Name: ..... Index No.: ..... Class: .....

Bukit Batok Secondary School

GCE 'O' LEVEL PRELIMINARY EXAMINATIONS 2022

SECONDARY FOUR EXPRESS

BIOLOGY
Paper 1 Multiple Choice

6093/01
29 August 2022
1105 – 1205h
1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, index number and class on the Answer Sheet in the spaces provided.

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 **soft pencil** on the separate Answer Sheet.

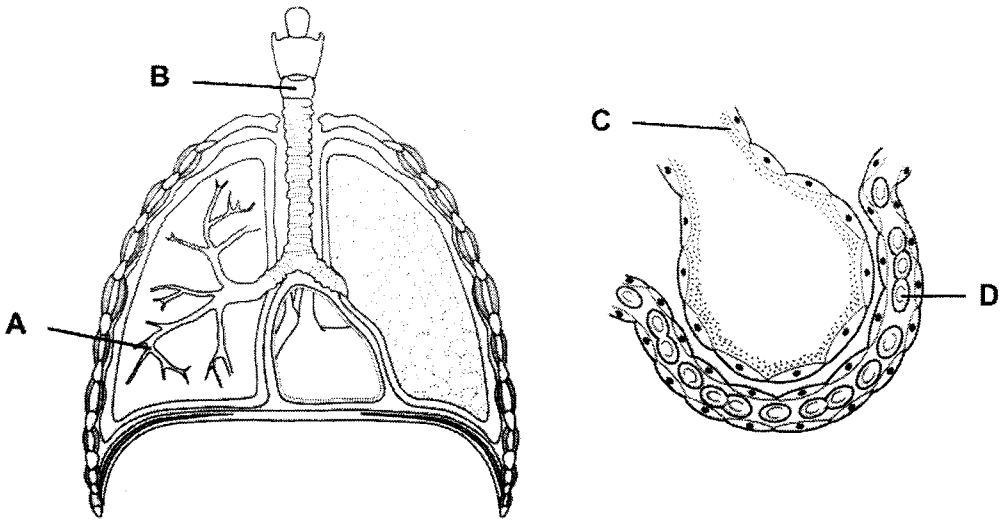
Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

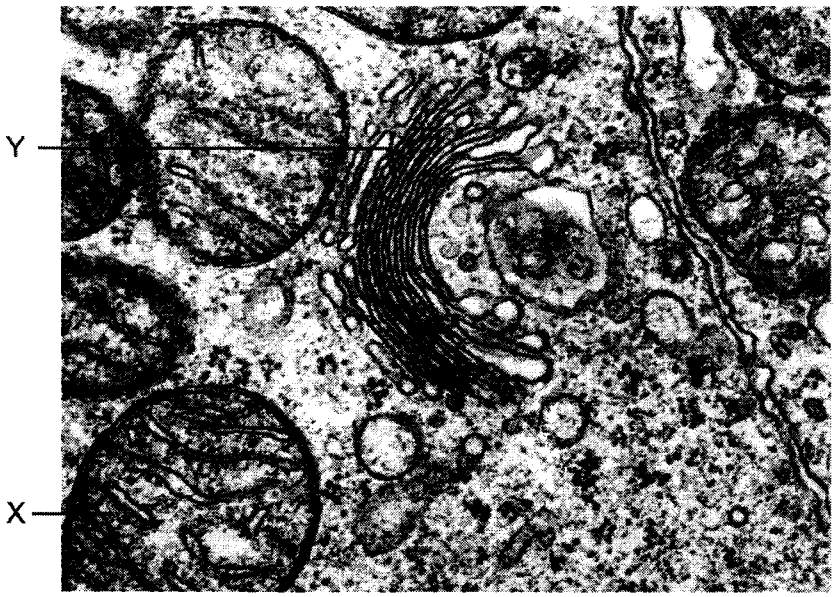
This document consists of **20** printed pages.

1 The diagram shows the breathing system and a section of an alveolus surrounded by a capillary.

Which structure is a cell?



2 The diagram shows an electron micrograph of the internal structures of an animal cell.



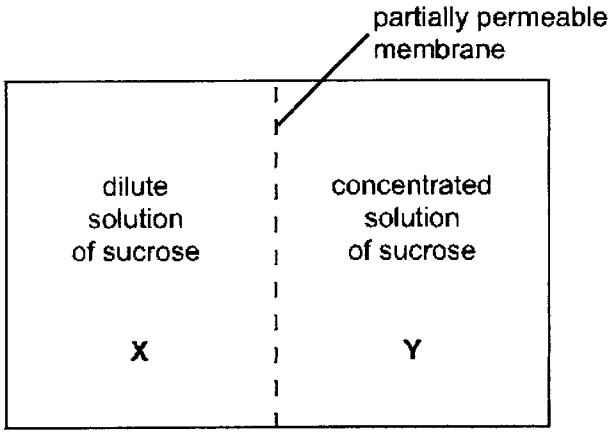
What are organelles X and Y?

	X	Y
A	nucleus	smooth endoplasmic reticulum
B	nucleus	Golgi apparatus
C	mitochondrion	smooth endoplasmic reticulum
D	mitochondrion	Golgi apparatus

2

Applying past knowledge to new situations

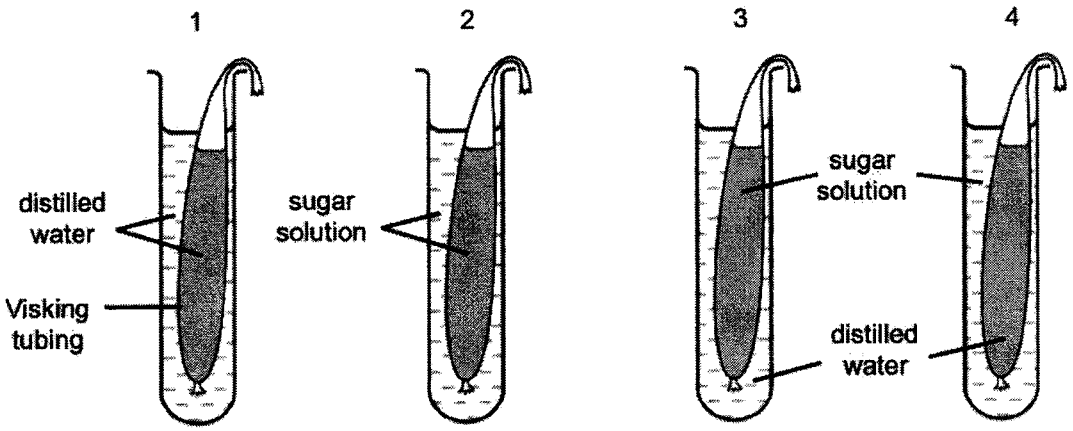
3 The diagram shows two solutions that are separated by a partially permeable membrane.



In which direction will the water and sucrose molecules move?

	water molecules	sucrose molecules
A	from X to Y against their water potential gradient	from Y to X down their concentration gradient
B	from X to Y down their water potential gradient	stays within X and Y respectively
C	from Y to X against their water potential gradient	from X to Y down their concentration gradient
D	from Y to X down their water potential gradient	stays within X and Y respectively

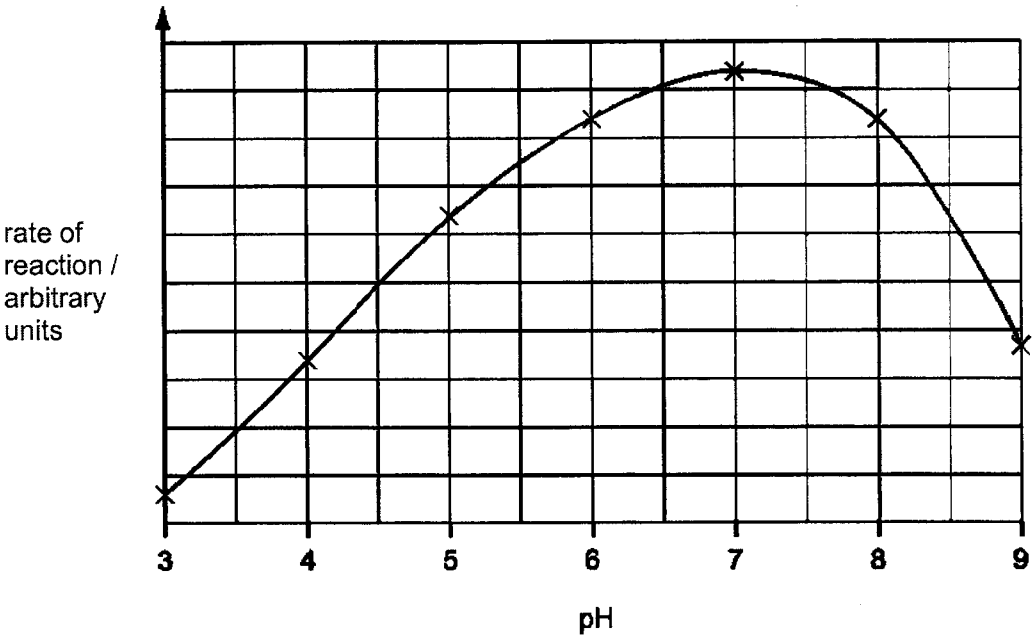
4 The diagram shows the apparatus used in an experiment on osmosis.



In which tubes will osmosis take place?

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

5 The graph shows the effect of pH on the rate of reaction of an enzyme.



What does the graph show?

A The enzyme is denatured completely at pH 9.

B The enzyme works best at pH 6.

C The rate of reaction halves as the pH changes from pH 5 to pH 7.

D The rate of reaction is the same at pH 5 and pH 8.5.

4

Applying past knowledge to new situations

6 The table below shows the contents in five test-tubes. They are left for eight hours and then tested for amino acids.

tube	contents	results of test for amino acids
1	protein + pepsin	traces
2	protein + pepsin + alkali	absent
3	protein + distilled water	absent
4	protein + pepsin + acid	large amounts
5	protein + boiled pepsin + acid	absent

Which tubes show that pepsin is an enzyme?

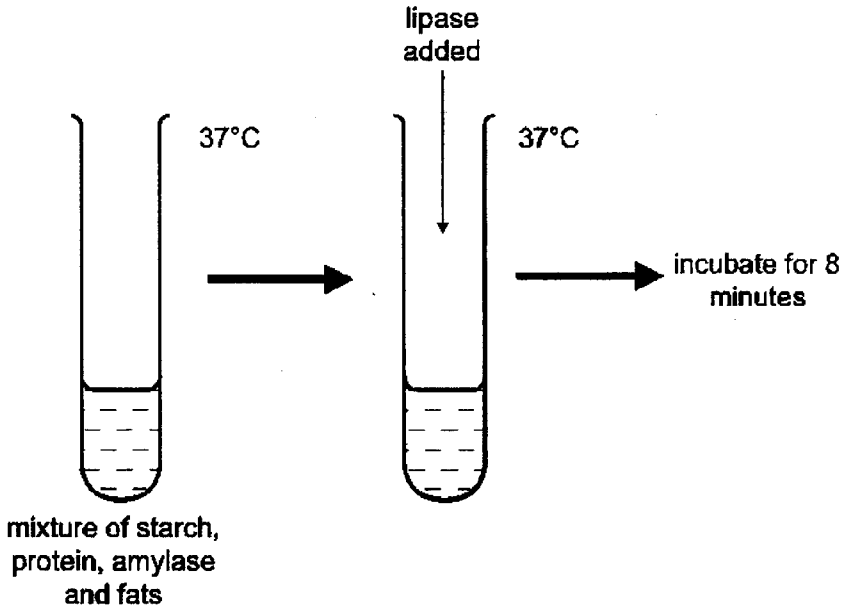
A 1 and 5

B 2 and 3

C 2 and 4

D 4 and 5

7 The diagram shows an experiment to investigate the effects of enzymes.



What will be in the test-tube after the incubation?

I : fatty acids
II : glucose
III : glycerol
IV : maltose
V : protein

A I and II

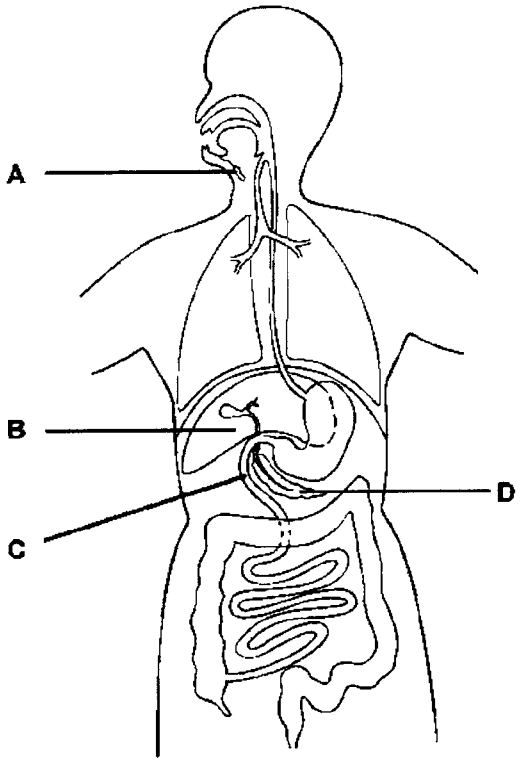
B I, II, III and V

C I, II, IV and V

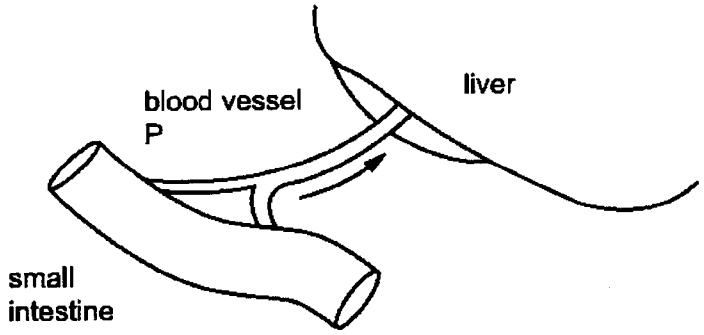
D I, III, IV and V

8 The diagram shows the human alimentary canal.

Which structure does **not** secrete digestive enzymes?



9 The diagram shows blood vessel P which carries digested food from the small intestine to the liver.



Which of the following describes the level of glucose in blood vessel P and the level of glycogen in the liver, a few hours after a large meal containing carbohydrates?

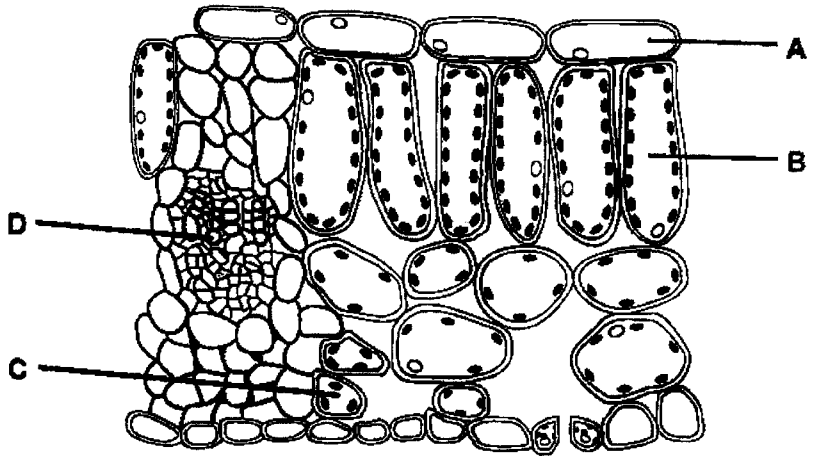
	glucose in blood vessel P	glycogen in liver
A	high	decreasing
B	high	increasing
C	low	decreasing
D	low	increasing

7

Applying past knowledge to new situations

10 The diagram shows a section through a leaf, seen under the microscope.

In which part is the carbon dioxide concentration lowest on a warm sunny day?



11 Which chemical change takes place in green plants but **not** in animals?

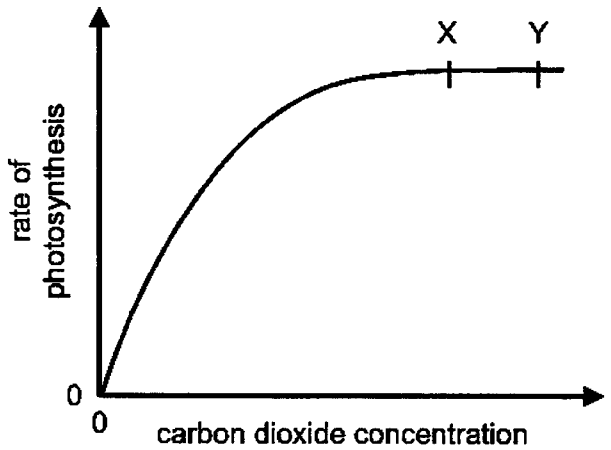
A glucose → cellulose

B glucose → glycogen

C glycogen → glucose

D glycogen → cellulose

12 The graph shows the effect of varying carbon dioxide concentration on the rate of photosynthesis.



Which environmental factor could be limiting the rate of photosynthesis between points X and Y?

A carbon dioxide concentration and light intensity only

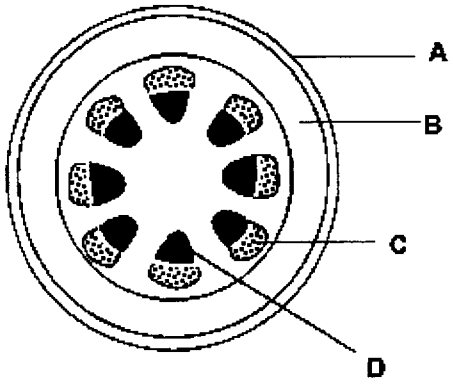
B carbon dioxide concentration and temperature only

C carbon dioxide concentration, light intensity and temperature

D light intensity and temperature only

13 The photomicrograph shows a section of a young stem.

Which labelled cells do **not** respire?



14 The table shows some characteristics of four different plants.

The plants are growing in the same environmental conditions.

Given that all the factors below are equally important in the determination of the rate of transpiration, which plant will have the highest rate of transpiration?

	number of leaves on plant	average surface area of one leaf / cm^2	average density of stomata on leaves / cm^{-2}
A	12	44	253
B	25	18	256
C	25	52	280
D	36	45	167

15 A green plant was exposed to light and air containing radioactive carbon (^{14}C) for 30 minutes.

Which region would radioactivity be detected after 1 hour?

A intercellular air space

B phloem

C stomata

D xylem

16 The table below shows the outcome of an investigation on the uptake of bromide ions by a plant.

time from the start of experiment / min	amount of bromide ions taken up by plant tissue under the following conditions / arbitrary units		
	sugar absent, oxygen present	sugar present, oxygen absent	sugar and oxygen present
0	0	0	0
30	0	30	100
60	0	50	150
90	0	70	180
120	0	70	200

These results show that the uptake of bromide ions

A is via active transport only.

B is via diffusion only.

C occurs during aerobic respiration only.

D stops in the absence of oxygen.

17 Which of the following is **not** the cause of coronary heart disease?

A family history

B low fibre diet

C sedentary lifestyle

D tobacco smoke

18 Red blood cells were donated to a recipient with blood group B.

Which statement is accurate?

A the donated blood cannot be of blood group A as the donated blood cells have antigen A

B the donated blood cannot be of blood group A as the donated blood have antibodies a

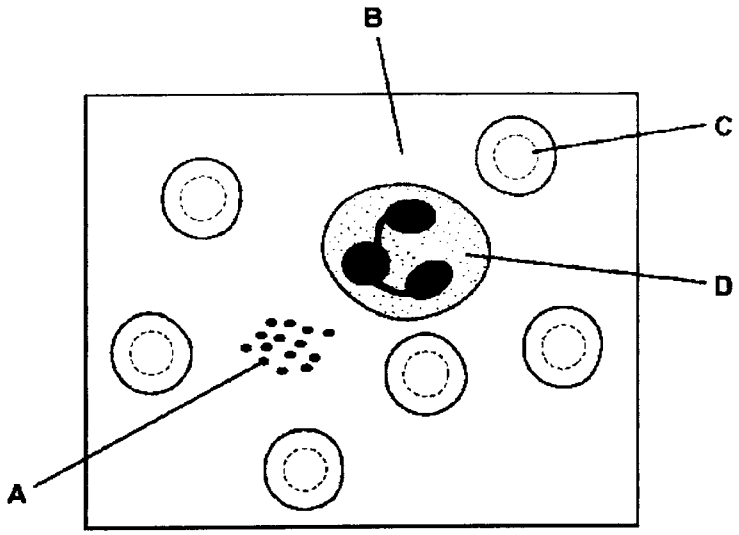
C the donated blood cannot be of blood group AB as the donated blood cells have antigen B

D the donated blood cannot be of blood group AB as the donated blood have antibodies b

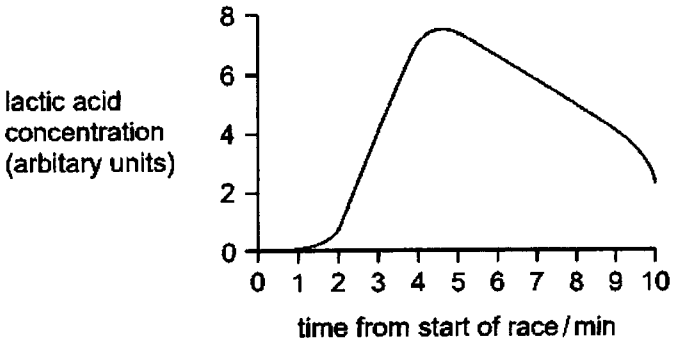
19 The diagram shows human blood, as seen under a microscope.

A person was found to be easily breathless, and panting when climbing up a short flight of stairs.

Which component is most likely to be responsible for the phenomenon above?



20 An athlete runs a race. The graph shows how the concentration of lactic acid in his leg muscles changes.



How long did the athlete run?

A 2 minutes

B 4 minutes

C 6 minutes

D 10 minutes

21 What happens to the diaphragm and the internal intercostal muscle during inhalation?

	diaphragm	internal intercostal muscle
A	contract	relax
B	contract	contract
C	relax	relax
D	relax	contract

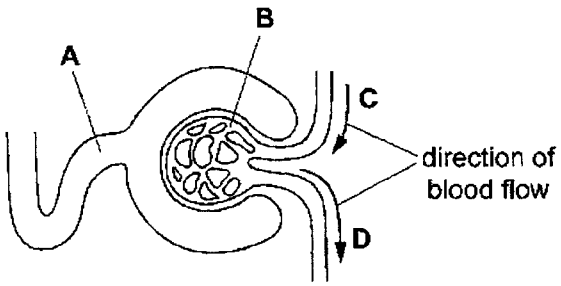
22 When a mother smokes during pregnancy, the oxygen supply to the fetus is reduced.

Which row correctly describes how the components of tobacco smoke cause this reduction?

	combines with haemoglobin	constricts blood vessels in umbilical cord
A	carbon monoxide	nicotine
B	carbon monoxide	tar
C	tar	carbon monoxide
D	tar	nicotine

23 The diagram shows the first part of a kidney tubule and its blood supply.

Which part contains the highest concentration of protein?



24 Four processes that take place in the human body are listed below:

I absorption of amino acids through villi
II maintenance of constant body temperature
III production of lactic acid in muscles
IV regulation of blood glucose concentration

Which two processes are controlled directly by negative feedback?

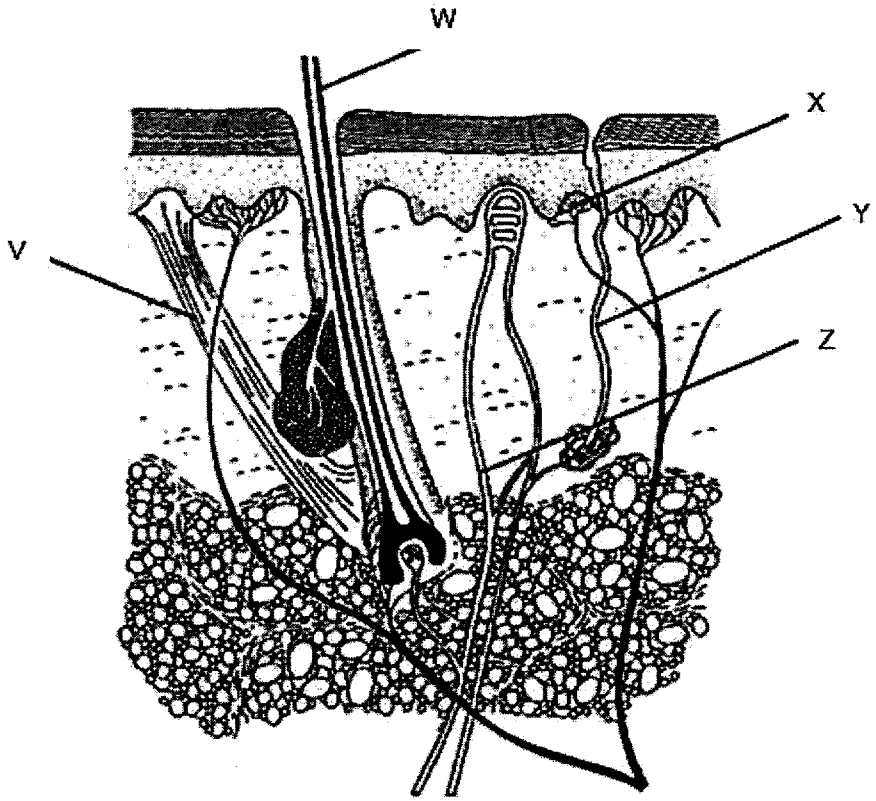
A I and III

B I and IV

C II and III

D II and IV

25 The diagram shows the internal structures of the human skin.



What would occur in the skin if the person moves from an air-conditioned room to a sunny beach?

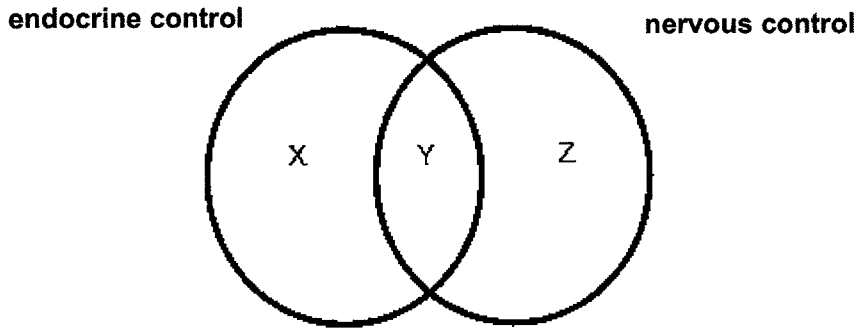
A contraction of V and Z

B detection of temperature change by W and relaxation of Z

C detection of temperature change by X and decrease flow of fluid in Y

D increased flow of fluid in Y and relaxation of V

26 The comparison between an endocrine control and a nervous control can be illustrated using the following Venn diagram.



Which of the following fits into the regions X, Y and Z?

	X	Y	Z
A	a method of coordination within the body	always voluntary	may be voluntary or involuntary
B	always involuntary	a method of coordination within the body	may be voluntary or involuntary
C	always involuntary	always voluntary	a method of coordination within the body
D	may be voluntary or involuntary	a method of coordination within the body	always voluntary

27 A volunteer was asked to play an intense computer game. His body responses after 30 minutes are listed.

1 increased blood glucose concentration
2 increased breathing rate
3 dilated pupils
4 increased perspiration

Which of the following hormones is responsible for the above responses?

A adrenaline

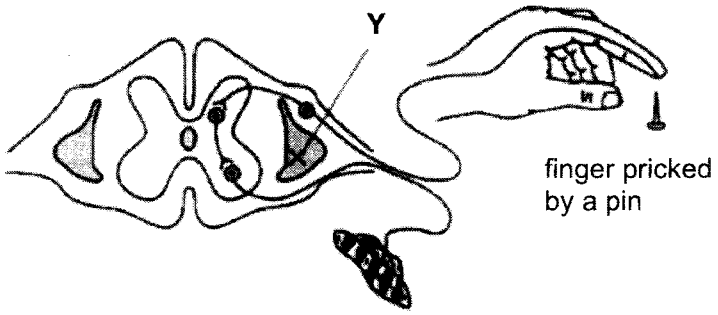
B anti-diuretic hormone

C glucagon

D insulin

28 The finger is accidentally pricked by a pin.

The diagram shows part of the nervous system, including a reflex arc, which has been damaged along the line XY.

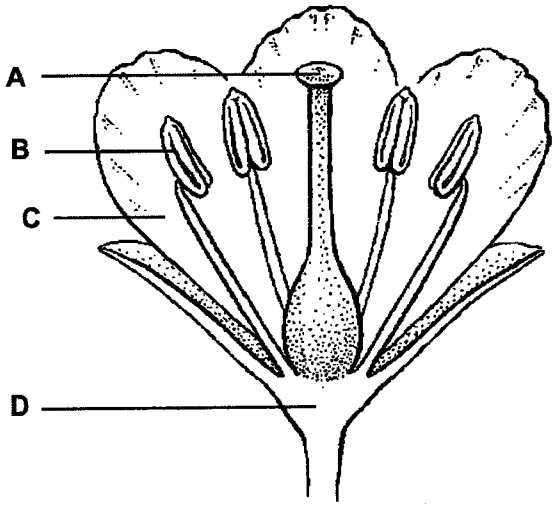


What are the effects of this pin prick?

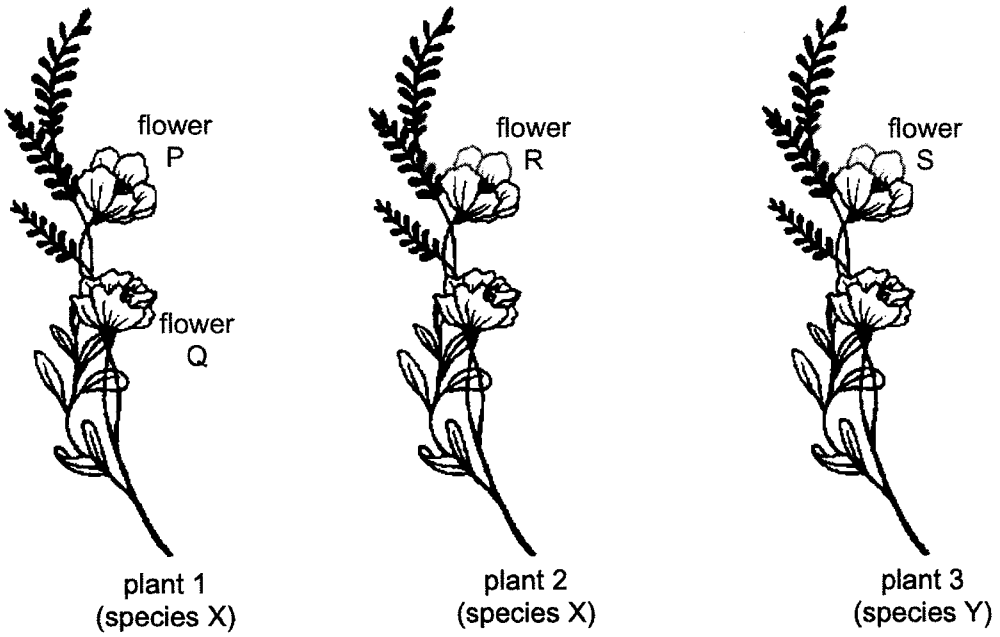
	pain felt	arm moved
A	no	no
B	no	yes
C	yes	no
D	yes	yes

29 The diagram shows a section through a flower.

Which labelled part contains gametes?



30 The diagram shows three separate flowering plants.



Which of the following is **not** an example of cross-pollination?

A pollen from flower Q landing on stigma of flower R

B pollen from flower R landing on stigma of flower Q

C pollen from flower R landing on stigma of flower P

D pollen from flower S landing on stigma of flower P

31 Which of the following statements about the human immunodeficiency virus (HIV) is true?

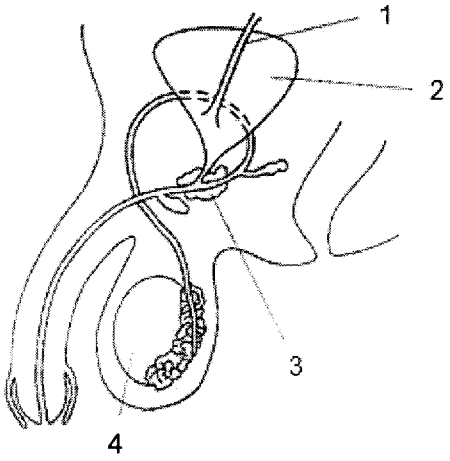
A Avoiding direct skin contact with an infected person prevents further spread of the HIV.

B Only adults can be infected by the HIV.

C The HIV attacks white blood cells in the human body.

D The HIV is transmitted from one person to another through sexual intercourse only.

32 The diagram shows the male reproductive and urinary systems.



Which two structures are involved in producing semen?

A 1 and 2

B 2 and 3

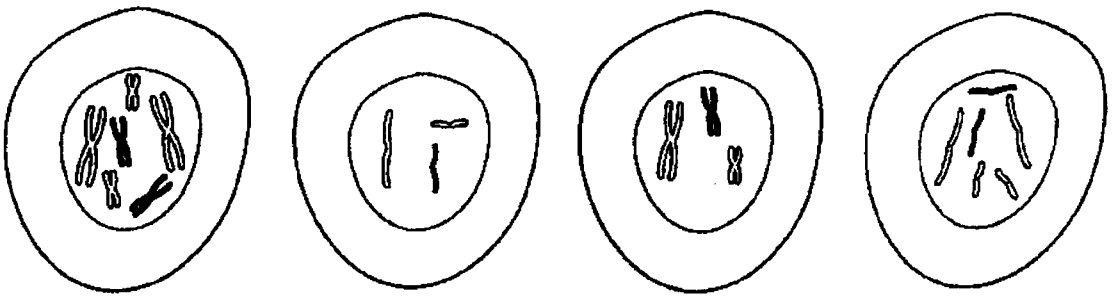
C 2 and 4

D 3 and 4

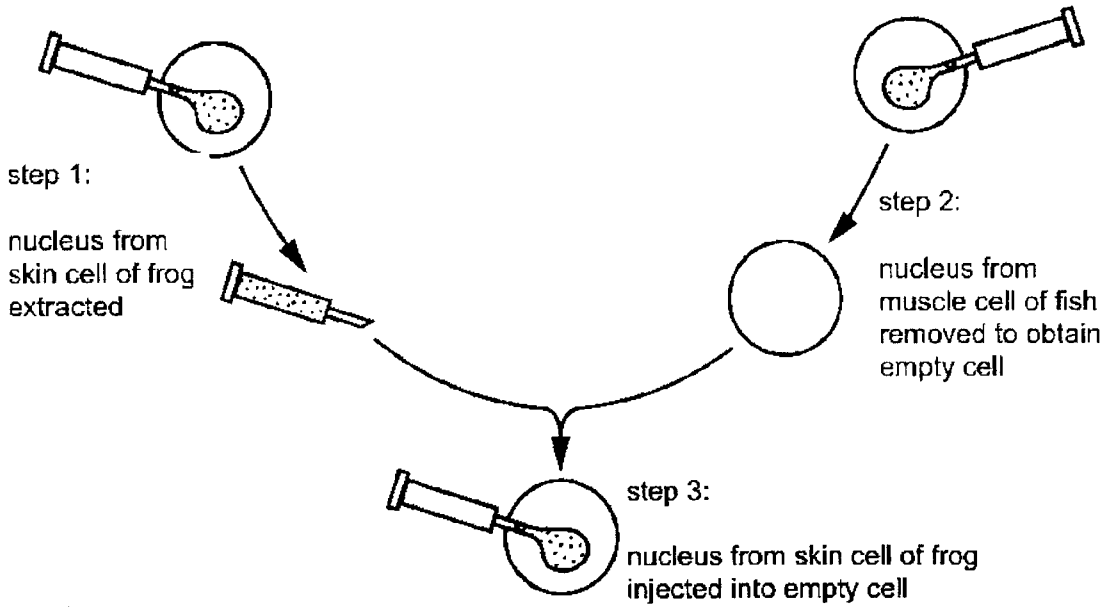
33 A cell containing three pairs of chromosomes divides by meiosis.

Which diagram shows one of the daughter cells after telophase I?

A **B** **C** **D**



34 The diagram shows a process carried out by a scientist in a lab.



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 statement about a gene is correct?

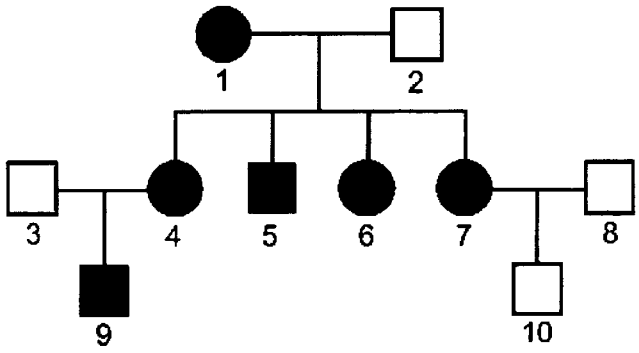
A It codes for a polypeptide.

B It is bigger in size than a DNA molecule.

C It is made up of a sequence of alleles.

D It is made up of a base with sugar and phosphate group.

36 Phenylketonuria (PKU) is a condition caused by a recessive allele.
The following pedigree shows the inheritance of phenylketonuria in a family. Black circle or square indicates individuals who suffer from phenylketonuria.



Which individual are heterozygous for the trait?

A individuals 2 and 10

B individuals 3 and 8

C individuals 2, 3 and 10

D individuals 3, 8 and 10

37 The diagram below shows the chromosomes in the cell of an individual.

Which of the following conclusions about this individual is correct?

A The individual is a normal male.

B The individual is a normal female.

C The individual is a male with Down Syndrome.

D The individual is a female with Down Syndrome.

38 Many frog species inhabiting tropical rainforests have evolved green skin colour.

Which of the following is most likely the main selection pressure leading to the evolution of green skin in frogs?

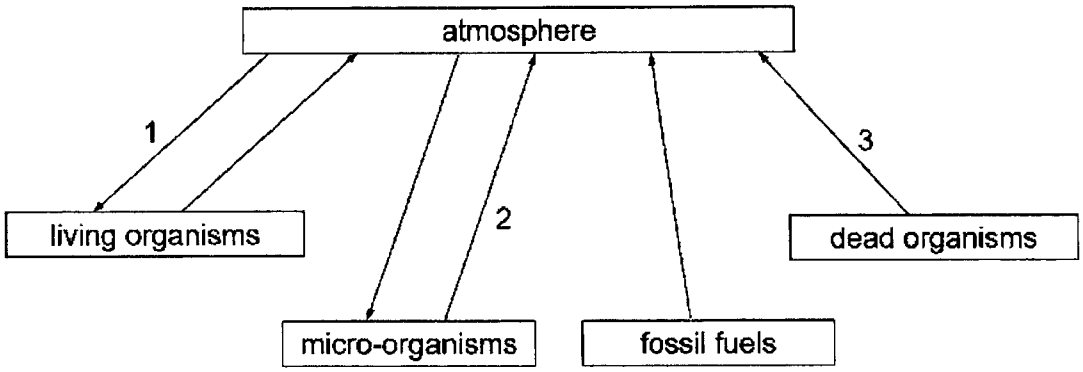
A climate

B infection by disease

C predation

D type of food available

39 The diagram below shows part of the carbon cycle.



Which of the following correctly identifies processes 1, 2 and 3?

	1	2	3
A	feeding	decomposition	combustion
B	feeding	respiration	combustion
C	photosynthesis	decomposition	respiration
D	photosynthesis	respiration	decomposition

40 Different types of bacteria are used in sewage treatment plants.

Which of the following processes involve anaerobic bacteria?

	breakdown of organic molecules	production of methane	production of carbon dioxide and water
A	✓	✓	✗
B	✓	✗	✓
C	✗	✗	✓
D	✗	✓	✓

End of paper

Name: ..... Index No. ..... Class: 4A.....

Bukit Batok Secondary School

GCE 'O' LEVEL PRELIMINARY EXAMINATIONS 2022

SECONDARY FOUR EXPRESS

BIOLOGY **6093/02**

Paper 2 **29 August 2022**

0820 – 1005

1 hour 45 minutes

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces provided at the top of this page.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

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

Section B
Answer **all** the questions, the last question is in the form either/or.
Write your answers in the spaces provided on the Question Paper.

Electronic calculators may be used.

You are advised to spend no longer than one hour on Section A and no longer than 45 minutes on Section B.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
8	
9	
10 E / O	
Total	

This document consists of 17 printed pages.

SECTION A [50 marks]

Answer **ALL** questions. Write your answers in the spaces provided.

1 Fig. 1.1 shows an *Amoeba proteus*, a unicellular organism that lives in fresh water. It has contractile vacuoles that help to regulate the water potential in the cell by expelling excess water from its cytoplasm.

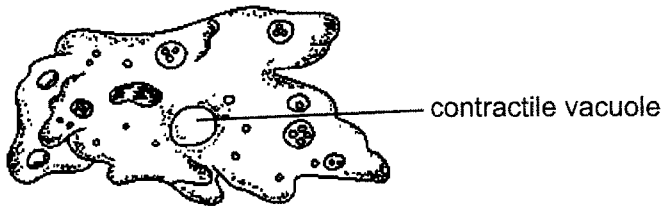


Fig. 1.1

The amoeba was placed in salt solutions of different concentrations and the average number of contractions it made was recorded. Table 1.1 shows the recorded data.

Table 1.1

concentration of salt solution / mol dm^{-3}	0.00	0.20	0.50	0.70
average number of contractions per minute	112	101	69	53

(a) With reference to Table 1.1, describe the relationship between the concentration of the solution the *Amoeba proteus* is in and the number of contractions it makes.

.....

.....

..... [2]

(b) Explain the trend in the results in Table 1.1.

.....

.....

.....

.....

..... [4]

[Total: 6]

Applying past knowledge to new situations 2

2 Fig. 2.1 shows the percentage of undigested starch molecules passing through the alimentary canal.

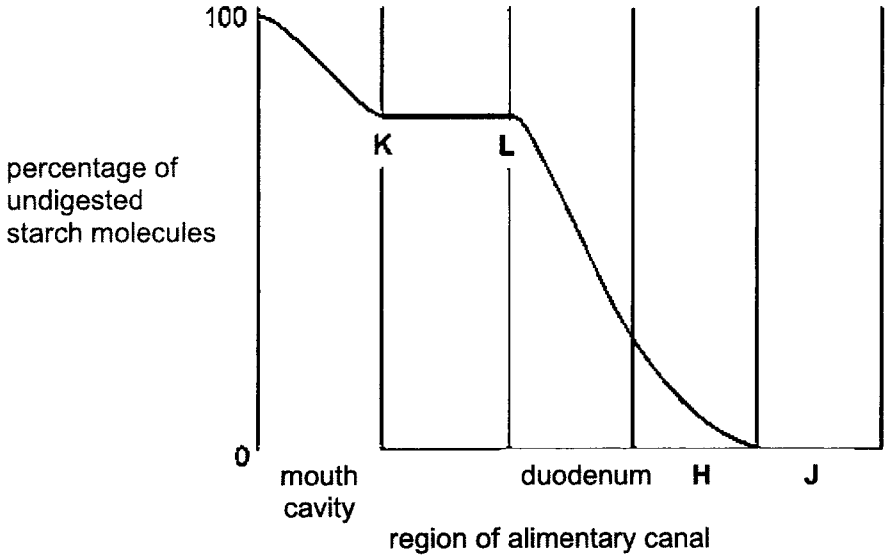


Fig. 2.1

(a) Name the parts of the alimentary canal labelled **H** and **J**.

H: ..... **J:** ..... [2]

(b) State and explain what happens to the digestion of starch between **K** and **L**.

.....

.....

.....

..... [3]

(c) Explain why the curve is not shown extending into region **J** of Fig. 2.1.

.....

.....

..... [2]

[Total: 7]

3 **(a)** Fig. 3.1 shows the flow of blood through a frog's heart. The frog's heart has three chambers.

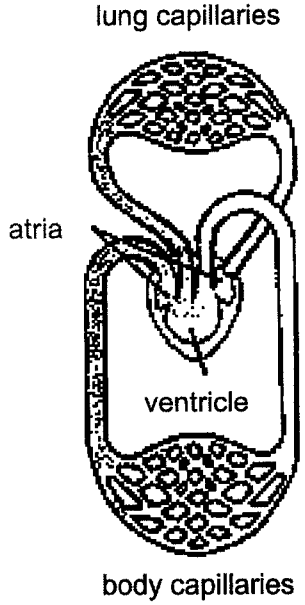


Fig. 3.1

(i) State the structure that is present in a human heart but absent in the frog's heart.

..... [1]

(ii) Explain a possible negative effect of having only one ventricle instead of two.

.....

.....

.....

..... [2]

(b) Fig. 3.2 shows the pressure changes in the left atrium, left ventricle and the aorta during a single heartbeat of a human heart.

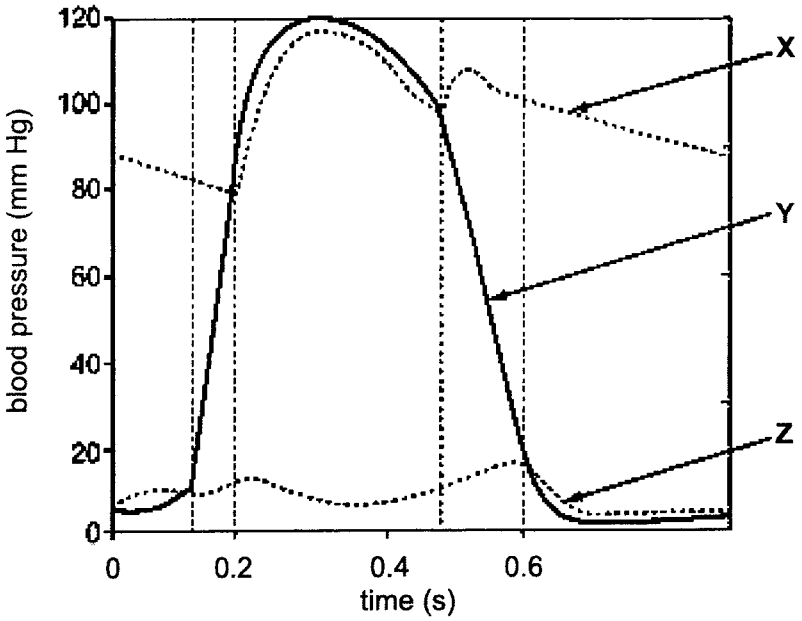


Fig. 3.2

(i) State the letters, **X**, **Y** or **Z**, which show the pressure changes in the

left atrium: .....

left ventricle: ..... [2]

(ii) Explain how ventricular systole causes these valves to open or close at 0.2 s of the cardiac cycle.

.....

.....

..... [2]

(c) Dynamic cardiomyoplasty is a surgical method that aims to improve cardiac function for patients with chronic heart failure. Skeletal muscle tissue from the patient's back are taken and wrapped around cardiac muscle tissue as shown in Fig. 3.3. Aided with a device, the grafted skeletal muscle tissue can contract together with the cardiac muscles.

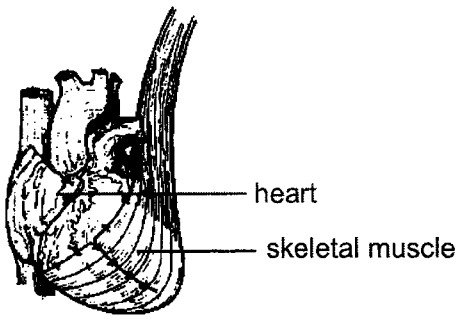


Fig. 3.3

However, skeletal muscle cells are structurally different from cardiac muscle cells. Hence the grafted skeletal muscle tends to be less effective and may even malfunction after awhile.

Suggest and explain why this tendency is there.

.....

.....

..... [2]

[Total: 9]

4 Dilating eye drops are often used on patients by doctors before an eye examination. These eye drops enlarge the pupils and keep them from getting smaller when the doctor shines light into the eye. These eye drops act as a muscle relaxant. The patient may experience blurred vision and may be asked to wear protective sunglasses when out under the sun for a few hours after the examination.

(a) Explain why it is important for the patient to wear sunglasses after leaving the clinic.

.....

.....

.....

..... [3]

(b) Suggest why the patient may experience blurred vision for a few hours after application of the eye drops.

.....

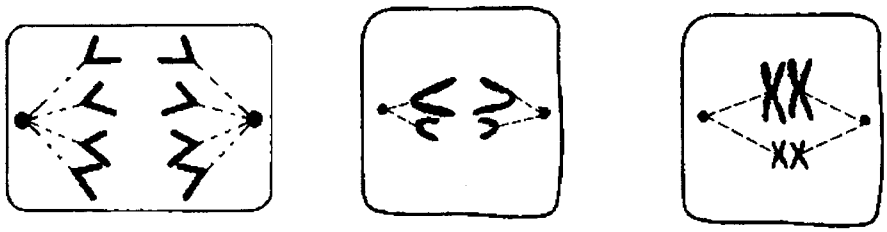
.....

.....

..... [3]

[Total: 6]

5 **(a)** Fig. 5.1 shows cells **A**, **B** and **C** of an organism at different stages of two different types of cell divisions.



A **B** **C**

Fig. 5.1

(i) Identify the stages in cells **A** and **B**.

A: .....

B: ..... [2]

(ii) State the importance of the type of cell division shown in cell **C**.

.....

.....

.....

..... [2]

(b) Fig. 5.2 shows the relative amounts of DNA per cell during two successive cell divisions in an animal.

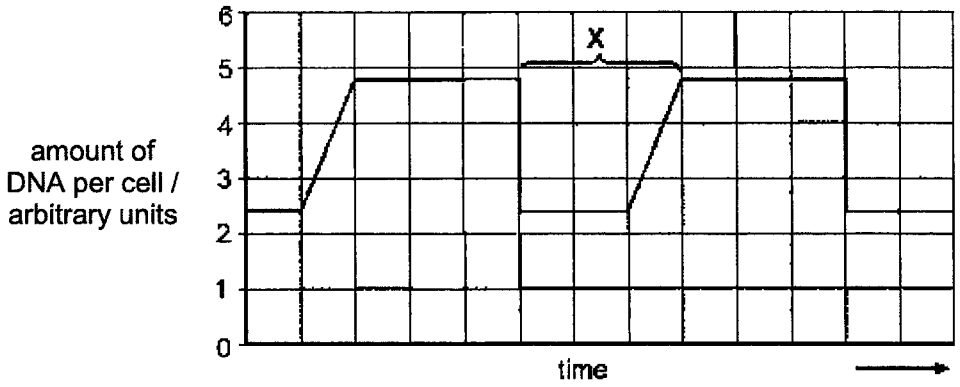


Fig. 5.2

State the phase of the cell cycle at **X**. Explain your answer with reference to Fig. 5.2.

.....

.....

..... [2]

[Total: 8]

6 **(a)** Tay-Sachs disease (TSD) is a rare, inherited genetic disorder that results in a build-up of toxic levels in the brain and spinal cord that could affect the function of nerve cells. A person with two copies of the TSD allele is said to suffer from TSD. This allele is recessive and is caused by a genetic mutation.

(i) Two people who are carriers of TSD got married and have children.

Use '**T**' to represent the dominant allele and '**t**' to represent the recessive allele to construct the genetic diagram.

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

[3]

(ii) Define *gene mutation* and state a possible cause of it.

.....

..... [2]

(b) Another example of genetic mutation is hemochromatosis that cause a buildup of toxic concentrations of iron that may lead to liver disease, heart problems and diabetes.

Fig. 6.1 shows a family tree for the condition. Individual 2 is known to be homozygous for hemochromatosis.

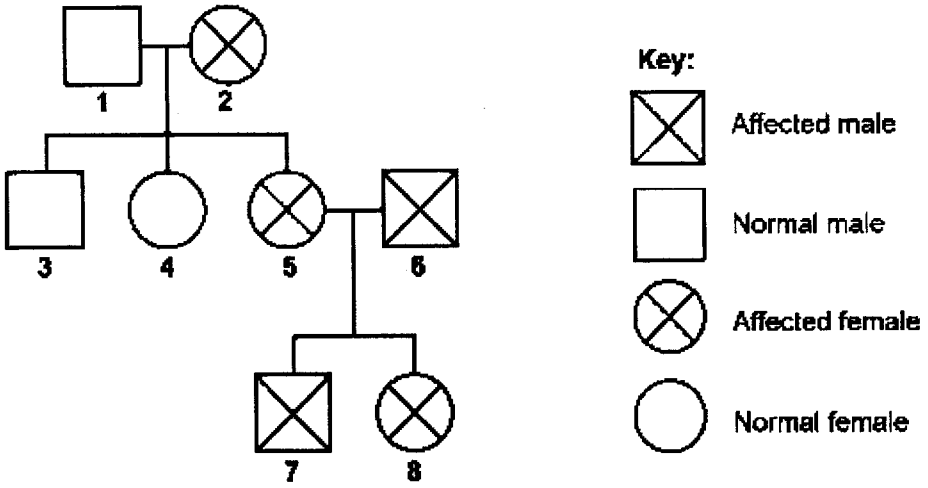


Fig. 6.1

With reference to Fig. 6.1, state and explain whether the condition is caused by the dominant or recessive allele.

.....

.....

.....

..... [3]

[Total: 8]

7 Fig. 7.1 shows changes in the thickness of the uterine lining and the concentration of two hormones **X** and **Y**.

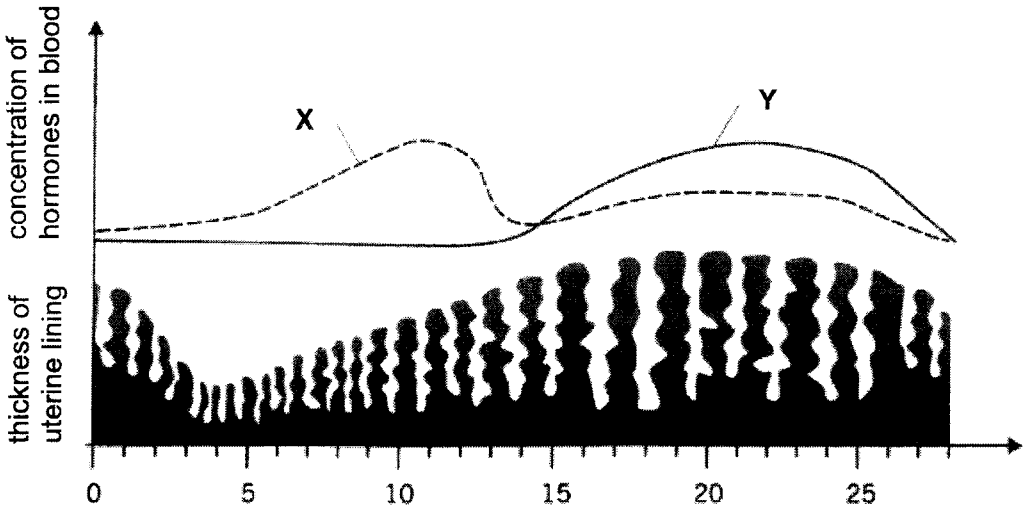


Fig. 7. 1

(a) Identify the two hormones **X** and **Y**.

X: ..... **Y**: ..... [2]

(b) With reference to Fig. 7.1, suggest the role of hormone **X** in the woman's menstrual cycle.

..... [1]

(c) With reference to Fig. 7.1, suggest a range of days when a successful implantation of an embryo will take place.
Explain your answer.

.....

.....

..... [3]

(d) Chemicals that resemble hormones **X** and **Y** are used in the manufacture of contraceptive pills.

Suggest how these pills prevent conception.

.....

.....

..... [2]

[Total: 8]

SECTION B

Answer **three** questions.
Question 10 is in the form of an **Either /Or** question.
Only one part should be answered.

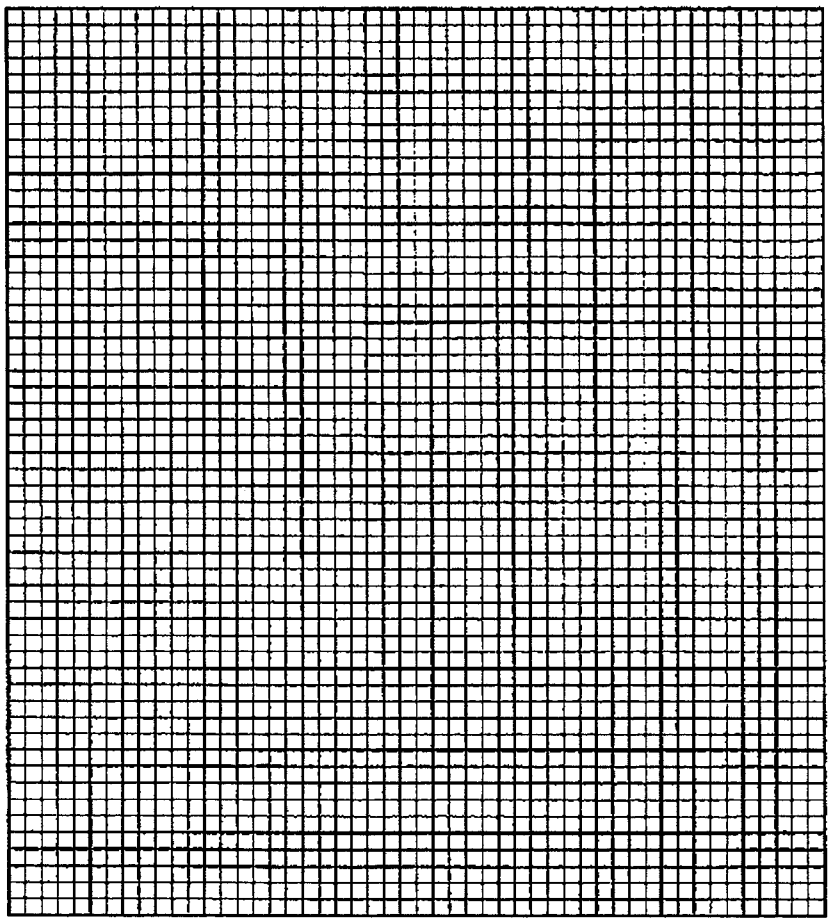
8 Daily insulin injections have been a standard treatment for most patients suffering from type 1 diabetes mellitus. However, repeated injections in the same body area may lead to some scarring and other undesired side effects. Researchers have recently developed a new way of administering insulin – via a nasal spray. Through inhalation of the spray, insulin is directly absorbed into the bloodstream by the lungs.

Table 8.1 shows the changes in blood glucose concentration for two diabetic patients, one of whom received inhaled insulin while the other received injected insulin.

Table 8.1

time after treatment (h)	0	1	2	3	4	5	6	7
blood glucose concentration with inhaled insulin (arbitrary units)	35	15	8	6	7	11	16	22
blood glucose concentration with injected insulin (arbitrary units)	35	24	17	11	6	7	9	11

(a) Using data from Table 8.1, plot the changes in blood glucose concentration for inhaled insulin and injected insulin treatment.



[4]

(b) With reference to Table 8.1 and the graphs plotted in **(a)**, compare the differences in blood glucose concentration between patients undergoing inhalation and injection treatments.

.....

.....

..... [2]

(c) Type 1 diabetic patients receiving injection treatment are required to reduce the quantity of insulin injected if they plan to engage in vigorous exercise a few hours after their meal to avoid having hypoglycaemia, where the blood glucose level falls to very low levels.

Explain why the reduction of the amount of insulin injected helps avoid hypoglycaemia.

.....

.....

..... [2]

(d) Using data from Table 8.1, explain why the risk of hypoglycaemia is higher among patients receiving inhaled insulin as compared to injected insulin if they engaged in vigorous exercise an hour after they received the treatment.

.....

.....

..... [2]

[Total: 10]

9 **(a)** Fig. 9.1 and Fig. 9.2 show a nephron of a common house rat and a kangaroo rat (drawn to scale), an animal found in dry and hot regions such as a desert.

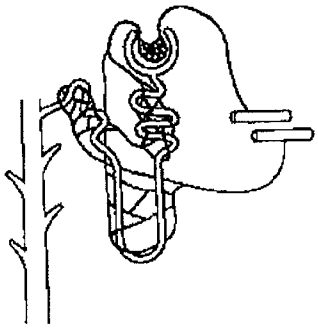


Fig. 9.1

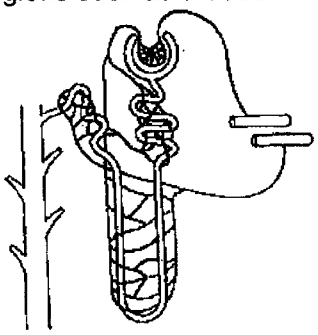


Fig. 9.2

With reference to Fig. 9.1 and 9.2, explain why the kangaroo rat is able to survive in a desert but not a common house rat.

.....

.....

.....

.....

..... [4]

(b) Compare the similarities and differences between a kidney and a dialysis machine performing the same function.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [6]

[Total: 10]

10 EITHER

(a) Explain the effect of light intensity on the rate of transpiration.

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

(b) Discuss the advantages and disadvantages of wilting.

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

[Total: 10]

10 OR

Fig. 10.1 shows a pyramid of numbers for a food chain in the sea.

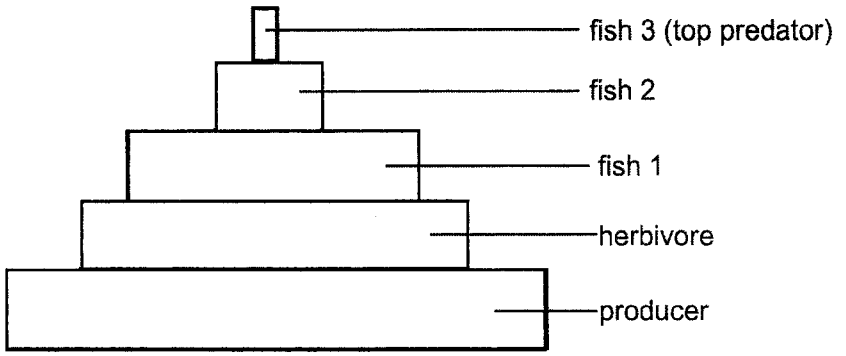


Fig. 10.1

(a) Sea fishing often removes the top predator fish.

Describe and explain the effects of removing the top predator fish through overfishing.

.....

.....

.....

.....

.....

..... [4]

(b) Describe how seas play a role as carbon sinks.

.....

.....

.....

..... [2]

(c) Suggest how we can continue to fish but also maintain the biodiversity in the sea.

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 10]

~ END OF PAPER ~

BBSS Biology Prelim P1 2022

MARKING SCHEME

Paper 1 [40 marks]

1	D	6	D	11	A	16	A
2	C	7	D	12	D	17	B
3	B	8	B	13	D	18	A
4	D	9	B	14	C	19	C
5	D	10	B	15	B	20	B

21	A	26	B	31	C	36	C
22	A	27	A	32	D	37	C
23	D	28	A	33	C	38	C
24	D	29	B	34	D	39	D
25	D	30	D	35	A	40	B

2022 4E Bio 6093 Prelims P2

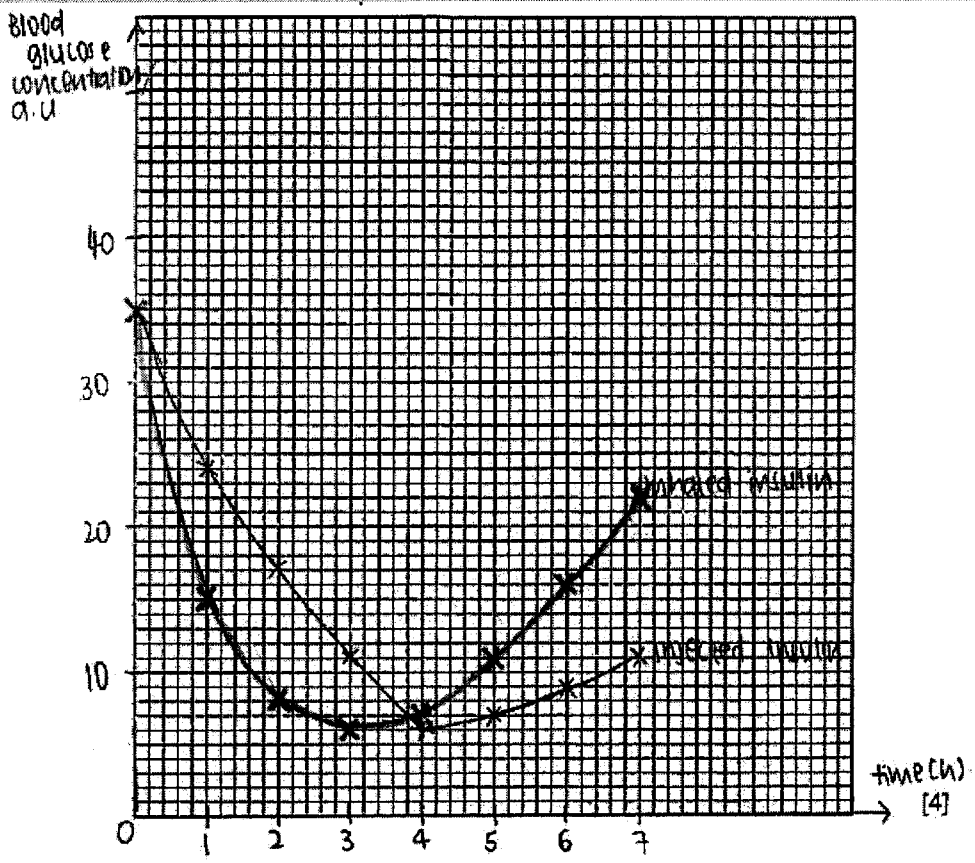
AW alternative wording
A accept
R reject

Qn	Section A: Answer [Marks]	Marks
1a	As the concentration of salt solution increase from 0 to 0.70 mol dm^{-3}, the average number of contractions decrease from 112 to 53 contractions per minute. *Relationship + data quote*	2
1b	• At low salt concentrations of 0 or 0.2 mol dm^{-3}, the water potential of the amoeba is lower than the solution it is placed in. A lot of water enters amoeba via osmosis • and it needs more contractions to pump the excess water out. • At higher salt concentrations of 0.5 or 0.7 mol dm^{-3}, the water potential of the amoeba is now similar to the solution it is placed in / smaller water potential gradient. Lesser water enters amoeba via osmosis. • Hence it needs less contractions to pump excess water out	4
2a	H: Ileum [R: small intestine] J: large intestine / colon	2
2b	• No digestion of starch occurs between K and L / percentage of undigested starch remains the same • No amylase is produced/present in stomach. • Salivary amylase from the mouth cavity is denatured in acidic pH in the stomach and stops working	3
2c	• All starch molecules have been digested • Digested nutrients (glucose) absorbed into the bloodstream	2
3ai	Septum	1
3aii	• Mixing of oxygenated and deoxygenated blood • resulting in less oxygen transported through the body *or* • Pressure of blood transporting to the rest of the body is lower • Resulting in inefficient transport of nutrients and waste *or* • Pressure of blood entering the lungs is higher; • Hence exchange of substance is not as efficient as the flow rate is higher due to pressure	2

3bi	Left atrium: Z Left ventricle: Y	2
3bii	• Blood pressure in ventricle higher than atrium → causing bicuspid valve to be closed • Blood pressure in ventricle higher than aorta → causing aortic / semi-lunar valve to be opened	2
3c	• The grafted skeletal muscle cells have less/insufficient mitochondria • To release sufficient energy to perform at the same rate as the cardiac muscles. → hence less effective	2

4a	• Light intensity increases significantly after the patient leaves the clinic and goes under the sun. • Since the iris muscles is relaxed, the pupil is unable to constrict. • Sunglasses can help to reduce intensity of light entering the eye and avoid damaging the retina/eye.	3
4b	• Ciliary muscles are relaxed / unable to contract • Suspensory ligaments unable to slacken or become taut to vary thickness of lens • Light rays not able to be sharply/accurately focused on retina, causing blurred images to be formed.	3
5ai	**A**: anaphase (mitosis) **B**: anaphase II (meiosis II)	2
5aii	• Cell C undergoes meiosis which produces haploid gametes, important for sexual reproduction which introduces genetic variation • With genetic variation, organisms have different traits and are able to colonise new habitats more effectively • And also survive changes in the environment better *Any two points*	2
5b	• Interphase • Amount of DNA doubled from 2.4 a.u to 4.9 a.u (data quote)	2

6ai	<table><tr><td></td><td colspan="2">father</td><td>x</td><td colspan="2">mother</td></tr><tr><td>genotype of parents</td><td colspan="2">Tt</td><td></td><td colspan="2">Tt</td></tr><tr><td>gametes</td><td>T</td><td>t</td><td></td><td>T</td><td>t</td></tr><tr><td>genotype of offspring</td><td>TT</td><td>Tt</td><td></td><td>Tt</td><td>tt</td></tr><tr><td>phenotype in offspring</td><td>No TSD / normal</td><td>No TSD / normal</td><td></td><td>No TSD / normal</td><td>TSD</td></tr></table> [1] – correct parent genotypes [1] – correct offspring genotypes [1] – correct offspring phenotypes	3
6aii	• Gene mutation is a change in the nucleotide sequence in a gene. • Radiation / mutagenic chemicals	2
6b	• Recessive allele • Individual 2 is homozygous for the condition hence would pass down the allele responsible for the condition to all her offspring • But only one out of three of her offspring (3, 4, 5) were affected (as offspring heterozygous for the condition were normal) *or* otherwise, a dominant allele would cause all offspring to be affected	3
7a	**X**: estrogen **Y**: progesterone	2
7b	Repairs and thickens the uterus lining	1
7c	• Days 18 – 22 • Progesterone (hormone Y) is at the maximum level and the uterine lining is the thickest • This enables embryo to implant in the uterine wall firmly to receive nutrients and oxygen from the mother	3
7d	• Ovulation is prevented • Egg is not released into oviduct to be fertilised after sperms are ejaculated into the vagina	2

Qn	Section B: Answer [Marks]	Marks
8a	 • Scale – occupy ½ of grid space, axes appropriate scale • Line – line of best fit / plotted lines • Axes – correctly labelled with units • Points – plotted accurately	4
8b	• Inhalation treatment causes blood glucose concentration to decrease sharply from 35 a.u to 6 a.u in first 3 hours, while injection treatment causes the same decrease but gradually in first 4 hours. • Inhalation treatment increase significantly to 22 a.u at 7 hours after start of treatment, while injection treatment increase gradually to 11 a.u in the same duration. *1m = comparison + quote*	2
8c	• Glucose used up for aerobic respiration to release energy needed for vigorous exercise. • If insulin not reduced, conversion of glucose to glycogen, plus the glucose used up for respiration will fall to very low levels, leading to hypoglycaemia.	2
8d	• Inhaled insulin treatment takes a shorter time to take effect as compared to injected insulin treatment • (data quote) blood glucose concentration dropped to 15 a.u for inhaled insulin as compared to 24 a.u for injected insulin after an hour, increasing risk for hypoglycaemia.	2

9a	• Kangaroo rat has a longer loop of Henle compared to common house rat • Allows more time for kangaroo rat to selectively reabsorb water into bloodstream • Maintains water potential of blood at normal levels so do not need a large intake of water compared to common house rat • Water can be hard to come by in a desert so they are able to survive without needing a constant supply of water.	4
9b	Similarity: • Remove toxic and nitrogenous waste such as urea from the body • Uses partially permeable membrane – dialysis tubing and glomerulus of Bowman's capsule Differences: • Kidney uses two processes – ultrafiltration and selective reabsorption while dialysis machine uses diffusion • Through ultrafiltration, small substances such as glucose, amino acids, water and urea are filtered out into the Bowman's capsule while in the dialysis machine, blood containing large molecules such as blood cells and small substances go through the dialysis machine • Essential substances are reabsorbed at the collecting duct into bloodstream (kidney) while essential substances do not leave the blood in the dialysis machine • Nephron surrounded by blood capillaries in the kidney to transport essential substances away whereas dialysis tubing surrounded by dialysis fluid to transport urea (waste) away • Blood is drawn from the renal artery in the kidney, while blood is drawn from a vein for dialysis fluid *Any 6 points; must be mixture of similarities and differences*	6

10 E (a)	• Light affects the size of stomata on the leaf. • With strong light intensity, stomata open and become wider. • This allows for gaseous exchange to take place and water vapour is able to exit the leaf. • Rate of transpiration (loss of water vapour from a plant) increases. • With low or no light intensity, stomata closes. • Water vapour is not able to exit the leaf and hence rate of transpiration decreases. *Any 5 points*	5
10 E (b)	Wilting occurs when the rate of transpiration exceeds the rate of water absorption by the roots. Advantages: • When leaf folds up, surface area that is exposed to sunlight reduced. • Excessive loss of water causes guard cells to become flaccid and stomata close. Rate of transpiration is reduced. Disadvantages: • However, as water becomes a limiting factor, rate of photosynthesis is reduced. • As stomata is closed, amount of carbon dioxide entering leaf is reduced, leading to decrease in rate of photosynthesis. • As the surface area exposed to sunlight is reduced, rate of photosynthesis is also reduced.	5

10 O (a)	• When top predator fish 3 is removed, population of fish 2 increases, resulting in decrease of population of fish 1 • This leads to increase in population of herbivores, thus resulting in decrease in number of producers • This decrease in number of producers may affect other food chains • Which may lead to populations in other food chains affected and affect biodiversity in the sea *or* • cause oxygen level in sea to decrease • Hence marine organisms may struggle to survive with depleted oxygen and affect biodiversity *Accept alternative answers*	4
10 0 (b)	• Carbon dioxide that <u>dissolves</u> in the sea's water is absorbed and used by the producers in <u>photosynthesis</u> • Carbon compounds found in <u>buried</u> in seabeds in the form of <u>fossil fuels</u>	2
10 O (c)	• Different countries can have an agreement on regulation of fishing such as to mark out clear areas for fishing by studying the biodiversity of that area • Practice responsible fishing where no pollutants/rubbish are left in fishing area • Have laws against irresponsible use of fishing methods such as trawls which can lead to loss of marine habitats and reduce biodiversity • Formulate policies to ensure that marine conversation does not focus on only one or certain few species • Restrict the seasons, duration of fishing for particular species • Constant monitoring by relevant authorities to ensure species have time to reproduce and do not dip below a certain number *Any 4 points* *Accept alternative answers*	4