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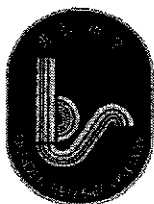
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BENDEMEER SECONDARY SCHOOL
2024 PRELIMINARY EXAMINATION
SECONDARY FOUR EXPRESS

CANDIDATE
NAME

CLASS

INDEX
NUMBER

BIOLOGY
Paper 1

6093 / 01

27 August 2024
1 hour

READ THESE INSTRUCTIONS FIRST

Write in 2B pencil.

Write your name, class and register number on the work you hand in.
Do not use paper clips, glue or correction fluid.

There are **forty** questions on this paper. Answer **all** questions.

For each question, there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in 2B pencil on the Answer sheet.

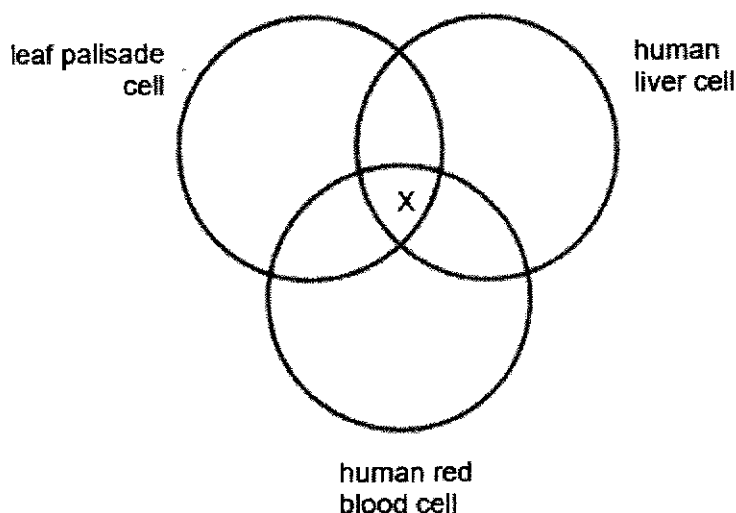
Read the instructions on the Answer sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done on the question paper.

The use of approved scientific calculator is expected, where appropriate.

FOR ASSESSMENT USE	
40	

- 1 The diagram represents the cell structures of a human liver cell, a leaf palisade and a human red blood cell.



What is cell structure X?

- | | |
|--------------------|----------------------|
| A cell wall | B chloroplast |
| C cytoplasm | D nucleus |

- 2 Four students (**A**, **B**, **C** and **D**) were asked to match the function with the appearance of some cell structures in an animal cell.

The functions were listed below.

- | | |
|-----|--|
| I | detoxifies harmful substances |
| II | mRNA passes through to the ribosome |
| III | stores and packages hydrolytic enzymes |

The appearances were listed by letter.

- | | |
|---|--|
| V | a double membrane interspersed with pores |
| W | a double membrane with highly folded inner layer |
| X | membrane-bound sacs, arranged as a flattened stack |
| Y | membrane-bound, network of tubular spaces |
| Z | non-membrane bound, spherical structures |

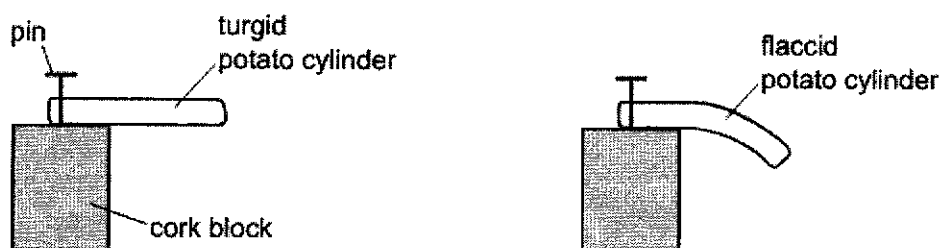
Which student correctly matched the function with the appearance of the cell structure?

	I	II	III
A	V	W	Y

3

B	V	Y	Z
C	Y	V	X
D	Y	W	Z

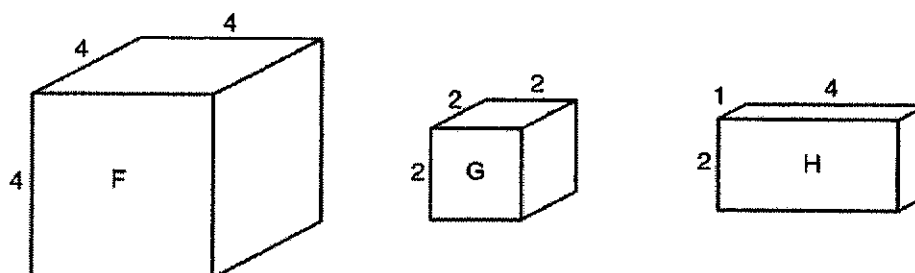
- 3 Four freshly cut potato cylinders were soaked for one hour in different salt solutions. The potato cylinders were then pinned to cork blocks. Two of the potato cylinders are shown.



Which solution would cause the potato cylinder to be the most flaccid?

- A 0.1 mol per dm^3 salt solution
 - B 0.3 mol per dm^3 salt solution
 - C 0.7 mol per dm^3 salt solution
 - D 1.0 mol per dm^3 salt solution
- 4 An experiment was carried out to investigate the effect of surface area to volume ratio on diffusion.

A block of agar containing sodium hydroxide solution and Universal Indicator solution was cut into three smaller blocks of different sizes, as shown. All dimensions are in centimetres.



The blocks were placed in a solution of 0.1 mol/dm^3 hydrochloric acid. As the hydrochloric acid diffused into each block, a colour change was observed. The time taken for each block to change its colour completely was recorded.

Which statement is correct?

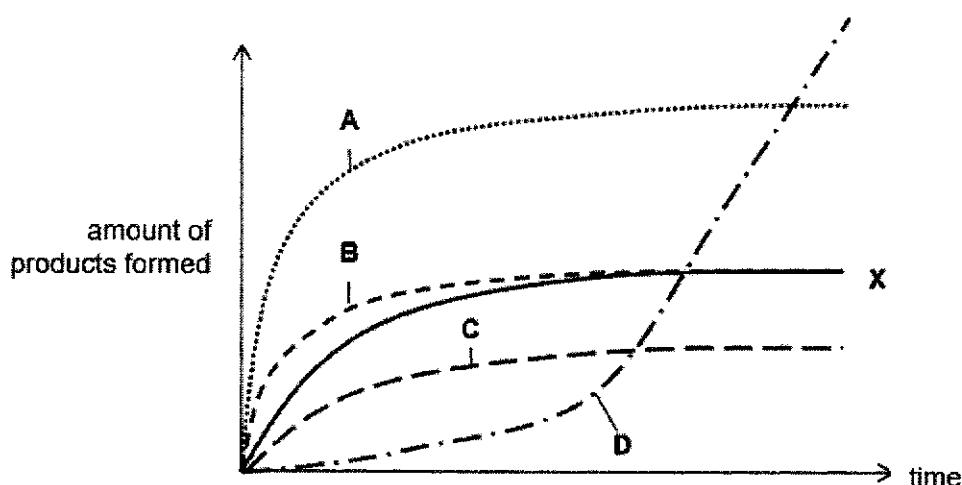
- A Although H and G have equal volumes, it will take less time for G to change colour completely.

- III R belongs to a group of biomolecules that always contain the elements C, H, O and N.
 IV R is synthesised from basic units glycerol and fatty acids.

- A I and II
 B I and IV
 C II and III
 D III and IV

- 7 The graph shows curve X which represents the activity of an enzyme at 20°C.

Which curve represents the activity when the temperature is raised to 30°C and with more enzymes added?



- 8 Four statements about the active site of an enzyme in the human body are given.

- I The shape of the active site changes when the temperature falls to 10°C and does not return to its original shape when the temperature returns to 37°C.
 II The active site of an enzyme has the same shape as the substrate molecule.
 III The specificity of the enzyme depends on the shape of its active site.
 IV The shape of the active site changes when the enzyme is heated to 60°C and does not return to its original shape when the temperature returns to 37°C.

Which statements are correct?

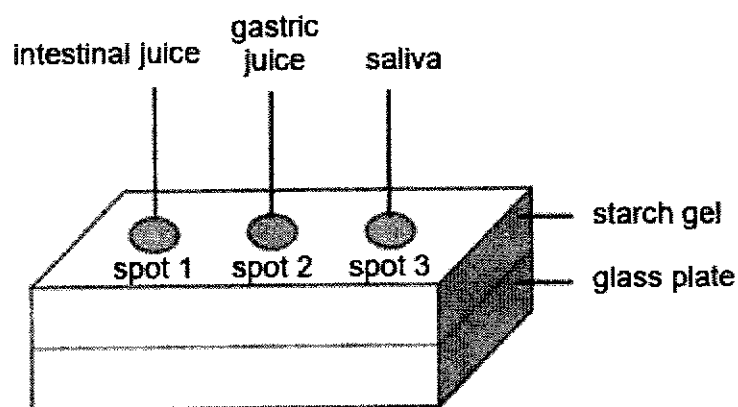
- A I, II and III only
 B I and IV only
 C II and III only
 D III and IV only

- 9 A student is fasting.

What effect will this have on the composition of the blood in the hepatic portal vein, hepatic vein and hepatic artery?

	hepatic portal vein	hepatic vein	hepatic artery
A	high in glucose	high in glucose	low in glucose
B	high in glucose	low in glucose	high in glucose
C	low in glucose	high in glucose	low in glucose
D	low in glucose	low in glucose	high in glucose

- 10 Digestive juices were collected from different regions of the alimentary canal. Drops of these juices were added to a glass plate coated with starch gel as shown in the diagram. After 1 hour, the starch gel was rinsed with distilled water and iodine solution was added to each spot.



Which row shows the correct results?

	spot 1	spot 2	spot 3
--	--------	--------	--------

A	blue-black	blue-black	brown
B	brown	blue-black	blue-black
C	brown	blue-black	brown
D	brown	brown	blue-black

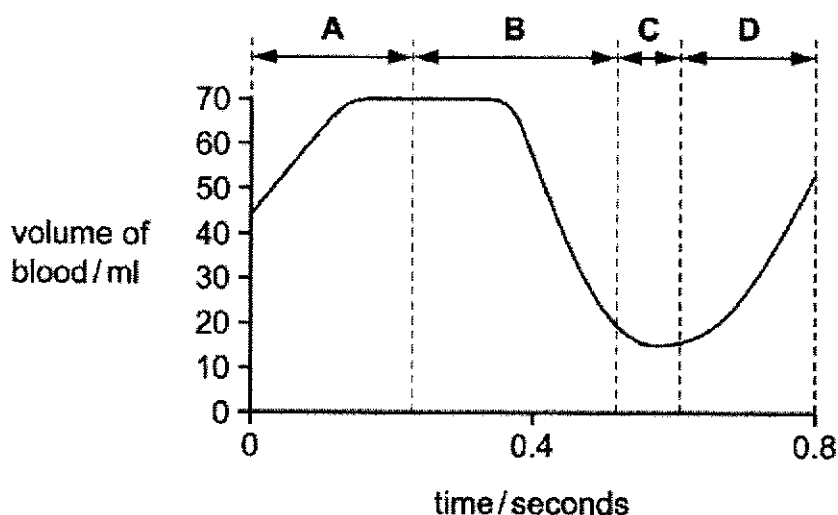
- 11** The pressure of blood flowing through the heart changes during the cardiac cycle. The table shows some values for the pressure in the chambers of the right side of the heart and the pulmonary artery.

Which row shows the correct values when the atrioventricular valves are opened, and the semilunar valves are closed?

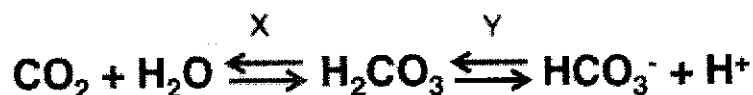
	pressure in right atrium/ mmHg	pressure in right ventricle/ mmHg	pressure in pulmonary artery/ mmHg
A	2	25	25
B	8	5	25
C	2	25	5
D	8	5	5

- 12** The diagram shows how the volume of blood in the left ventricle of a human heart changes during one heartbeat.

When is the left ventricle contracting?



- 13 Reactions X and Y take place within the human body.



Which row correctly matches X and Y to the site where each occurs, and whether an enzyme is needed?

	reaction X		reaction Y	
	enzyme needed	location	enzyme needed	location
A	yes	alveoli	yes	red blood cell
B	no	plasma	no	alveoli
C	no	red blood cell	yes	red blood cell
D	yes	red blood cell	no	plasma

- 14 The table shows the concentration levels of different substances present in the blood of a blood vessel found in the human body.

oxygen concentration	carbon dioxide concentration	glucose concentration
low	high	high

What could be the identity of this blood vessel?

- A** aorta
- B** hepatic portal vein
- C** pulmonary vein
- D** vena cava

- 15 Asthma is a lung disease triggered by the inhalation of an allergen such as pollen or dust. The allergen triggers the following responses:

- bronchi and bronchioles become inflamed and narrow
- excess mucus is secreted

What effects will the responses have on the gases exchange system?

- I diffusion gradient for oxygen in the lungs becomes less steep
- II increase in diffusion distance from the alveoli into blood
- III increased risk of developing a lung infection

- A I and II
- B I and III
- C II and III
- D I, II and III

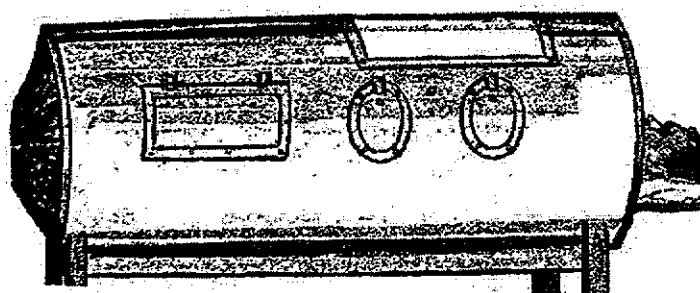
- 16 Electronic cigarettes are a cigarette substitute allowing nicotine to be inhaled without the other components found in cigarette smoke.

Which effects of cigarette smoking will also be the effects of using electronic cigarettes?

- A Smoking increases heart rate, narrows the arterioles, and increases blood pressure.
- B Smoking irritates the airways and increases mucus production.
- C Smoking reduces oxygen carried by red blood cells and reduces oxygen delivered to the tissues.
- D Smoking narrows the airways and increases coughing.

- 17 The diagram below shows an 'iron lung'.

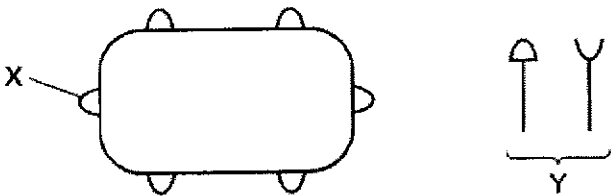
This is an airtight chamber inside which the air pressure can be varied. It is designed to help patients who have lost the ability to breathe. The chamber encloses the whole body of the patient except the head, and there is no leakage of air.



What are the air pressures in the chamber, as compared with atmospheric pressure, during inhalation and exhalation of the person?

	air pressure in the chamber as compared with atmospheric pressure	
	during inhalation	during exhalation
A	equal	higher
B	higher	equal
C	higher	lower
D	lower	higher

- 18 The diagram with the structure labelled X shows a bacterium with proteins on its surface. The diagram labelled Y shows proteins made by the human body.



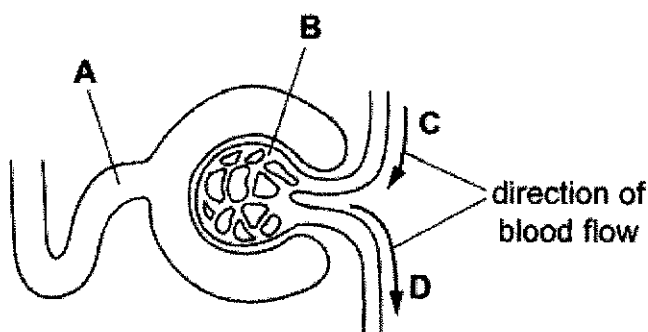
Which row shows the correct combination for destroying the bacterium?

	name of X	name of Y	correct shape of Y
A	antigen	antibody	
B	antibody	antigen	
C	antigen	antibody	

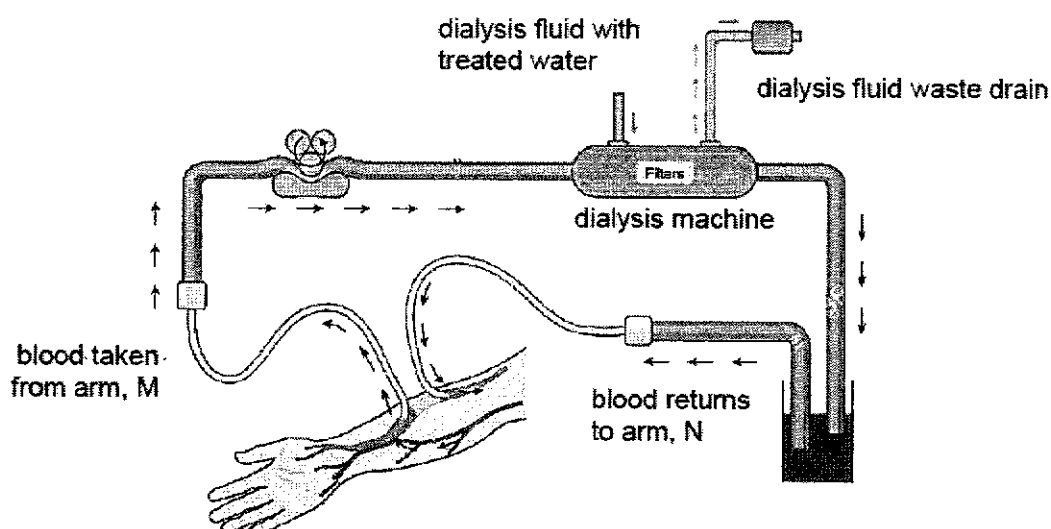
D	antibody	antigen	
----------	----------	---------	---

- 19 The diagram shows the first part of a kidney nephron and its blood supply. During filtration, protein molecules do not pass through the wall of the glomerulus.

Which part contains the highest concentration of protein?



- 20 A patient undergoing dialysis has blood samples taken at point M and N.



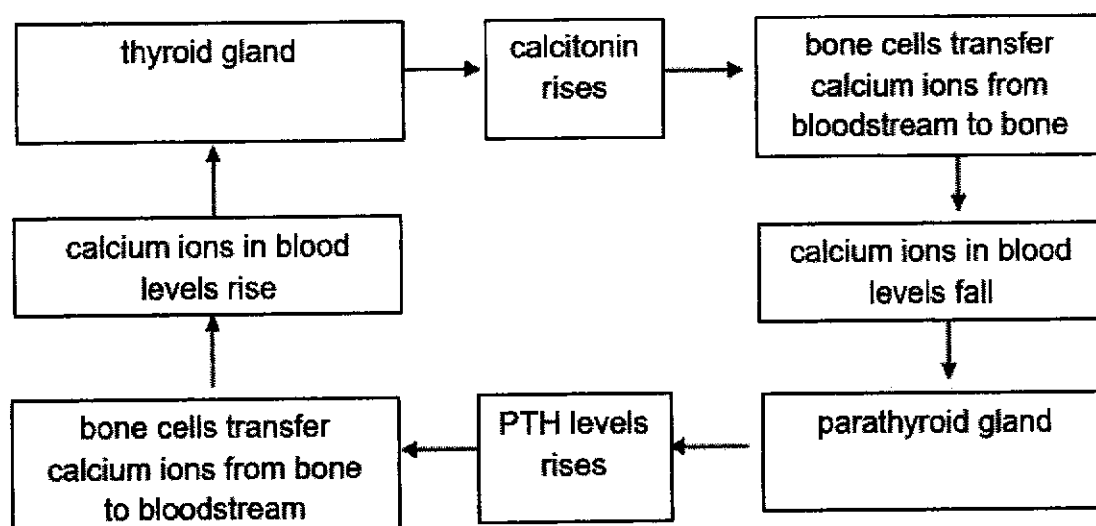
Biuret and Benedict's test were carried out on the dialysis fluid and blood samples, M and N. The results are as follows:

sample	biuret test result	Benedict's test result
M	violet colour solution	orange-red precipitate
N	violet colour solution	orange-red precipitate
dialysis fluid	blue colour solution	orange-red precipitate

Which of the following best explains the results?

- A** Most protein molecules have been removed from the patients' blood after dialysis.
- B** The dialysis fluid contains glucose and proteins.
- C** The partially permeable dialysis tubing allows proteins to pass through but not glucose.
- D** Proteins are too big to pass through the partially permeable dialysis tubing.

- 21** The diagram shows mechanisms for regulating level of calcium ions in blood. Calcitonin and PTH are hormones.

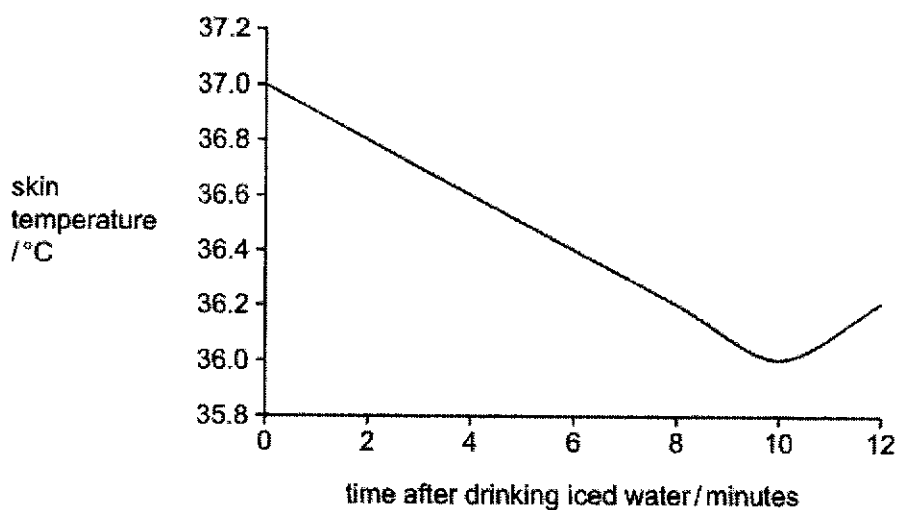


Which combination of answers is correct?

	stimulus	receptor	effector	response
A	high levels of calcium ions in blood	bone cells	parathyroid gland	calcium ions transferred from bloodstream to bone
B	low levels of calcium ions in blood	bone cells	thyroid gland	levels of PTH rise
C	high levels of calcium ions in blood	thyroid gland	bone cells	levels of calcitonin rise
D	low levels of calcium ions in blood	parathyroid gland	bone cells	calcium ions transferred from bone to bloodstream

- 22** A scientist investigated the effect of drinking iced water on skin temperature. They drank a large volume of iced water and monitored the temperature of their skin.

The results are shown on the graph.



Which explanation of the change in skin temperature during the first 10 minutes is correct?

- A Vasoconstriction occurred increasing blood flow to the skin.
- B Vasoconstriction occurred reducing blood flow to the skin.
- C Vasodilation occurred increasing blood flow to the skin.
- D Vasodilation occurred reducing blood flow to the skin.

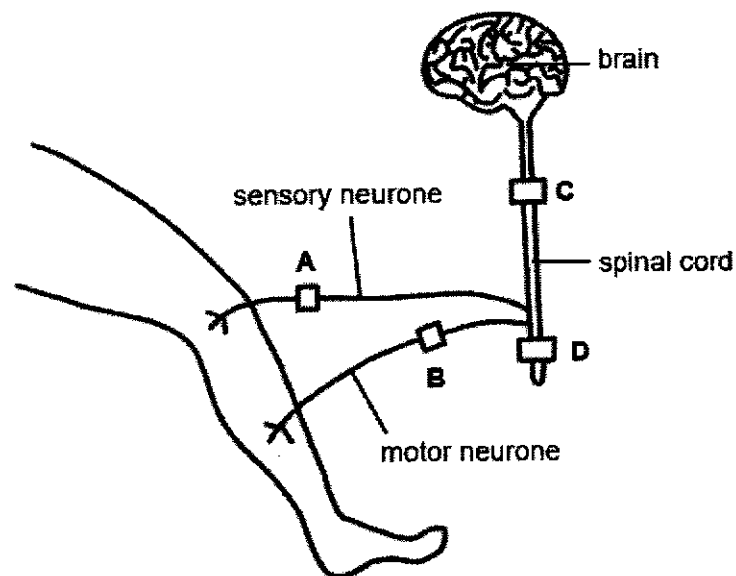
23 In myopia, distant objects appear blurred while near objects are clear.

- 1 The ciliary muscles cannot relax sufficiently.
- 2 The lens is unable to become thinner.
- 3 The suspensory ligaments cannot become sufficiently taut.

Which of the following would result in myopia?

- A 1 only
- B 3 only
- C 2 and 3 only
- D 1, 2 and 3

24 Anaesthetic blocks can be applied to various parts of the nervous system to prevent nerve impulses from travelling along neurones. The diagram shows the different sites, A, B, C and D where the anaesthetic can be applied.



Which option correctly shows the effect of the anaesthetic block at **A**, **B**, **C** or **D** respectively?

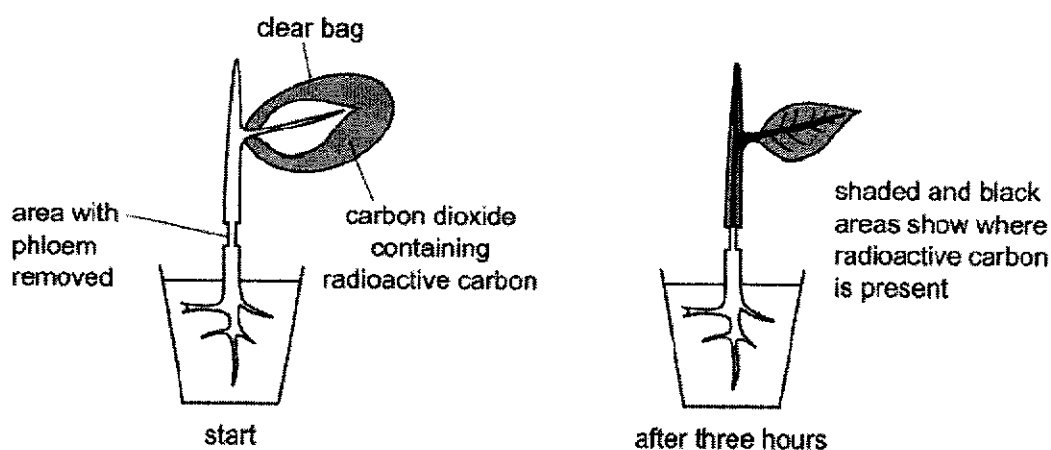
	pin prick can be felt on the leg	involuntary movement of leg	voluntary movement of leg
A	✓	✓	X
B	✓	X	X
C	X	X	✓
D	X	X	X

- 25** Diabetics who are on rapid-acting insulin are advised not to wait more than 20 minutes to eat after taking an insulin shot.

Which of the following best explains this?

- A** The insulin injected will serve as negative feedback to prevent the body from producing more insulin necessary to maintain blood glucose concentration.
- B** The injection of insulin can cause a dangerously low blood glucose concentrations.
- C** Insulin is required for increased absorption of glucose in the small intestine.
- D** The liver and muscles will be stimulated to convert stored glycogen to glucose.

- 26** A ring of phloem tissue was removed from the stem of a plant, as shown in the first diagram. Carbon dioxide containing radioactive carbon was supplied to the leaf of the plant. The second diagram shows where radioactive carbon was present after three hours.



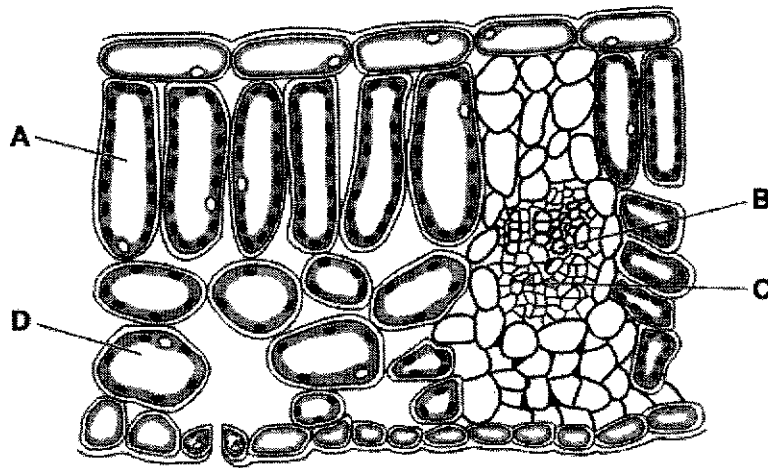
Which statement does the experiment support?

- I Translocation of sugar only occurs in one direction.
- II Translocation occurs in the phloem.
- III Translocation requires energy.

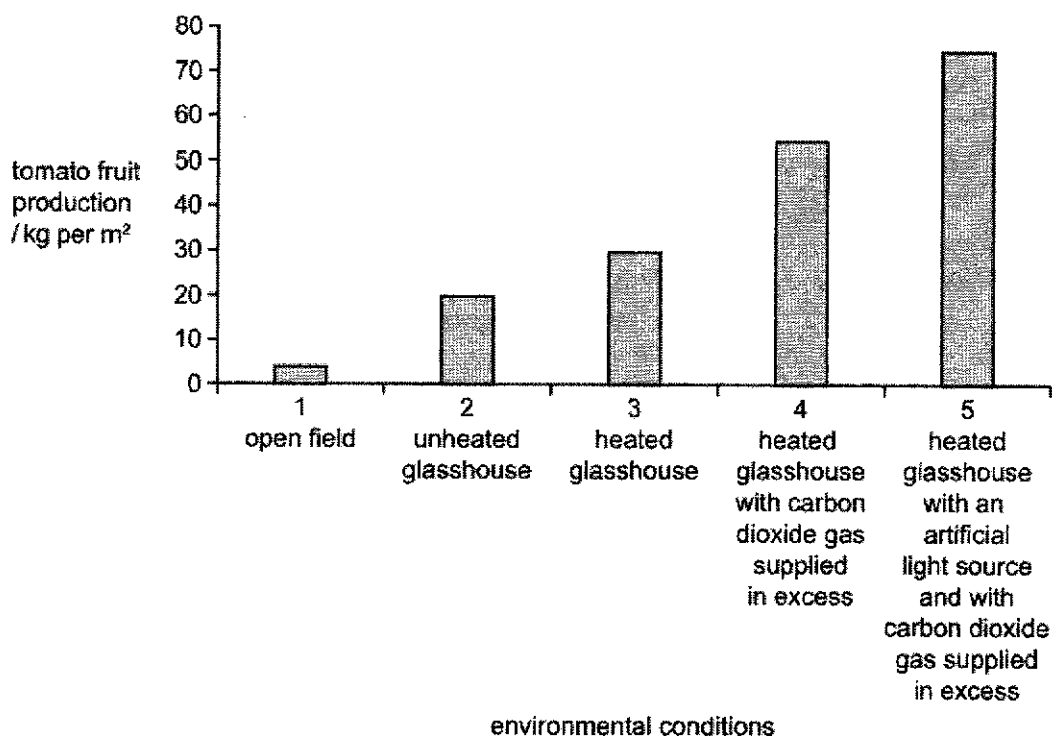
- A I only
- B I and II only
- C II only
- D II and III only

27 The diagram shows a cross-section through a leaf.

From which cell will most water evaporate during transpiration?



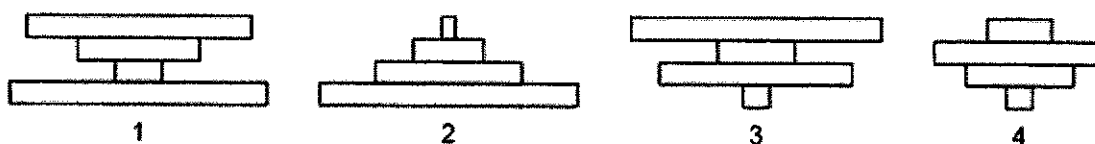
28 Tomato fruit production was measured in five different environmental conditions.



What is a correct conclusion for the data shown in the graph?

- A There are no limiting factors in 1, so tomato fruit production is the lowest.
- B Temperature is the limiting factor in 3.
- C Carbon dioxide is the limiting factor in all five environmental conditions.
- D Light is the limiting factor in 4.

- 29 A tree has insect larvae burrowing in its leaves. The emerging insects are eaten by birds and the birds have parasitic fleas living amongst their feathers.



Which is the pyramid of biomass and pyramid of numbers of this food chain?

	pyramid of biomass	pyramid of numbers
A	1	3
B	1	4
C	2	3
D	2	4

- 30 The statements describe some of the events that occur during eutrophication.

What is directly responsible for the increase in decomposers?

- A a decrease in dissolved oxygen concentration
- B an increase in nitrate concentration
- C an increase in the population of algae
- D an increase in the death of producers

- 31 Pure-breeding black-feathered chickens are mated with pure-breeding white-feathered chickens. All of the offspring (F1 generation) have black feathers and white feathers.

When two of the F1 generation chickens are crossed, what will be the ratios of offspring phenotypes?

- A 1 black: 1 white
- B 1 black: 2 black and white: 1 white
- C 3 white: 1 black
- D 3 black: 1 white

- 32 A man marries a woman who has a different blood group from him. They have two children. The children have different blood groups from each other and different blood groups from their parents.

What are the genotypes of the parents' blood groups?

- A $I^A I^A$ and $I^A I^B$
- B $I^A I^A$ and $I^O I^O$
- C $I^A I^B$ and $I^B I^B$
- D $I^A I^B$ and $I^O I^O$

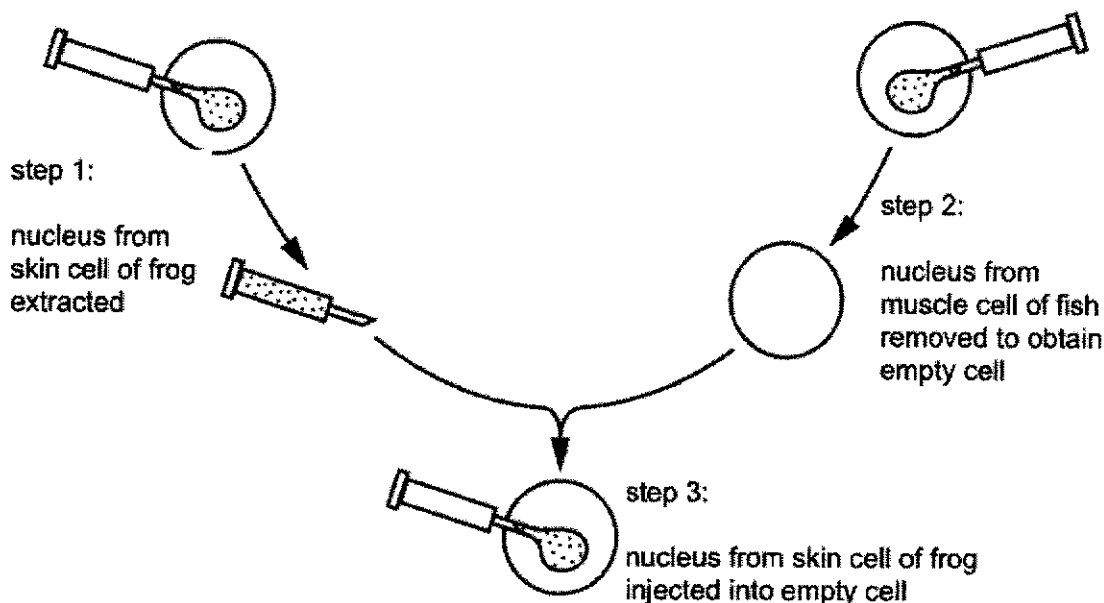
- 33 The table shows the percentage of nucleotides found in a rat and a turtle.

source of DNA	guanine %	thymine %	cytosine %	adenine %
rat	22	28	22	28
turtle	22	28	22	28

Which statement best explains why the rat and the turtle are different animals despite both having same percentages of each nucleotide?

- A Amino acids are used to produce different proteins in rats and turtles.

- B** The deoxyribonucleic acid (DNA) of the rat uses deoxyribose while the DNA of the turtle uses ribose.
- C** The rules of complementary base pairing are different in rats and turtles.
- D** The sequence of nucleotides is different and therefore code for different proteins.
- 34** The diagram shows a process carried out by a scientist in a laboratory.



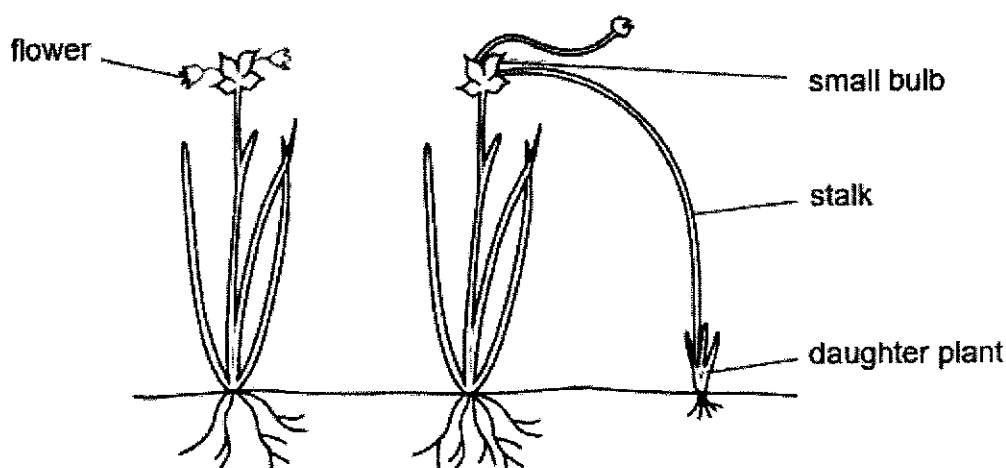
The empty cell which contains the injected nucleus from the frog skin cell is subsequently allowed to multiply to produce more cells.

What would the cluster of cells most likely form?

- A** fish muscle
 - B** fish skin
 - C** frog muscle
 - D** frog skin
- 35** Which statements about natural selection are correct?

	natural selection can lead to better adapted species surviving	natural selection can lead to extinction of a species	natural selection can lead to gene mutations occurring
A	✓	✓	✓
B	✓	✓	x
C	✓	x	✓
D	x	✓	✓

- 36 The diagram shows two onion plants.



Which statement about these onion plants is correct?

- A Daughter plants are produced from the small bulb by meiosis.
 - B Daughter plants produced are genetically identical to the parent plant.
 - C The plants can reproduce sexually and asexually.
 - D Two parent plants are required for reproduction.
- 37 Three different experiments were conducted on three separate newly-opened flowers growing on three plants of the same species. The experiments are summarised below.

flower on plant 1	Anthers of the flower were removed and the flower was left open to air.
flower on plant 2	Anthers were left untouched and a paper bag was tied tightly around the flower.
flower on plant 3	Anthers were carefully removed and a paper bag was tied around each flower.

At the end of the experiment, only plant 1 produced seeds.

What is the best explanation for this?

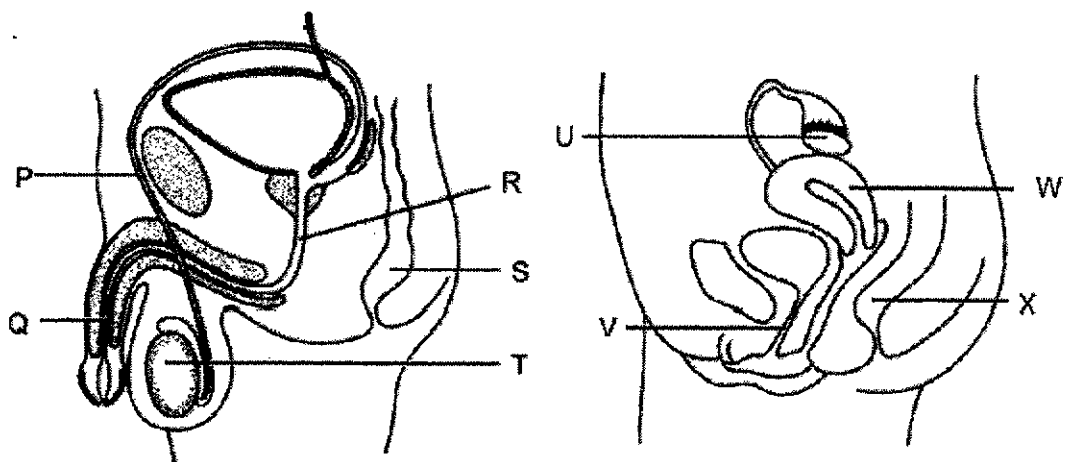
- A This species of plant is pollinated by insects and wind.

- B** This species of plant reproduces asexually.
- C** Only self-pollination takes place in this species.
- D** Both self-pollination and cross-pollination takes place in this species.

38 Which is an example of sexual reproduction?

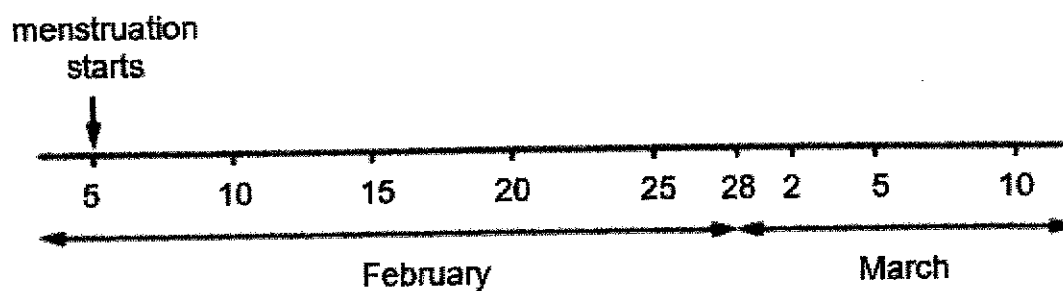
- A** one bacterial cell dividing to produce two daughter bacterial cells
- B** one banana plant being divided into two banana plants
- C** one pollen grain nucleus fusing with one ovule nucleus in a flower
- D** one yeast cell producing buds which separate to become new yeast cells

39 The diagram shows the side view of the male and female reproductive structures.



Which structures have similar functions?

- A** S and X, T and U
 - B** R and V, T and W
 - C** Q and U, S and X
 - D** T and W, R and X
- 40** The diagram shows a calendar for 33 days in February and March. A girl with a regular menstrual cycle of 28 days, begins menstruation on 5 February.



During which dates would the progesterone concentration in her blood rise most rapidly?

- A** 5 – 12 February
C 20 – 26 February

- B** 13 – 19 February
D 27 February – 5 March



BENDEMEER SECONDARY SCHOOL
2024 PRELIMINARY EXAMINATION
SECONDARY FOUR EXPRESS

CANDIDATE
NAME

CLASS

INDEX
NUMBER

BIOLOGY

6093 / 02

Paper 2

27 August 2024
1 hour 45 mins

Candidates answer on the Question Paper.
 No additional materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on the work handed in.
 Write in dark blue or black pen.
 You may use a 2B pencil for any diagrams or graphs.
 Do not use paper clips, glue or correction fluid.

The use of an approved scientific calculator is expected, where appropriate.
 You may lose marks if you do not show your working or if you do not use appropriate units.

Section A (70 marks)

Answer **all** questions. Write your answers in the spaces provided on the question paper.

Section B (10 marks)

Answer any **one** question.

Write your answers in the spaces provided on the question paper.

The number of marks is given in brackets [] at the end of each question or part question.

FOR ASSESSMENT USE	
80	

Section A [70 marks]

Answer all questions in the spaces provided.

- 1 Fig. 1.1 is a photomicrograph of a cell from the pancreas. The cell secretes the hormone insulin.

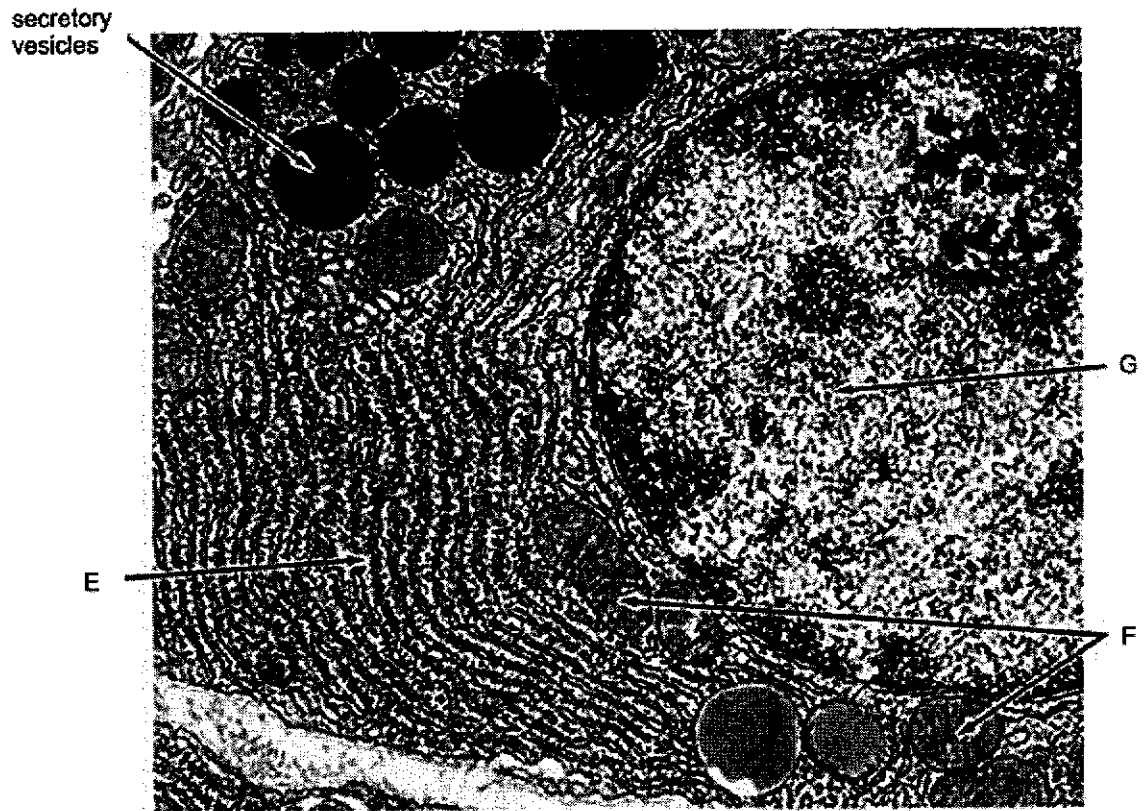


Fig. 1.1

- (a) Name organelles E, F and G.

E:

F:

G:

[2]

- (b) Define hormone.

.....

 [2]

(c) Explain the role of insulin in the regulation of blood glucose.

.....

.....

.....

.....

.....

..... [3]

(d) Diabetics can control their blood glucose level by injecting the hormone through the skin. In recent years, intensive research is conducted on the possibility of introducing the hormone into the body through either ingestion of a tablet or inhalation through a nasal spray.

Suggest why using nasal sprays is preferred over using injections and tablets.

.....

..... [1]

[Total: 8]

- 2 Protoplasts are plant cells that have had their cell walls removed by treatment with enzymes. Scientists often use protoplasts when researching ways to improve the yield of crop plants.

Fig. 2.1 is a scanning electron micrograph of protoplasts of cells from the tobacco plant, *Nicotiana tabacum*.

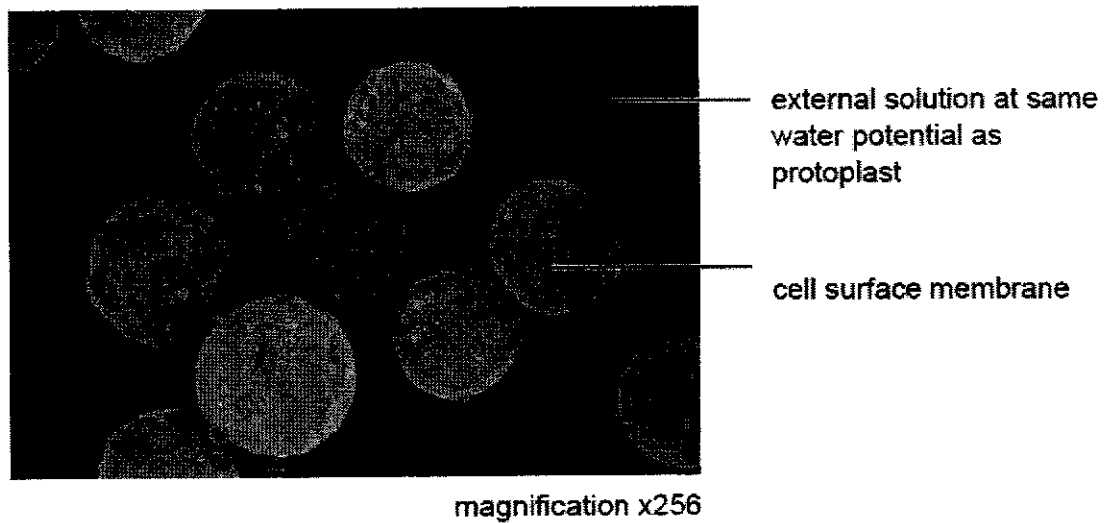


Fig. 2.1

- (a) Suggest the name of the enzyme used in the treatment to produce protoplasts.

..... [1]

- (b) Explain why scientists keep the protoplasts in a solution that is the same water potential as the cell.

.....

 [2]

- (c) An investigation was carried out on a sample of protoplasts to determine the effect of light intensity on photosynthesis. Fig. 2.2 shows the results of the investigation.

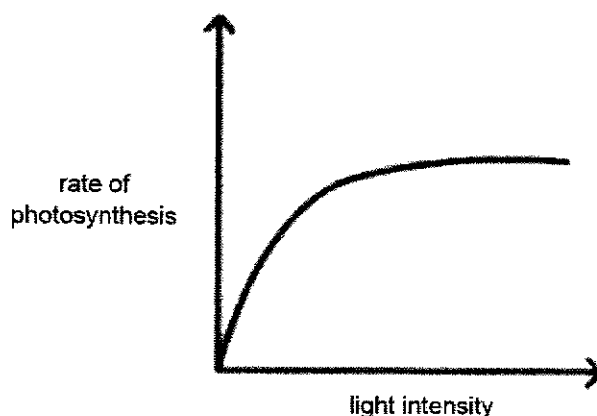


Fig. 2.2

- (i) Describe and explain the relationship between light intensity and rate of photosynthesis.

.....

.....

.....

..... [2]

Farmers often install additional lighting in their glasshouses for their tobacco plants. Table 2.1 summarises some of the factors considered by farmers when choosing the type of lamps to install.

Table 2.1

type of lamp	electrical energy used by the lamp/ J per s	light intensity output/ arbitrary units	notes
sodium	1041	1767	• releases lots of heat • best when used in addition to sunlight
LED	423	378	• releases very little heat • can be used as an alternative to sunlight
metal halide	651	817	• releases some heat • can be used as an alternative to sunlight

fluorescent	394	374	• releases some heat • best when used in addition to sunlight
-------------	-----	-----	---

(ii) Calculate the percentage increase in the energy used by the metal halide lamp compared to the energy used by the fluorescent lamp.

Give your answer to two significant figures.

.....% [2]

(iii) Some types of lamp release a lot of heat.

Explain the possible effects of excessive heat on the tobacco plants in a glasshouse.

.....
.....
.....
.....[2]

[Total: 9]

- 3 Fig. 3.1 shows part of a capillary and two alveolar cavities.

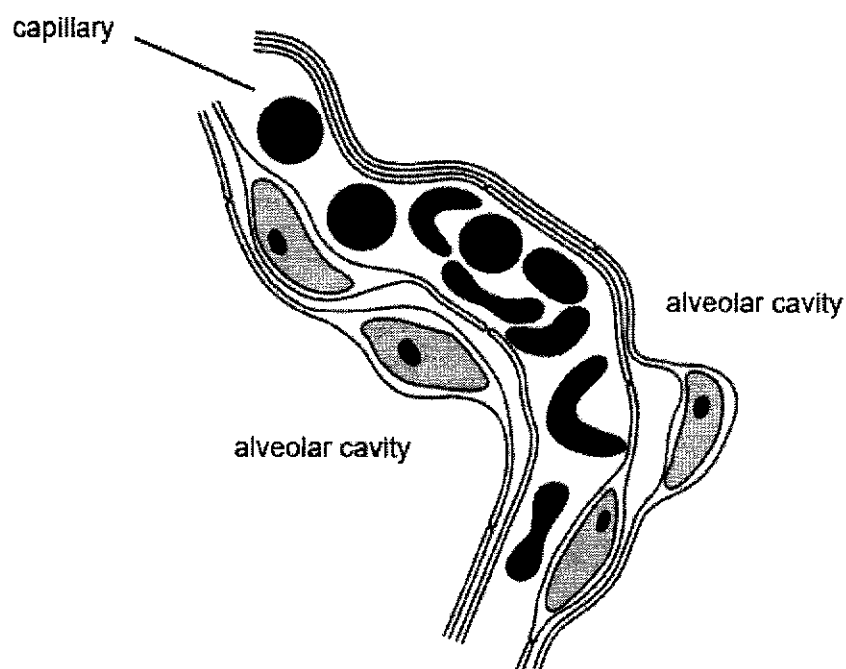


Fig. 3.1

(a) With reference to Fig. 3.1, describe the adaptation(s) of the

- (i) alveoli,

.....

.....

.....

.....

[2]

- (ii) red blood cell.

.....

.....

.....

.....

[2]

- (b) Fig. 3.2 shows a section of a bronchiole from the lungs of a person who never smoked cigarettes (non-smoker) and a section of a bronchiole from a person who smoked cigarettes (smoker) for the past five years. The two sections were taken from the same relative position in the lungs and are drawn to the same scale.

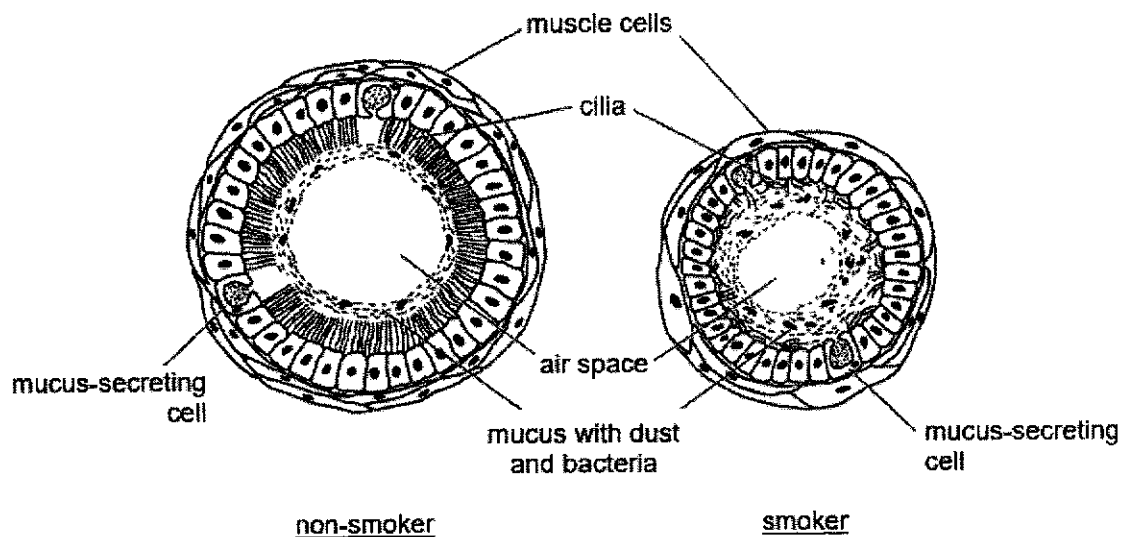


Fig. 3.2

- (i) With reference to Fig. 3.2, state two visible changes in the bronchiole of a smoker.

.....

.....

.....

[2]

- (ii) State the component of cigarettes that could have caused the changes in the bronchiole of a smoker.

.....

[1]

- (iii) With reference to Fig. 3.2, explain why the smoker has a higher risk of lung infections than a non-smoker.

.....

.....

.....

.....

[2]

[Total: 9]

- 4 Fig. 4.1 shows the circulatory system in a fetus developing in the uterus. The foramen ovale is an opening between the right and left atria. The opening naturally closes six to twelve months after birth.

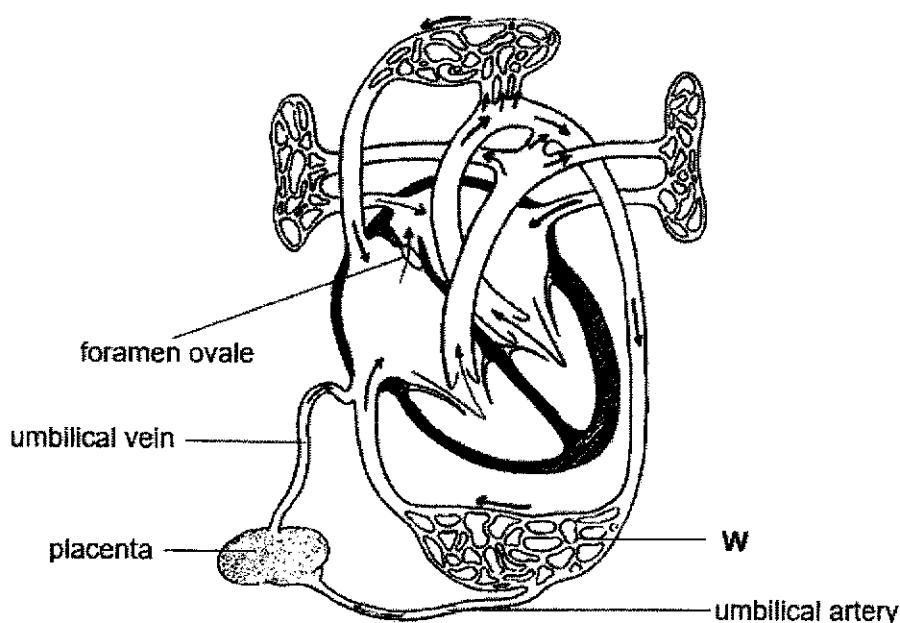


Fig. 4.1

- (a) Describe and explain the difference in the composition of blood in the right ventricle of a fetus and a healthy adult.

.....

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.....

[2]

- (b) With reference to Fig. 4.1, explain how the structure of W allows it to carry out its function efficiently.

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.....
.....
[2]

- (c) A pregnant woman has the blood type B while her growing fetus has blood type A. Explain why it is dangerous if their bloods were to mix.

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.....
.....
[2]

[Total: 6]

- 5 Some dogs have different-coloured eyes. This genetic condition is called heterochromia. The allele for heterochromia is dominant.

(a) Fig. 5.1. shows a family of dogs with heterochromia.

11

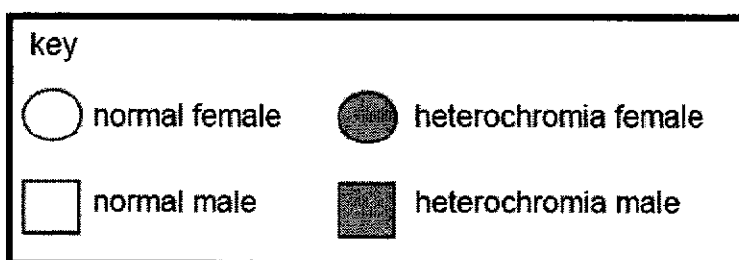
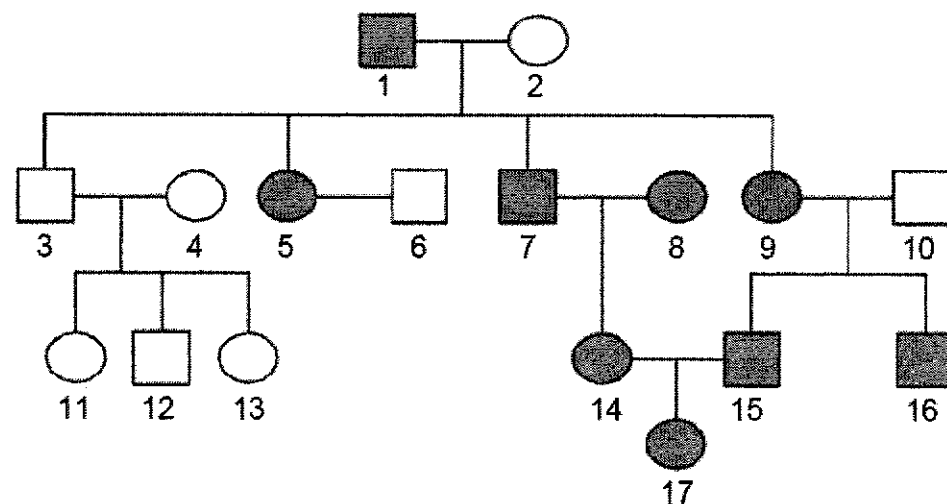


Fig. 5.1

- (i) Describe what is an allele.

..... [1]

- (ii) Using the numbers 1 to 17, identify the dogs that are heterozygous.

..... [1]

- (iii) Dog 13 is crossed with dog 7.

State the expected phenotypic ratio of their offspring. Explain your answer.

.....

.....

.....

.....[3]

- (iv) Explain why the observed ratio of dogs from the cross between dog 9 and dog 10 with heterochromia is different from the expected ratio.

.....

..... [1]

- (b) Table 5.1 shows a comparison of the base sequence from a section of the DNA that controls eye colour in dogs.

Table 5.1

condition	base sequence
dogs not affected by heterochromia	CGT TAA AGA GGC GTA
dogs affected by heterochromia	CGT TAA AGA GCA GTA

- (i) Using information from Table 5.1, explain why some dogs display heterochromia while some do not.

.....

[2]

- (ii) State the name of the process that causes changes in DNA sequence.

.....
 [1]

[Total: 9]

- 6 Fig. 6.1 shows the changes that occur in atmospheric pressure and oxygen concentration as altitude changes. The highest altitude at which people live permanently is 5100 m.

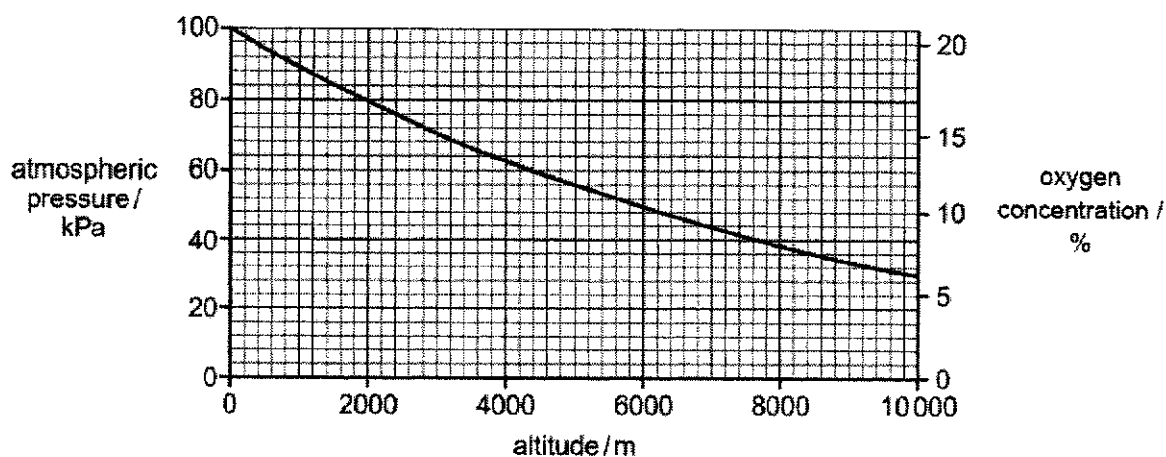


Fig. 6.1

(a) With reference to Fig. 6.1,

- (i) describe the effect of increasing altitude on both atmospheric pressure and the oxygen concentration,

.....

.....

.....

.....

[2]

- (ii) calculate the change in atmospheric pressure when a person travels from sea level to an altitude of 3500 m.

Show your working.

..... [2]

- (b) When a person travels from 0 m (sea level) to a high altitude, gas exchange in the lungs is affected. A condition known as hypoxia results, where the body tissues do not receive an adequate oxygen supply.

Explain how hypoxia occurs when a person ascends from sea level to a high altitude.

.....

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.....

[3]

(c) At high altitudes, short-term responses by the body to hypoxia include:

- a decrease in the volume of plasma in the blood
- a decrease in the volume of blood pumped out of the heart per heart beat
- an increase in the heart rate
- an increase in the breathing rate

Explain why an increase in the heart rate occurs in response to hypoxia.

.....

.....

.....

..... [2]

[Total: 9]

- 7 During pregnancy, the peptide human chorionic gonadotrophic (hCG) hormone is produced by the embryo. HCG hormone stimulates the ovary to produce

progesterone. Table 7.1 shows the concentration of hCG hormone in the blood of a woman in the first 18 weeks of pregnancy. Fertilisation occurs in week 3.

Table 7.1

weeks of pregnancy	2	4	6	8	10	12	14	16	18
hCG concentration/ mIUcm ⁻³	0	800	10000	12000	11000	6000	2000	1000	1000

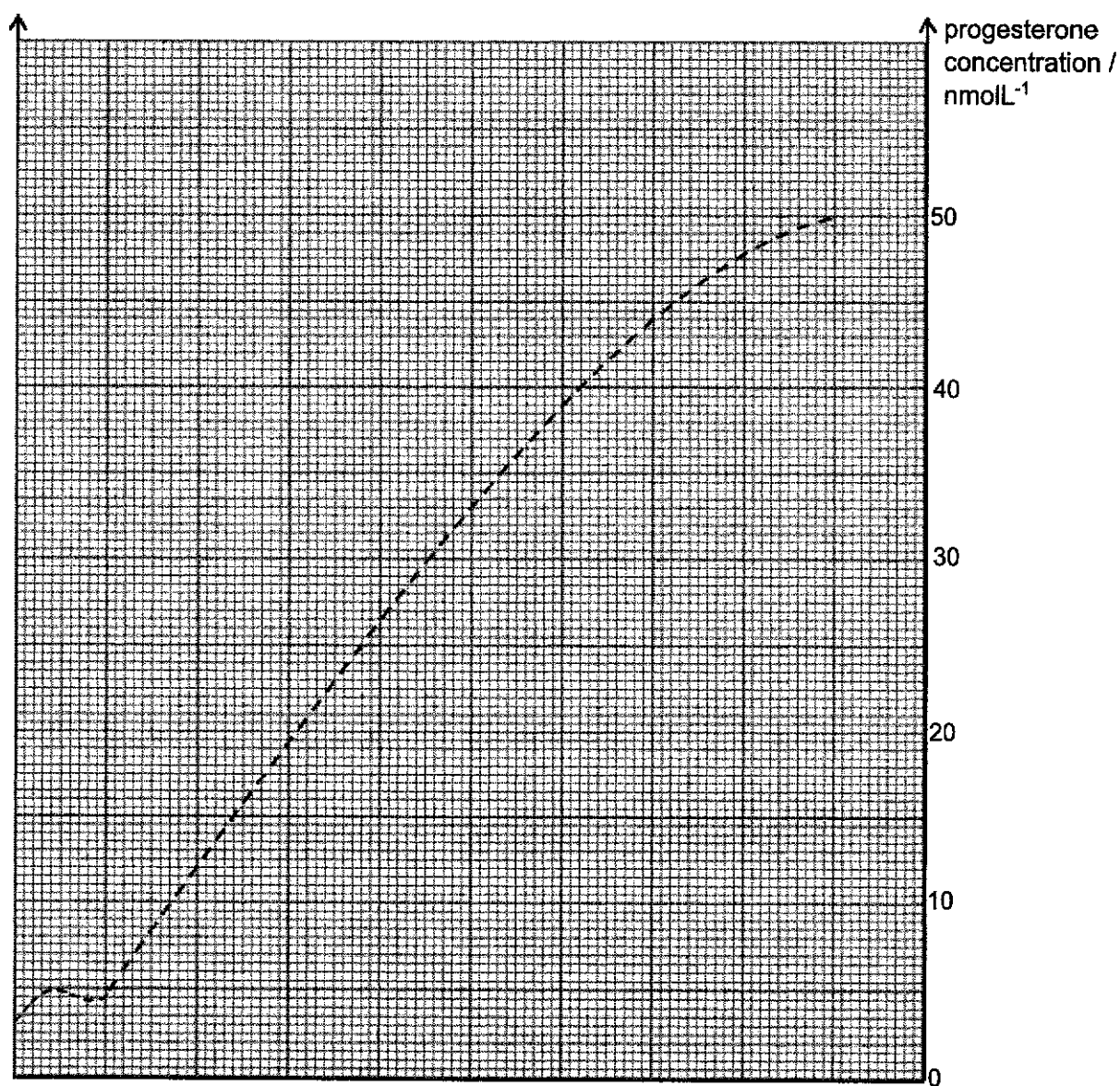


Fig. 7.1

- (a) Draw a line of best fit in Fig. 7.1 using the same grid to show the concentration of hCG in the first 18 weeks of pregnancy.

[3]

(b) Describe the trend in hCG concentration from week 2 to 16 of a pregnancy.

.....

.....

.....

.....

[2]

(c) Suggest why progesterone concentration continues to increase even when hCG concentration decreases.

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.....

[2]

(d) Home pregnancy test kits commonly test for the presence of hCG in urine.
Suggest why hCG can be found in the urine of pregnant women even though it is a protein.

.....

.....

[1]

(e) Oligohydramnios is a condition in pregnancy characterised by low quantities of amniotic fluid.
Explain how this condition can be dangerous for a developing fetus.

.....

.....

.....

.....

[2]

[Total: 10]

- 8 Two subspecies of reindeer, *Rangifer tarandus*, live in North America. Members of the different subspecies belong to the same species but have some physical differences and are found in different geographical locations. Fig. 8.1 shows a reindeer.



Fig. 8.1

Table 8.1 compares the features of the two reindeer subspecies.

Table 8.1

feature	woodland subspecies, <i>R. tarandus caribou</i>	barren-ground subspecies, <i>R. tarandus groenlandicus</i>
habitat	warmer, southern woodland	snowy, northern tundra
colour of fur	dark	light
type of food	tree leaves, grass	lichen, moss

- (a) During the last ice age, an ice sheet separated the southern and northern populations of *R. tarandus* in North America.

Using your understanding of natural selection and Table 8.1, explain how the ice sheet resulted in the evolution of two subspecies of *R. tarandus*.

.....

.....

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.....

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..... [4]

(b) A scientist studied the effects on kidney function of reindeer fed either with a low-protein diet or supplemented with salt (sodium chloride).

- (i)** When fed with a low-protein diet, there was a significant decrease in glomerular filtration rate (GFR) in the reindeer. The GFR can change when the afferent arteriole carrying blood to the glomerulus constricts.

Explain why the lumen of the afferent arteriole needs to be wider than the lumen of the efferent arteriole.

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[2]

- (ii)** State one adaptation of the afferent arteriole that allows it to change its lumen size.

..... [1]

- (iii)** Explain why a smaller volume of concentrated urine was produced in reindeer whose diet was supplemented with salt.

.....

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.....

.....

[3]

[Total: 10]

Section B [10 marks]

Answer only **one** of the questions in the space provided.

- 9** Some pollutants are not broken down easily and remain in the environment for a long time. These are described as persistent pollutants. PCBs are a waste material from the manufacturing of electrical insulation. PCBs are one of the most persistent pollutants in the environment.

Between 1947 and 1976, factories dumped large quantities of PCBs into the Hudson River in the USA. Studies measured the concentrations of PCBs in the tissues of organisms in a food chain in the sea near Hudson River, as shown in Fig. 9.1.

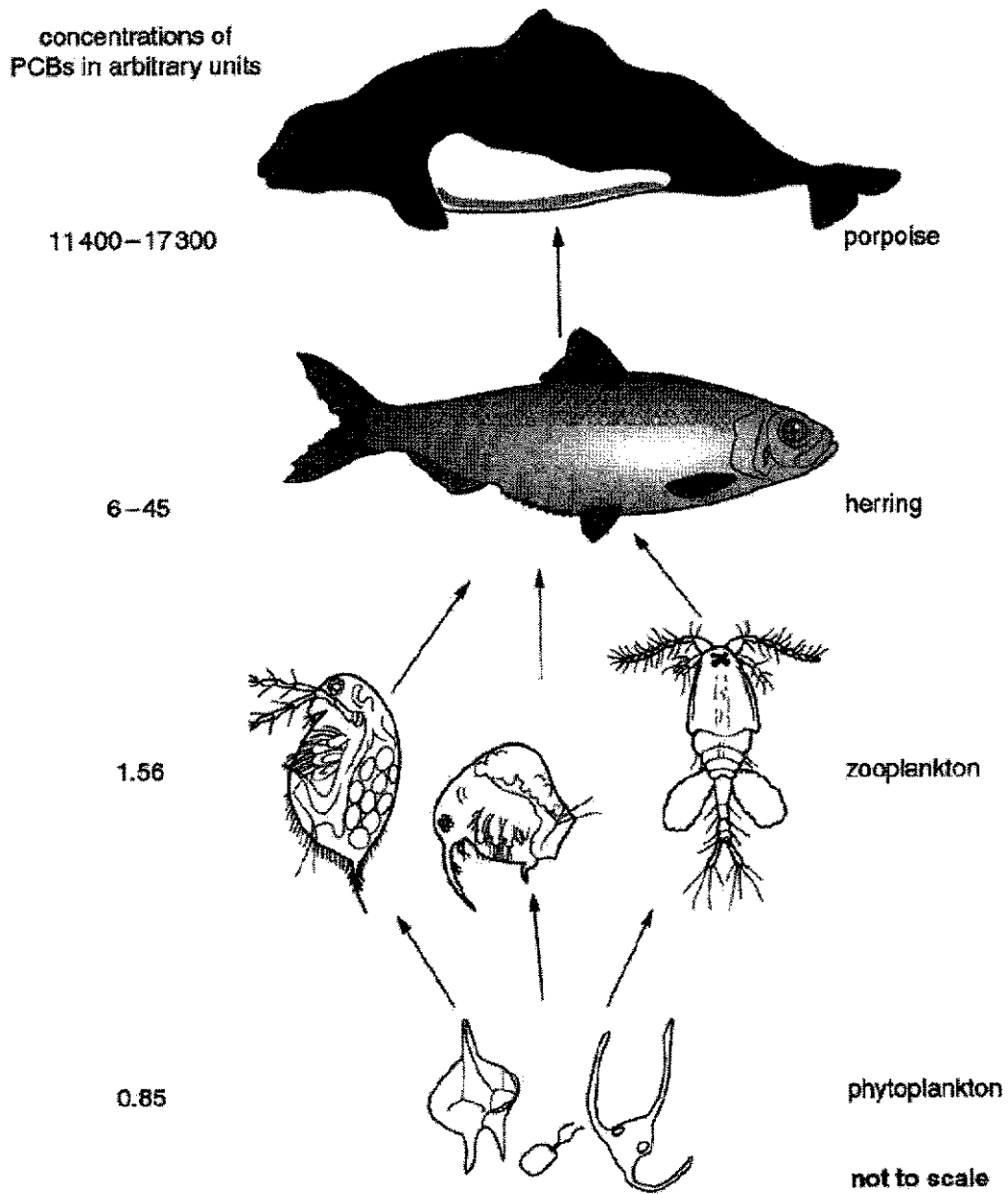


Fig. 9.1

(a) (i) Describe the results shown in Fig. 9.1.

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.....

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.....

.....

..... [3]

- (ii) Suggest an explanation for the different concentrations of PCBs in the organisms of the food chain.

.....

 [3]

- (b) Explain why there are no more than four trophic levels in the ecosystem shown in Fig. 9.1.

.....

 [3]

- (c) Humans play a significant role in ecosystems.

Suggest possible conservation programmes that have helped to prevent the extinction of endangered species.

.....

 [1]

[Total: 10]

10 Fig. 10.1 shows a strawberry plant.

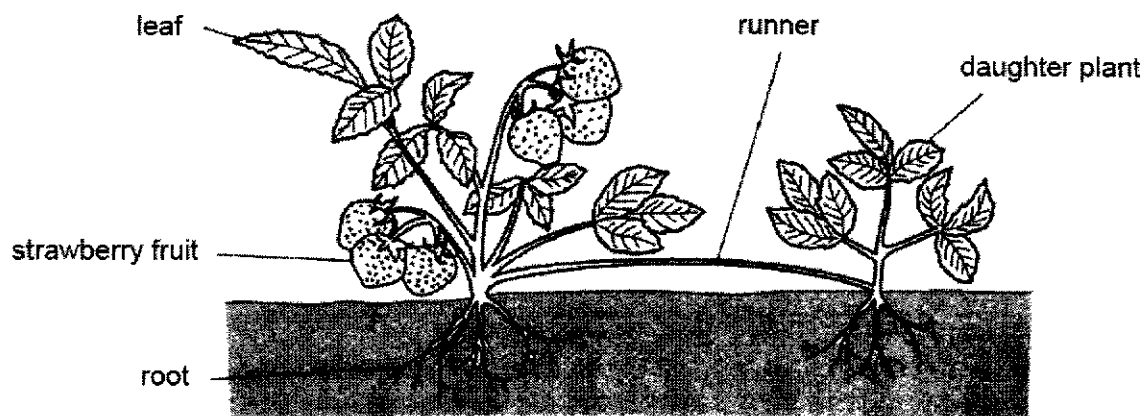


Fig. 10.1

- (a) With the aid of Fig. 10.1, explain how the strawberry plants reproduce and state reasons for it.

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[4]

- (b)** Three strawberry plants of the same species were placed in different greenhouses A, B and C. The conditions of each greenhouse are shown in Table 10.1.

Table 10.1

conditions	greenhouse A	greenhouse B	greenhouse C
humidity/ %	0.2	0.5	
Light intensity/ arbitrary unit	50	30	

- (i) It was found that the plant in greenhouse C shown the highest rate of water loss. Complete Table 10.1 by predicting the humidity and light intensity in greenhouse C.

[1]

- (ii) Explain how humidity and light intensity affect the rate of water loss in the strawberry plant in greenhouse C.

[5]

..... [5]
[Total: 10]

2024 Prelim
4EPure Biology
6093

Answer Key
Paper 1

1	C	21	D
2	C	22	B
3	D	23	C
4	C	24	B
5	B	25	B
6	B	26	C
7	B	27	D
8	D	28	D
9	C	29	C
10	C	30	D
11	D	31	B
12	B	32	D
13	D	33	D
14	B	34	D
15	D	35	B
16	A	36	C
17	D	37	A
18	A	38	C
19	D	39	A
20	D	40	C

2024 Prelim
4EPure Biology
6093
Paper 2

No	Answers	Marks
1a	E rough endoplasmic reticulum F mitochondrion G nucleus 2 correct 1m, 3 correct 2m	3
1b	Chemical substance produces by endocrine gland; transported in the bloodstream to its target organs where it exert its effect;	1 1
1c	- Increased blood glucose concentration above set point stimulates (β cells of) islets of Langerhans of the pancreas to increase insulin secretion; - Insulin travels in bloodstream to liver / muscles; - Stimulating increased uptake of glucose & conversion of glucose to glycogen; - Decreasing blood glucose to set point (A: 70-100 mg/dm³)	1 1 1
1d	Spray is less invasive than skin injections / doesn't have to pierce through the skin; Spray is faster acting than tablets + diffuses directly into blood; Proteins in the tablets might be denatured from proteases in the digestive system;	Any 1
2a	cellulase	1
2b	ensure no net movement of water molecules into the cells/AW; prevent the cells from increasing in volume and bursting/ AW;	1 1
2ci	As light intensity increases at first, rate of photosynthesis increases as light intensity is the limiting; at high light intensities, rate of photosynthesis remains constant/reaches maximum/no longer increases; showing that light intensity is no longer limiting;	1 1
2cii	(651-394)/394 x 100%; minus 1m if not 2sf (65.22);	2
2ciii	enzymes involved in photosynthesis denature; photosynthesis to stop/ wilting / leaves fold up / stem droops;	1 1
3ai	- Wall is made up of a single layer of cell to reduce diffusion distance, so that gases exchange between the alveoli and the bloodstream can take place quickly - Close proximity of the alveoli to the blood capillary to reduce diffusion distance for faster rate of gases exchange	1 1
3aii	- Biconcave in shape, increasing surface area to volume ratio for faster diffusion of oxygen into the cell - No nucleus to have more space to contain more haemoglobin to carry more oxygen	1 1 (max 1)
3bi	- Thick layer of mucus (smoker) - Cilia paralysed (smoker) - Smaller air space (smoker)	1 1 1 (max 2)
3bii	Irritants/ Tar	1
3biii	Unable to remove the bacteria trapped in the mucus; Mucus build up and result in persistent coughing and breathing difficulties and lung infections	1 1

4a	The right ventricle in the fetus contains mixed blood/blood has a higher concentration of oxygen while the right ventricle in an adult contains deoxygenated blood;	1
	The foramen ovale allows oxygenated blood from the umbilical vein to mix with the deoxygenated blood from the vena cava;	1
4b	As the cross-sectional area of the vessel increases/when branching occurs, the blood pressure in the vessel decreases, slowing blood flow through the body tissues;	1
	There is more time/longer duration for the blood to flow through the tissue, increasing the efficiency of exchange of substances such as oxygen and nutrients between the capillaries and the tissues;	1
4c	The mothers blood <u>plasma</u> contains <u>antibodies a</u> while the surface of the <u>red blood cells</u> of the fetus has <u>antigen A</u> .	1
	When <u>antibodies a</u> comes into contact with <u>antigen A</u> , <u>agglutination/clumping</u> occurs;	1
5ai	Allele is an alternative form of the gene. Heterochromia is an alternative form for the eye colour gene.	1
5aii	1, 5, 7, 9, 15, 16;	1
5aiii	1 heterochromia : 1 no heterochromia; (rej: 50%)	1
	13 is homozygous recessive / 13 has no dominant allele for heterochromia / 13 has only recessive alleles;	1
	7 is heterozygous / 7 has 1 dominant and 1 recessive allele;	1
5aiv	the expected ratio is a mathematically calculated value that is true for large sample sizes only. Since dog 9 and 10 only has 2 children (small sample size) the observed ratio does not have to be the same as the expected ratio	1
5bi	Codon for heterochromia is GCA different to GGC in normal dogs;	1
	Different amino acid formed + different protein formed in eye colour;	1
5bii	Mutation;	1
6ai	As altitude increases, both atmospheric pressure and oxygen concentration decrease;	1
	Correct comparative data quote of altitude and atmospheric pressure or oxygen concentration, with units;	1
	Non-linear decrease;	1
	Decrease in oxygen concentration proportionate to decrease in atmospheric pressure;	1 (max 2)
6aii	-34kPa	2
6b	Lower atmospheric pressure/ oxygen concentration	
	• Lower concentration of / less/ oxygen in, alveolar/ inspired/inhaled air;	1
	• Decreased, diffusion/ concentration gradient;	1
	• Between alveolus and capillary (ref to concentration gradient);	1
	• Less oxygen enters capillaries/ the blood;	1
	• So fewer molecules of oxygen combining with haemoglobin;	1 (max 3)
6ci	Greater concentration of red blood cells (through pulmonary capillaries per unit time)	1
	Increases the percentage of red blood cells to the total blood volume;	1
	Increases carbon dioxide/ bicarbonate ions concentration (to increase heart and breathing rates);	1 (max 1)
6cii	More red blood cells flowing to the lungs (per unit time);	1
	To maximise oxygen uptake from alveoli/ takes in more oxygen/ compensates for lack of oxygen;	1
	More blood pumped through the systemic circulation to the rest of the body;	1 (max 2)

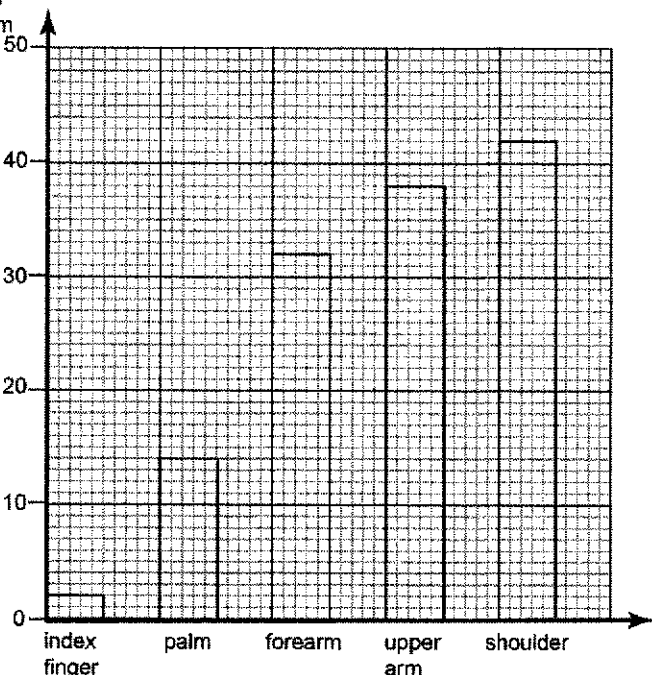
	Compensates for the lowered plasma volume	
7a	Scale + Axes (unit); Line; Point; hCG concentration/ mIUcm⁻³ progesterone concentration / nmolL⁻¹ weeks of pregnancy	3
7b	From week 2 to 8, hCG concentration increased sharply from 0mIUcm⁻³ to 12000 mIUcm⁻³ From week 8 to 16, hCG concentration decreased sharply from 12000mIUcm⁻³ to 1000 mIUcm⁻³	1 1
7c	Placenta is formed; Take over the role of secreting progesterone;	1 1
7d	hCG is small enough to pass through the basement membrane hCG is degraded into smaller subunits in the kidney	1 1 (max 1)
7e	Insufficient amniotic fluid - to provide the developing fetus with support and cushioning before birth, making the developing fetus susceptible to physical injury; - act as a shock absorber making the developing fetus susceptible to physical injury; - to function as an incompressible layer surrounding the developing fetus, causing the fetus to be susceptible to physical injury; - insufficient space to move about resulting in underdeveloped muscles;	
8a	- random/spontaneous mutations resulted in variation between the population of reindeers in the North and South; - selection pressure: due to difference in habitat / availability of food + provide ref. from table; - reindeer that is darker/lighter / ability to forage for food are at selective advantage in North/South; - able to survive and reproduce to pass down beneficial genes to offspring;	1 1 1 1 1

	- over time/many generations the populations evolved into the 2 subspecies separately; - geographical separation due to ice sheet;	1 (max 4)
8bi	generate high hydrostatic pressure within the glomerulus; to force plasma/ small molecules/ fluid out of the Bowman's capsule during ultrafiltration ;	1 1
8bii	presence of thick muscular walls;	1
8biii	salt lowers/decreases blood water potential, causing more anti-diuretic hormone (ADH) to be secreted by hypothalamus / released by pituitary gland; cells of walls of collecting duct become more permeable ; more water is reabsorbed back into the blood capillaries surrounding the nephron;	1 1 1
9ai	- concentration of PCBs increases up the food chain; - concentration is much higher in larger organisms; - great increase between herring and porpoise; - herring/ porpoise at the top of food chain have a range of concentrations; - use data to make comparison between two trophic levels;	1 1 1 1 1 (max 5)
9aii	- animals at higher trophic levels live longer; - eat many of the animals below them in the food chain; - non-biodegradable, unable to be broken down and store and build up in the fatty tissues of the organisms - bioaccumulation	1 1 1
9b	- 90% of energy is lost through heat during respiration, excretory products - Only 10% is transferred to the next trophic level - Too little energy left in the last trophic level to support another trophic level	1 1 1
9c	- Monitoring and protecting the species/ habitat; - Education; - Captive breeding programme; - Zoos/ wildlife parks; - Law to ban hunting	Any 1
9a	Parent plant produces runners which allow a new daughter plant to grow close by. (genetic composition) Daughter plants are genetically identical to parent plant. Sexual reproduction allows genetically different / genetically dissimilar offspring to be produced. This is advantageous as it allows a larger proportion of offspring to survive in a range of environments / prevents a single disease from wiping out the whole population.	1 1 1 1
9b	Humidity – less than 0.2%, light intensity more than 50 AU	1
9c	The lower the humidity, the steeper the concentration gradient of water vapour between the intercellular air spaces and the surrounding air. Water vapour diffuses out of the stomata faster so there is a higher rate of water loss. The higher the light intensity, the higher the rate of photosynthesis in the guard cells. The higher rate of photosynthesis causes faster accumulation of glucose within the guard cells, lowering their water potential. Water molecules enters the guard cells by osmosis causing them to be turgid. This results in the stomata opening wider and hence, the rate of water loss will be higher.	1 1 1 1 1

No	Answer	Marks												
1ai	50.0, 50.0	1												
aii	Prediction : 1. As concentration of sodium chloride solution increases, the angle of bend of the potato increases. Reason : 2. As the concentration of sodium chloride solution increases, the water potential of the sodium chloride solution decreases as compared to the potato cells. 3. Increase in net movement of water molecules from potato cells outwards into the sodium chloride solution 4. via osmosis Reject: diffuse 5. Increased plasmolysis of potato cells causing potato to be more flaccid (aw)	1 Max 2												
aiii	6. CH (column heading) - Column heading <u>with UNITS</u> 7. D (data) - Different angle of bend each conc of sodium chloride (Angle of bend cannot be more than 90°) 8. T (trend) – 10% is the highest angle of bend & 0% (distilled water) is the lowest angle of bend 9. P – angle of bend to whole number Example: <table><tr><th>concentration of sodium chloride solution / %</th><th>angle of bend / °</th></tr><tr><td>10.0</td><td>30</td></tr><tr><td>7.5</td><td>25</td></tr><tr><td>5.0</td><td>20</td></tr><tr><td>2.5</td><td>10</td></tr><tr><td>0.0</td><td>6</td></tr></table>	concentration of sodium chloride solution / %	angle of bend / °	10.0	30	7.5	25	5.0	20	2.5	10	0.0	6	1 1 1 1
concentration of sodium chloride solution / %	angle of bend / °													
10.0	30													
7.5	25													
5.0	20													
2.5	10													
0.0	6													
a iv	Based on student results (tally with angle of bend for 7.5% sodium chloride solution)	1												
a v	7.5% ; Accept range between known values	1												

a vi	10. When placed against the protractor, pressure exerted on each piece of potato tissue may be different / inconsistent. 11. The potato tissue is difficult to hold and measure. 12. Potato pieces were NOT immersed in sodium chloride for the same duration / inconsistent incubation time. 13. Containers not covered and evaporation may have affected the concentration of the NaCl that the potato were immersed in. 14. The widths / cross sectional area of the potato tissue varies slightly when cutting 15. Measuring cylinder which was used for measuring volume of distilled water and sodium chloride is imprecise. R. fluctuations in temperature	Max 2.
a vii	16. Increase the number of concentrations of sodium chloride ; 17. Use a stabiliser or support for bottom of potato to reduce movement ; 18. Measure the change in mass rather than angle of bend ; 19. Carry out the test for each potato piece separately ; 20. Carry out repeat or replicate and calculate the mean ;	Max 2
a viii	Take precaution when handling the knife when cutting the potato.	1
b	Independent variable : Temperature (5 different temp with regular intervals) ; Dependent variable : Angle of bend / % of mass difference ; List at least 2 Control variable : • same concentration of (sodium chloride) solution ; • volume of solution used for each replicate ; • length / volume / surface area of potato tissue ; • time taken for each potato tissue to be immersed ; Method : • describe method of maintaining the temperature described (eg. using a thermostatically regulated water bath) ; • (if measuring mass) take mass of potato tissues using an electronic balance ; • place potato tissues in equal volume of solution for equal duration ; • dry off the potato cylinder with a paper towel before taking the angle of bend / mass ; • At least two repeats for each temperature, taking the mean ;	1 1 1 1

ci	Solution : iodine solution; Positive test result : iodine solution turns from yellow / brown to blue black;	1 1																													
cii	Lines : clear, continuous, unbroken link with no shading ; Size: at least half the space provided ; Detail : double line showing cell wall + minimum of five starch grains around perimeter of cell ; Label : one starch grain labelled ;	1 1 1 1																													
ciii	*Check after printing Length of AB = ~10mm ; Actual length = $\frac{100}{800} = 0.125$ Round off to 2 sf $\rightarrow 0.013$ (0.011 – 0.014) mm ;	1 1 1																													
2ai	index finger and thumb same number of ticks (± 1) must follow trend [1] palm less sensitive than finger [0.5] wrist less sensitive than finger [0.5] <table border="1"><thead><tr><th rowspan="2">Distance between two points</th><th colspan="4">area tested</th></tr><tr><th>end of index finger</th><th>end of thumb</th><th>palm</th><th>wrist</th></tr></thead><tbody><tr><td>20</td><td>✓</td><td>✓</td><td>✓</td><td>✓/x</td></tr><tr><td>15</td><td>✓</td><td>✓</td><td>✓</td><td>x</td></tr><tr><td>10</td><td>✓</td><td>✓</td><td>✓</td><td>x</td></tr><tr><td>5</td><td>✓</td><td>✓</td><td>x</td><td>x</td></tr></tbody></table>	Distance between two points	area tested				end of index finger	end of thumb	palm	wrist	20	✓	✓	✓	✓/x	15	✓	✓	✓	x	10	✓	✓	✓	x	5	✓	✓	x	x	2
Distance between two points	area tested																														
	end of index finger	end of thumb	palm	wrist																											
20	✓	✓	✓	✓/x																											
15	✓	✓	✓	x																											
10	✓	✓	✓	x																											
5	✓	✓	x	x																											
2aii	Index finger/ thumb answer is consistent with candidate's results	1																													

2bi	1. Scale: linear scale with 0 at origin for mean minimum distance graph and at least half of grid is used [1] 2. Axes: both axes fully labelled with units on distance axis [1] 3. Plotting of data: all data correctly plotted ± 1 mm [1] 4. Graph: all drawn bars are of equal width with gaps between the bars [1] mean minimum distance detected as two points / mm <table><thead><tr><th>Body Part</th><th>Mean minimum distance detected (mm)</th></tr></thead><tbody><tr><td>index finger</td><td>2</td></tr><tr><td>palm</td><td>13</td></tr><tr><td>forearm</td><td>32</td></tr><tr><td>upper arm</td><td>38</td></tr><tr><td>shoulder</td><td>42</td></tr></tbody></table>	Body Part	Mean minimum distance detected (mm)	index finger	2	palm	13	forearm	32	upper arm	38	shoulder	42	4
Body Part	Mean minimum distance detected (mm)													
index finger	2													
palm	13													
forearm	32													
upper arm	38													
shoulder	42													
2bii	to make results more reliable / improve reliability [1] if student mentions accuracy, mark will not be awarded.	1												
2biii	prevent seeing / knowing how many points being tested [1] so that touch is the only sense being tested [1]	Max 1												
2biv	ensure same area of each section of arm / shoulder tested [1] same pressure / force exerted on skin / time points in contact with skin [1] toothpicks of equal sharpness / same surface area [1]	Max 1												

2bv	different areas of skin have <u>different numbers of receptors</u> [1] (touch) receptors <u>closer together</u> in more sensitive areas / hands [1] fingers / hand involved in manipulating / handling objects [1] reject: - different number of sensory neurone, - different thickness of skin (receptors are in all layers of skin – epidermis, dermis to differentiate light vs deep pressure)	2
-----	---	---