Name: ..... ( ) Class: Sec .....

St. Gabriel's Secondary School

2024 'O' Preliminary Examination

Subject : **Biology**
Paper : **6093 / 2**
Level/Stream : **Sec 4 Express**
Duration : **1 hour 45 min**
Date : **20 August 2024**
Setter :

READ THESE INSTRUCTIONS FIRST

Write your name, index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.

Section A
Answer **all** questions.
Write your answers in the spaces provided.

Section B
Answer **one** question.
Write your answers in the spaces provided.

The use of an approved scientific calculator is expected, where appropriate.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Sect. A	/ 70
Sect. B	/ 10
TOTAL	/ 80

This question paper consists of **20** printed pages including this cover page.

Section A

Answer **all** questions.

1 Food poisoning can be caused by bacteria-infested foods that have been left out in the open for a long time. One such bacteria is *Campylobacter*.
People with *Campylobacter* infections in the intestines are often prescribed a medicine called erythromycin. Erythromycin is an antibiotic that is known to reduce *Campylobacter* bacteria counts.
Fig. 1.1 below shows the concentration of *Campylobacter* protein after erythromycin intake.

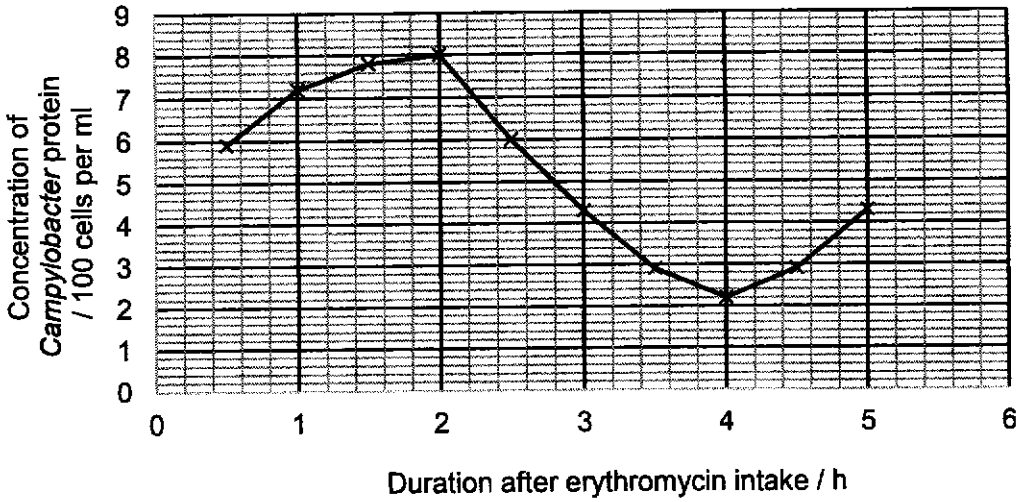

Fig. 1.1

(a) Patients are advised to be administered erythromycin every 6 hours.
Suggest the concentration of *Campylobacter* protein at the sixth hour by extending the line, before the next dose of erythromycin is administered.

..... [1]

(b) Describe and explain the results in Fig. 1.1, from 2 h to 4 h after erythromycin intake.

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..... [4]

(c) Some *Campylobacter* samples have been obtained from the patient before taking erythromycin and have been placed under the light microscope for research.
Fig. 1.2 shows the possible appearance of the *Campylobacter* bacterium obtained from the patient before taking erythromycin.

Draw label lines to the *Campylobacter* bacterium obtained in Fig. 1.2 and annotate your labels to identify **two** structures absent in a typical virus.

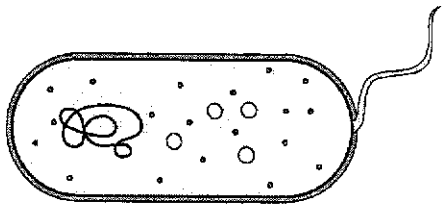

Fig. 1.2

[2]

(d) Campylobacteriosis is an illness caused by the *Campylobacter* bacteria. Development of an effective vaccine for the prevention of campylobacteriosis has been ongoing for over 20 years. In recent research, scientists have found that the *Campylobacter* vaccination not only reduces intestinal disease but also prevents stunted growth in infants.
The production of the vaccine involves the culturing, inactivation of *Campylobacter* strains, and removal of toxins to produce a "whole-cell" vaccine.

(i) Suggest and explain whether *Campylobacter* infections are infectious.

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..... [2]

(ii) Suggest how the vaccine prevents *Campylobacter* infection in an individual.

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..... [3]

[Total: 12]

2 Cacti are desert plants that grow in water scarce areas.

The leaves of cacti are modified into spines shown in Fig. 2.1 below.

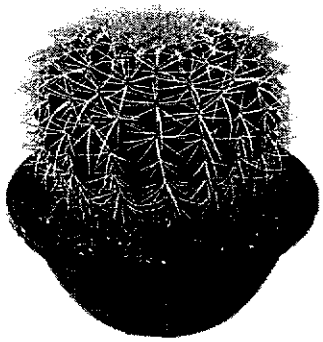

Fig. 2.1

(a) Suggest how the leaves in a cactus plant shown in Fig. 2.1 prevents wilting in water scarce environments.

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..... [2]

(b) Fig. 2.2 shows the cross section of a cactus plant.

Use label lines and labels to identify the position of the xylem and phloem in Fig. 2.2 below.

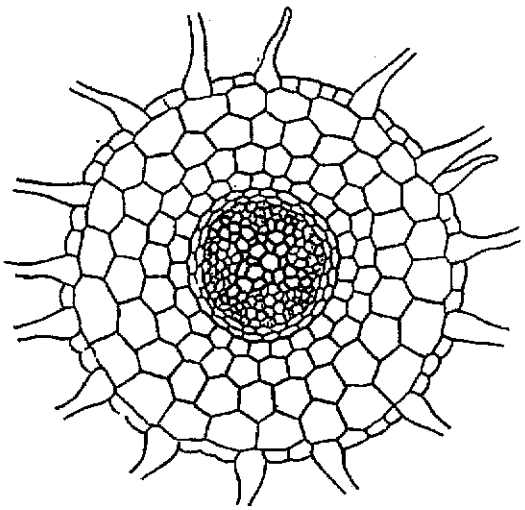

Fig. 2.2

[2]

Fig. 2.3 shows a mangrove tree growing in coastal swamp.

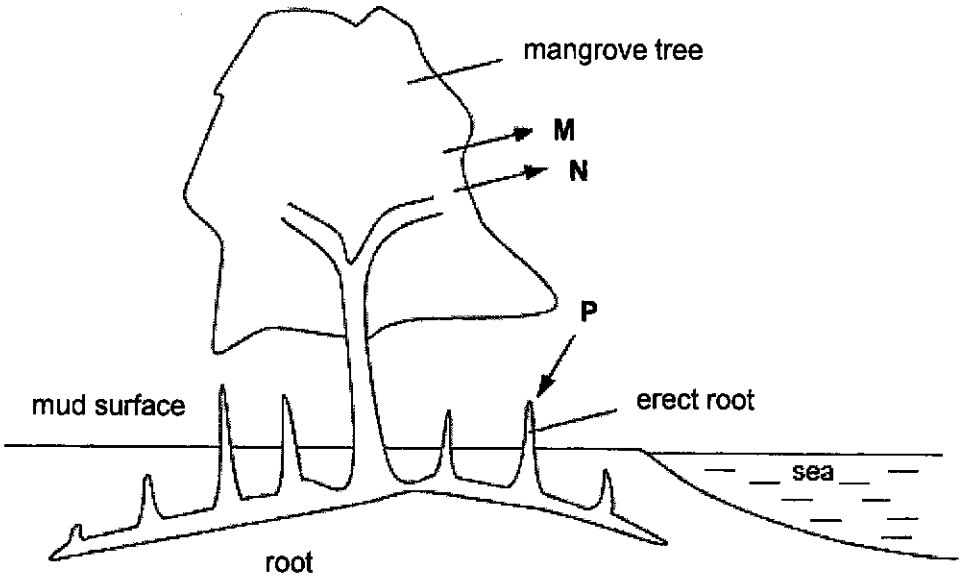

Fig. 2.3

The roots of the mangrove are specially modified to erect out of the ground as air spaces in the soil are always filled with water.

Arrows **M**, **N**, and **P** represent the movement of gases into and out of the tree during the day. Gas **M** only moves out in the day.

(c) Name gas **M** and gas **P** in Fig. 2.3. For each gas state the chemical process in the tree which produces it.

gas **M**:..... chemical process:.....

gas **P**:..... chemical process:.....

[2]

(d) Active transport is a process which occurs in most plant roots.
Suggest why mangrove roots may have difficulty in carrying out this process.

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..... [2]

[Total: 8]

3 Fig. 3.1 shows how a blocked blood vessel outside the heart can be bypassed using an artificial blood vessel.

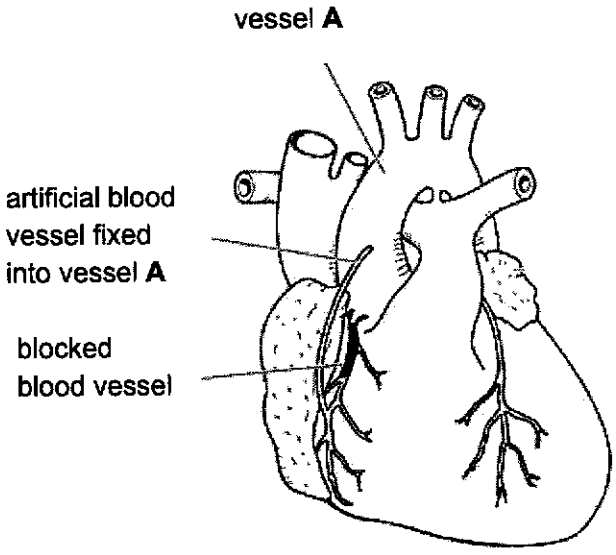

Fig. 3.1

(a) Name the blocked blood vessel and vessel **A** respectively.

vessel **A** .....

blocked vessel ..... [2]

(b) Describe how the blocked blood vessel in Fig. 3.1 can affect the normal functioning of the heart.

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..... [2]

(c) Sometimes, instead of using an artificial blood vessel, a vein from another part in the patient's body is used.

Suggest **two** ways in which a vein might not be suitable for this purpose.

1. .....

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2. .....

..... [2]

(d) Fig. 3.2 shows the same blocked blood vessel in Fig. 3.1, with a 'stent' in place.

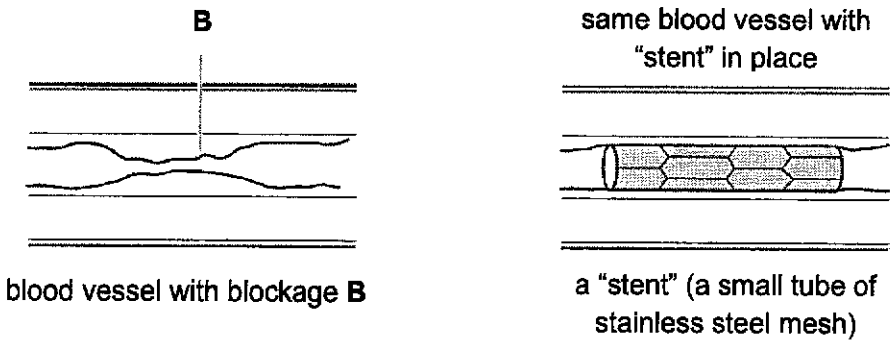

Fig. 3.2

(i) Name a substance that can cause the blockage **B**.

..... [1]

(ii) Insertion of the 'stent' can cause damage to the surrounding tissues around the blockage **B**.

Suggest and explain why patients are given 'anti-platelet' drugs before inserting the 'stent'.

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..... [2]

[Total: 9]

4 Kelp are large underwater plant towers that provide food and shelter for thousands of fish, invertebrates, and marine mammal species. With the water supporting them mechanically, kelp does not need strong trunks like land trees.

Fig. 4.1 shows a food chain for organisms supported by the kelp population.

kelp ➡ marine invertebrates ➡ small fish ➡ large fish ➡ tawny owl

Fig. 4.1

(a) (i) Sketch a pyramid of numbers for the food chain in Fig. 4.1.

[2]

(ii) Explain why the small fishes only receive 10% of the energy from the marine invertebrates.

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..... [2]

Tawny owls found in southern Finland may have brown feathers or light grey feathers. Feather colour is an inherited condition.

Both types of tawny owl are preyed on by larger carnivorous birds.

Fig. 4.2 shows the percentage of both types of tawny owl in different depths of snow.

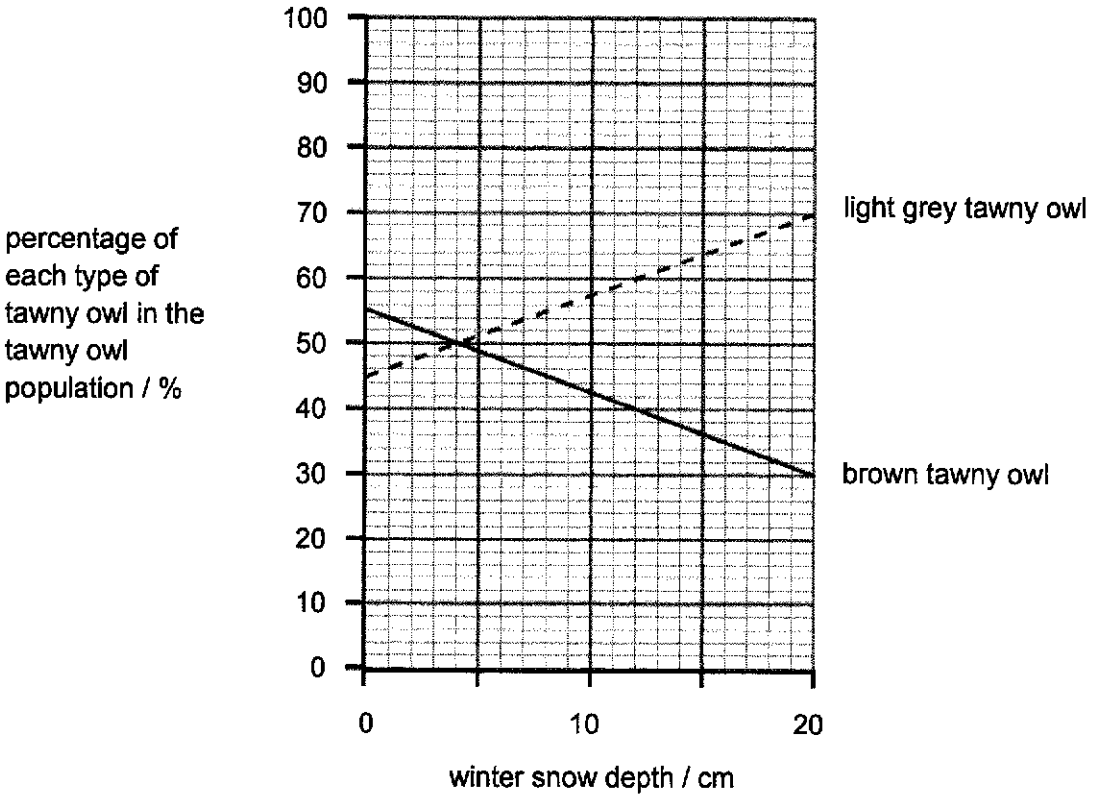

Fig. 4.2

(b) (i) Explain how natural selection brings about the change in the percentage of the tawny owls with light grey feathers as the winter snow depth increases.

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..... [3]

(ii) Describe how human activity can lead to a decrease in winter snow depth.

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..... [2]

(c) Some of the larger birds that feed on tawny owls include the northern goshawk.

Suggest how a decrease in the northern goshawk population, could affect the ecosystem.

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..... [2]

[Total: 11]

5 **(a)** Define the term *aerobic respiration.*

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..... [1]

(b) Describe how physical activity can lead to oxygen debt and how oxygen debt can be paid.

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..... [4]

(c) Electronic cigarettes are devices that simulates tobacco smoking, supposedly aimed at helping people quit tobacco products.

Liquids in electronic cigarettes may contain nicotine, propylene glycol, glycerol, and other chemicals, including those used to create flavours. When in contact with the skin, propylene glycol can cause irritations and inflammation. Exposure to fumes from the vaporisation of the liquids may also lead to cancer.

Electronic cigarettes are just as harmful as traditional tobacco smoke. Based on the given information, explain why this is so.

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..... [5]

[Total: 10]

6 It is important to keep the blood glucose concentration within narrow limits.

(a) A person eats a meal containing a lot of carbohydrate. This causes an increase in the person's blood glucose concentration.

Explain how insulin controls the person's blood glucose concentration after the meal.

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..... [4]

Tzield is a drug used for treating people who have Type 1 diabetes. Scientists investigated the effects of Tzield and two other drugs, **A** and **B**. The scientists wanted to see how the drugs affected the blood glucose concentrations of 220 people with Type 1 diabetes.

This is the method used.

1. Put the 220 people into five groups.
2. Treat each group with a different drug or combination of drugs for several weeks.
3. Give each person a meal high in carbohydrate.
4. Measure the blood glucose concentration of each person 30 minutes after the meal and again 3 hours after the meal.

(b) Suggest **one** variable that the scientists should control in the investigation.

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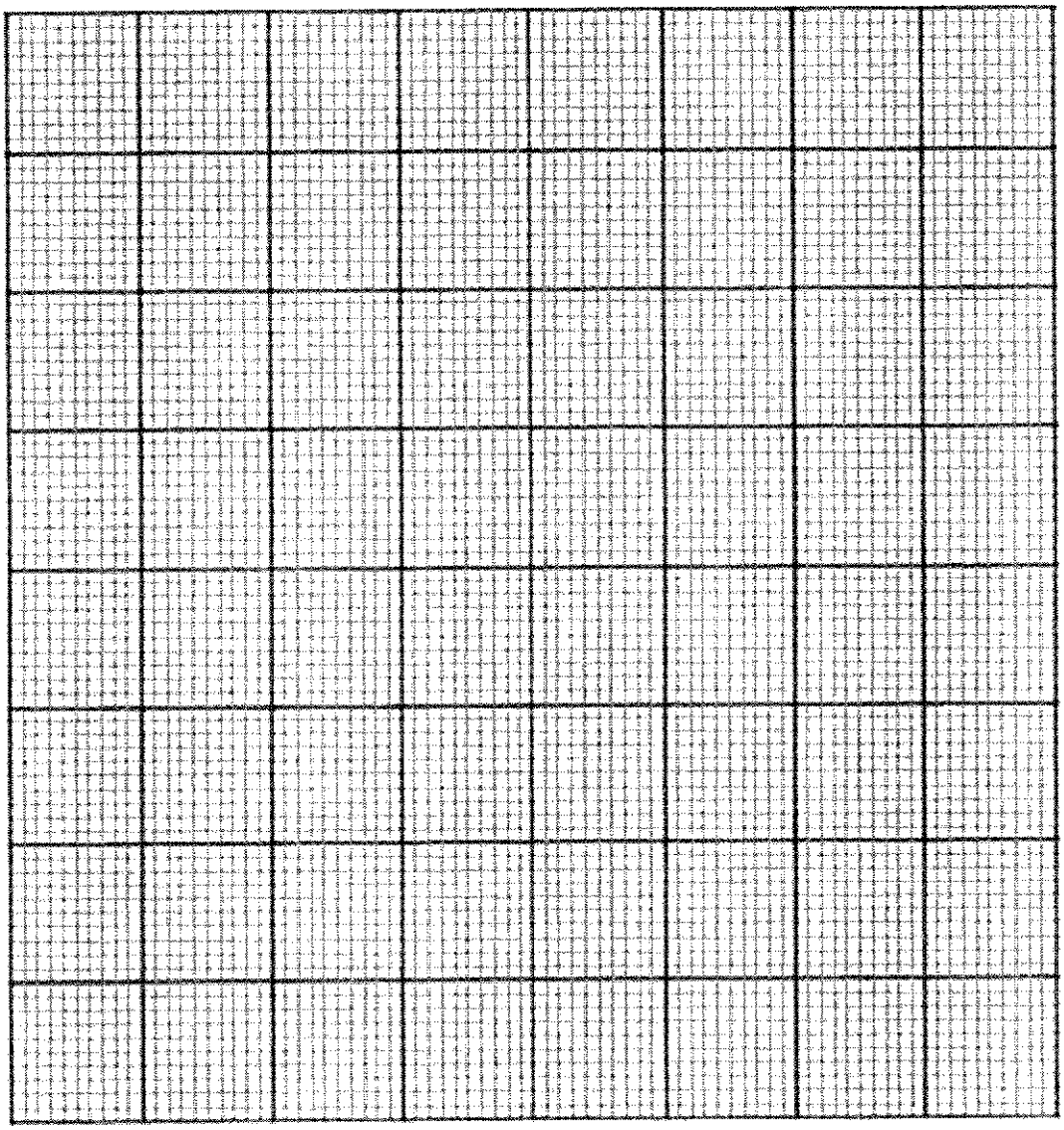
..... [1]

Table 6.1 shows the scientists' results.

Table 6.1

drug used	Tzield	**A**	**B**	Tzield + **A**	Tzield + **B**
number of people involved	60	40	25	65	30
Mean blood glucose concentration 30 minutes after the meal / mg per 100 cm^3	277	282	271	305	306

(c) Plot a suitable diagram to represent the data in Table 6.1 on the grid below



[4]

(d) A student looked at the scientists' method and the results.

The student stated: 'Tzield works better when used with other drugs.'

Do you agree or disagree with the student's statement. Use the given information to support your answer.

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..... [2]

[Total: 11]

7 **(a)** State the function of the nervous system.

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..... [1]

(b) Define the term *reflex action.*

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..... [2]

Dilating eye drops are medical drugs administered to patients before an eye examination. The eye drops act on and relax certain muscles in the eyes to dilate the pupils.

(c) **(i)** Name the muscle that the dilating eye drops act on.

..... [1]

(ii) With clear labels, complete Fig. 7.1 to show how a pupil will appear after dilation.

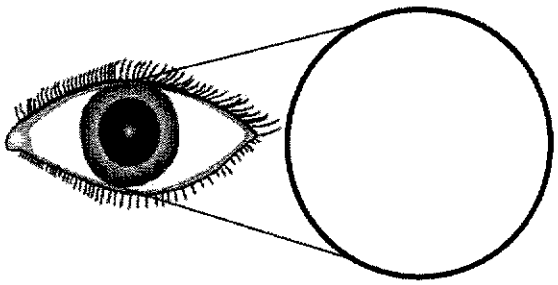

Fig. 7.1

[2]

(d) The usage of dilation drops can also lead to the paralysis of other muscles in the eye.

Predict how the paralysis of the ciliary muscle might affect the patient's vision.

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..... [3]

[Total: 9]

Section B

Answer **one** question from this section.

8 *Rhabdostyla* is a single-celled organism that has no cell wall and no chlorophyll. This organism lives in freshwater habitats, such as ponds, lakes, and rivers. Freshwater has very low concentration of solutes.

Rhabdostyla has a contractile vacuole that fills with water and empties at intervals as shown in Fig. 8.1. The contractile vacuole removes excess water.

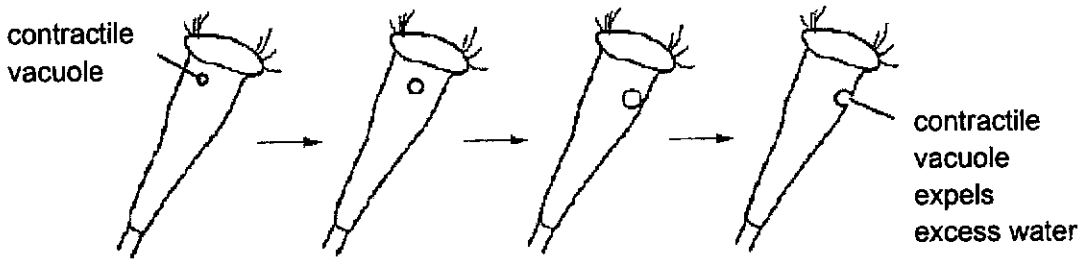

Fig. 8.1

(a) Suggest a reason why *Rhabdostyla* needs to remove excess water.

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..... [3]

(b) Explain whether osmosis is involved in expelling water out of the cell from the contractile vacuole.

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..... [1]

In an investigation, individual *Rhabdostyla* were placed into different concentrations of sea water. The rate of water excreted by the contractile vacuole of each organism was determined.

The results are shown in Fig. 8.2.

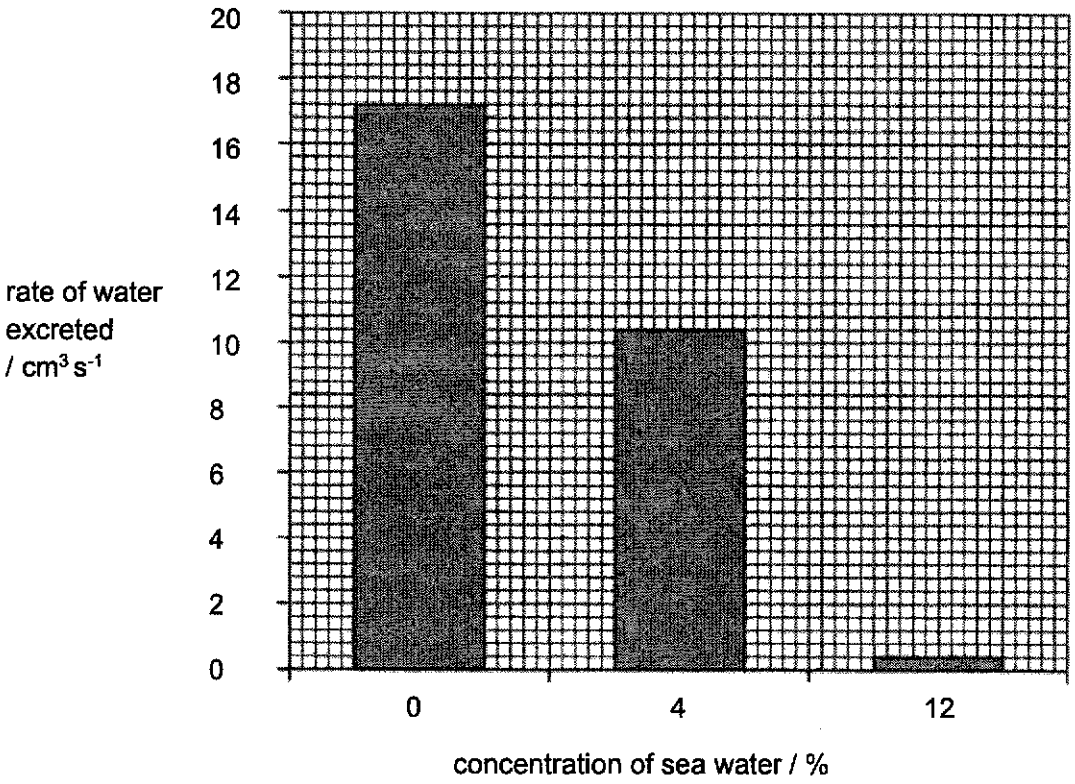

Fig. 8.2

(c) Describe and explain the results shown in Fig. 8.2.

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..... [3]

(d) A segment of the membrane forming the contractile vacuole is cut out and magnified under an electron microscope. These membranes are made of lipids.

Outline the experimental procedure that will give a positive result with the membrane.

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..... [3]

[Total: 10]

9 **(a)** Define the term *sexual reproduction*.

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..... [2]

Upon reaching sexual maturity, female humans will release mature egg cells every month. Young follicle cells are called primary follicles. Each primary follicle consists of a potential egg cell surrounded by a layer of smaller follicle cells. A primary follicle may develop into a Graafian follicle. The Graafian follicle contains an egg surrounded by follicle cells and a fluid-filled space. The release of matured eggs stimulates progesterone production.

The egg cells are developed from follicle cells in ovaries as shown in Fig. 9.1.

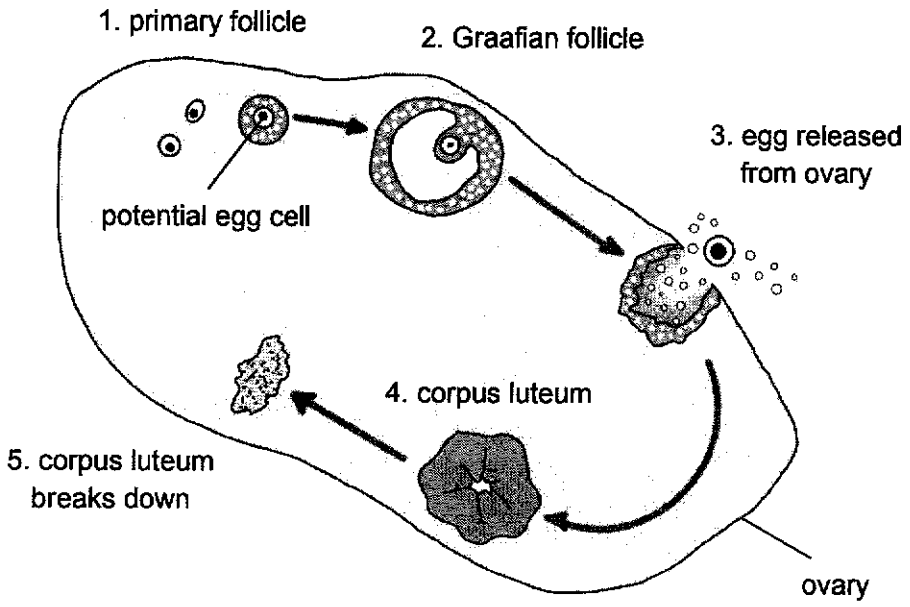

Fig. 9.1

(b) **(i)** A normal healthy woman experienced stage 3 on 15 May.
Name the event shown in stage 3 and identify the dates of the fertile period for the woman in this menstrual cycle.

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..... [2]

(ii) Explain why another healthy woman may not have the same fertile period as the woman in **(b)**.

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..... [1]

(c) Suggest why, at stage 4, the woman in **(b)** did not experience menstruation.

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..... [2]

Kallmann syndrome is a disease caused by mutations in gene sequences, resulting in lack of sex hormone production. Females with Kallman syndrome rarely experience the event shown in stage 3 and have to rely on medical treatments to increase their fertility.

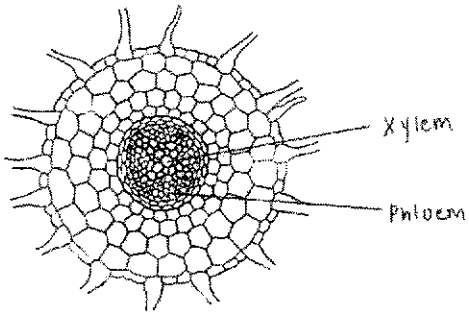
(d) Two parents are both heterozygous for Kallmann syndrome. Use the symbol **N** for the dominant allele and **n** for the recessive allele to complete the genetic diagram.

	father	x	mother
genotypes of parents	.....		.....
gametes	....		....
genotypes of offspring	....		....

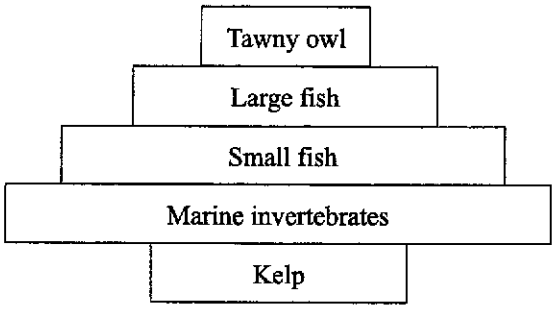
[3]

[Total: 10]

End of Paper

2	• Wilting occurs when rate of water loss by transpiration exceeds rate of water gained from roots • Thin / small leaves reduces surface area to volume ratio • Less water loss by transpiration • Reduces chances of rate of water loss by transpiration exceeding rate of water gained from roots / OWTTE	2
2 (b)	 • Correct xylem label (lignified vessels) • Correct phloem label (non-lignified vessels in the core)	2
2 (c)	• M: oxygen; photosynthesis • P: carbon dioxide; respiration	2
2 (d)	• active transport require energy from aerobic respiration. • Root is mostly submerge in water, where there is low concentration / level of dissolved oxygen in water available for aerobic respiration.	2

3a	• Blocked vessel: Coronary artery • Vessel A: Aorta	2
3b	• less oxygen and glucose delivered to heart muscles leads to reduced rate of aerobic respiration • Heart muscle cells die leading to heart attack	2
3c	• Thinner muscular walls hence less able to withstand high pressure ; • Presence of valves, hence blood travel slower/ impede blood flow ; • Less elastic fibre / tissue hence less able to stretch and recoil; • Large lumen relative to diameter, hence speed of blood slows down (any 2)	2 **R** small walls, thin without mentioning about the walls ; treated as foreign body and rejected by immune system
3di	• Fat deposit / cholesterol	1
3dii	• Anti-platelets drug administered to prevents platelet release, prevents soluble fibrinogen to change to insoluble fibrin ; • prevents blood to clot due to damage or injury caused by insertion of the stent • prevents blood vessel to be further narrowed (any 2)	2 **R** prevents agglutination

4ai	 • Correct Shape • Correct Order of organisms	
4aii	• About 90% of energy is lost at each trophic level / when transferred from one trophic level to another; • through processes like heat loss during respiration, faeces egestion, uneaten body parts, and excreted substances like urea/ carbon dioxide (any 2 stated)	
4bi	• Number of light grey owls increase; • as light grey owls camouflage better than brown tawny owls; • light grey owls selected for / have selective advantage over brown tawny owls • Less light grey owls eaten; • More light grey owls survive to reproduce / becomes a reproductive adult • More light grey owls survive to pass on genes/alleles for brown coats to offspring; (max 3)	3
4bii	Combustion of fossils/ deforestation/any activities that increase the release of carbon dioxide into atmosphere or destroy carbon sink (any 2)	2
4c	• Decreased northern goshawk population will increase tawny owl population, due to presence of less predators, and decreases large fish population due to presence of more predators (at least 2 trophic levels mentioned correctly) • Decreased northern goshawk population disrupts balance of ecosystem / biodiversity / every trophic level downstream in the food chain / OWTTE	1

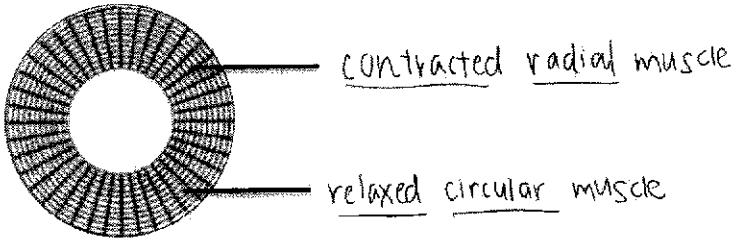
<table>
<tr><td>5a</td><td>• Aerobic respiration is the breakdown of glucose to release energy in the presence of oxygen.</td><td>1</td></tr>
<tr><td>5b</td><td>• During exercise, muscles contract vigorously, requiring energy.
• Muscle cells then carry out anaerobic respiration, producing lactic acid.
• Lactic acid accumulates in the muscles, causing soreness and fatigue. The body now incurs an oxygen debt.

(max 2)

• Heart rate remains high to maintain fast transport of
• lactic acid from muscles to liver and oxygen from lungs to liver
• Deeper and faster breathing allows continuously fast oxygen uptake
• In the liver, oxygen is required to remove lactic acid
• In the liver, lactic acid is also converted to glucose
• When all lactic acid is converted to glucose, oxygen debt is repaid.</td><td>4</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>5c</td><td>
<table>
<tr><th>Chemical</th><th>electronic cigarettes</th><th>traditional tobacco smoke</th></tr>
<tr><td>Nicotine [1]</td><td colspan="2">• Both electronic cigarettes and traditional tobacco smoke contain nicotine that is an addictive drug that releases adrenaline [1]
• increases heart rate and blood pressure / Makes blood clot/ narrows artery lumen easily, increasing risk of coronary diseases / affects fetal development, increase risk of miscarriage [1]</td></tr>
<tr><td>Tar [1]</td><td colspan="2">• Both electronic cigarettes and traditional tobacco smoke have carcinogenic / cancer - causing effects [1]
• due to fumes from the vaporisation of the electronic cigarettes liquids and tar in traditional tobacco smoke [1]

• Both electronic cigarettes and traditional tobacco smoke causes inflammation [1]
• due to propylene glycol in electronic cigarettes liquids and tar and irritants in traditional tobacco smoke [1]
• that paralyses cilia lining the air passages causing inflammation from the dust-trapped mucus in the air passages [1]</td></tr>
</table>
(any 5)
</td><td>5</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

6a	• When the blood glucose concentration becomes above threshold level / normal set point, • the cells in pancreas' islets of Langerhans are stimulated • to secrete insulin into the bloodstream, to be transported to liver and muscle cells • At the liver and muscle cells, insulin causes cell membranes to be more permeable to glucose, so glucose uptake increases from the bloodstream to the cells • Insulin stimulates conversion of glucose to glycogen to be stored in the liver/ muscle cells • insulin stimulates increased respiration rate to oxidise more glucose • Blood glucose concentration then decreases to threshold level / normal set point (max 4)	4
6b	• Age/ height and mass/ proportion of males and females or group size/(same) severity of diabetes/ (same) activity (during investigation)/ (same) type of meal/ dose of drug/ (similar) blood glucose concentrations at start/ other health conditions or other drugs being taken;	1
6c	• **Bar graph** drawn • **Axes** drawn • Correct **y-values** • Equal **width** for bars and Equal width for separators;	4
	Disagree with statement • (Tzield + A), 305 mg / 100 cm^3, gives lower (%) reduction (in blood glucose) than Tzield alone, 277 mg / 100 cm^3 + so statement is not supported; • (Tzield + B), 306 mg / 100 cm^3, gives lower (%) reduction (in blood glucose) than Tzield alone, 277 mg / 100 cm^3 + so statement is not supported; • number of people used, 220, is not very large; • number of people in each group is different (at least 2 group data quoted); (any 2)	2

7a	• The Nervous System: consists of brain, spinal cord, and nerves to co-ordinate and regulate bodily functions	1
7b	• A reflex action is an immediate response • to a specific stimulus without conscious control.	2
7ci	(circular and radial muscles of the) iris	1
7cii		2 1m for each correctly labelled muscle
7d	• The ciliary muscles controls the curvature or thickness of the lens • When ciliary muscles are paralysed, ciliary muscles cannot contract, Suspenso ligaments cannot slacken • Lens remain thin and less convex / cannot become thicker and more convex • Focal length remains long / cannot decrease • This causes one to have blurred / unfocused vision when looking at near object (max 3)	3

Paper 2 Section B

8a	• Fresh water has a higher water potential than animal cell. • Net movement of water molecules from outside cell into the cell by osmosis • Cells swell / increase in size + Without cell wall, the cell will burst. Therefore, it needs to remove excess water.	3
8b	• Osmosis is not involved as osmosis requires water molecules to pass through a partially permeable membrane but water molecules do not pass through a partially permeable membrane in the removal shown in Figure 8.1.	1
8c	• [D1] When concentration of sea water is at 0%, the rate of water excreted is at 17.2 $\mu m^3/s$. • [D2] When sea water concentration increases to 4%, rate of water excreted decreased to 10.4 $\mu m^3/s$, by 6.8 $\mu m^3/s$ • [D3] When sea water concentration increases to 12%, rate of water excreted decreased to 0.4 µm3/s, , by 10.0 $\mu m^3/s$ • [E1] This is because as concentration of sea water increases, the water potential gradient decreases / becomes less steep / more gentle. • [E2] Less water enters the cell + less excess water needs to be excreted (D: max 2)	3
8d	Ethanol emulsion test procedure: 1. Add 2 cm^3 of ethanol to 2 cm^3 of membrane. 2. Decant solution / mixture into a test tube with 2 cm^3 water. 3 Shake the tube vigorously	3

9a	Sexual reproduction is the process involving: • the fusion of a male gamete's haploid nucleus and a female gamete's haploid nucleus to form a diploid zygote • and produce genetically dissimilar offspring	2
9bi	• Stage 3: ovulation • Dates: 11 May - 16 May (Day 14: 15 May; fertile period: Days 10-15)	2
9bii	• there is a natural variation in the length of menstrual cycle, / OWTTE • different women have varying number of days in each cycle / OWTTE (max 1)	1
9c	• ovulation stimulates progesterone production, • high progesterone levels in stage 4 / after stage 3 • which maintains uterine lining to be thick and spongy • preventing breaking down of uterine lining (max 2)	2
9d	father x mother genotypes of parents: Nn Nn gametes: N n N n genotypes of offspring: NN Nn Nn nn	3 1 1 1

Symbols used in mark scheme and guidance notes.

/	separates alternatives for a marking point
;	separates points for the award of a mark
B.O.D	Benefit Of Doubt
ORA	or reverse argument / reasoning
OWTTE	or words to that effect
E.C.F	Error Carried Forward
A	accept - as a correct response
R	reject – this is marked with a cross and any following correct statements do not gain any marks
I	ignore / irrelevant / inadequate – this response gains no mark, but any following correct answers can gain marks.
( )	the word / phrase in brackets is not required to gain marks but sets the context of the response for credit. e.g. (waxy) cuticle. Waxy not needed but if it was described as a cellulose cuticle then no mark is awarded.

END OF MS