Wikimedia Commons/Jeff Kubina (2006), Sand Tiger Shark [photo]. Accessed April 2023. https://commons.wikimedia.org/wiki/File:Carcharias_taurus_newport.jpg. Licensed under CC BY-SA 2.0, https://creativecommons.org/licenses/by-sa/2.0/legalcode.

The species feeds on fish, crustaceans (prawns and lobsters), sharks, rays and squid. It plays an important role as a keystone species in marine ecosystems along the Australian coastline.

a. Define the following roles in terms of the grey nurse shark and the marine ecosystems in which it lives.

i. top order predator 1 mark

_____

_____

ii. keystone species 1 mark

_____

_____

The grey nurse shark has been greatly affected by hunting, human activity and shark control methods. The shark's skin has scales pointing backwards towards the shark's tail, which makes it fairly smooth in that direction; this property meant that the skin was used to make leather in the past. The grey nurse shark also has thick, white flesh that was historically a food source for humans.

b. Based on the information and photograph provided, describe how the following structural features have aided the survival of the grey nurse shark in its marine environments.

i. type of skin 1 mark

ii. body shape 1 mark

The grey nurse shark is classified as critically endangered on the east coast of Australia. It became a protected species in 1984 in New South Wales and is now protected under legislation in New South Wales, Tasmania, Queensland and Western Australia. It has been estimated that there are only 2000 grey nurse sharks inhabiting the east coast of Australia.

c. If the population of grey nurse sharks continues to decline rapidly, how would this affect its marine ecosystems? 1 mark

d. The perception of sharks is particularly negative in Western cultures as they symbolise predatory behaviour, vicious attacks and danger. However, to some coastal First Nations peoples, sharks are ancestors and totems; thus, they are important to these peoples' connection to the land and sea. These communities respect sharks, care for their habitats and avoid harming them.

Describe how First Nations peoples' perception and treatment of sharks could help the survival of shark populations, such as the grey nurse shark, and conservation of marine ecosystems in Australia. 2 marks

END OF QUESTION AND ANSWER BOOKLET

Extra space for responses

Clearly number all responses in this space.

Neap

Trial Examination 2023

VCE Biology Units 1&2

Written Examination

Multiple-choice Answer Sheet

Student's Name: _____

Teacher's Name: _____

Instructions

Use a **pencil** for **all** entries. If you make a mistake, **erase** the incorrect answer – **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.

All answers must be completed like this example: **[A]** B C D

Use pencil only

1	A	B	C	D
2	A	B	C	D
3	A	B	C	D
4	A	B	C	D
5	A	B	C	D
6	A	B	C	D
7	A	B	C	D
8	A	B	C	D
9	A	B	C	D
10	A	B	C	D
11	A	B	C	D
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13	A	B	C	D
14	A	B	C	D

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37	A	B	C	D
38	A	B	C	D
39	A	B	C	D
40	A	B	C	D