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Name	Class	Index Number

UNITY SECONDARY SCHOOL

PRELIMINARY EXAMINATIONS 2019

SECONDARY FOUR EXPRESS



BIOLOGY 6093/01

18 SEPTEMBER 2019

PAPER 1

1 HOUR

**Additional
Materials :** **Optical Answer Sheet**

READ THESE INSTRUCTIONS FIRST

This paper consists of **40** Multiple Choice Questions.

Answer **ALL** questions. For each question, there are four possible answers, **A**, **B**, **C** and **D**. Choose the most appropriate answer and shade on the Optical Answer Sheet (OAS) provided.

Write your name, class and shade your register number in the spaces on the OAS.

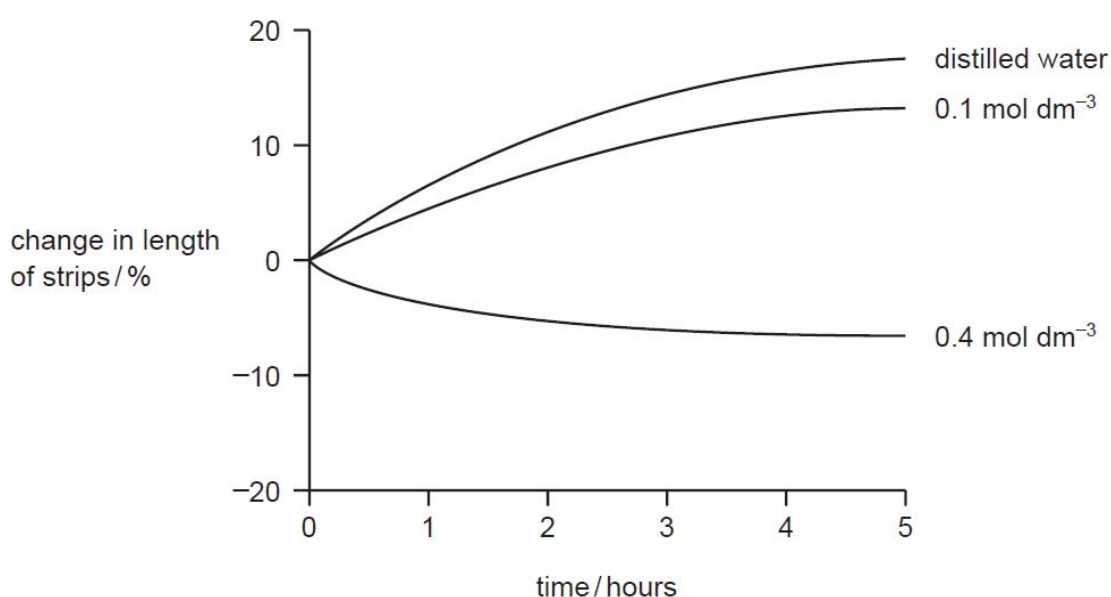
Do not fold nor use any correction fluid on the OAS. Read the instructions on the OAS carefully.

The total number of mark for this paper is 40 marks.

This paper consists of **19** printed pages, including this cover page.

Section A: Multiple Choice Questions (40 Marks)

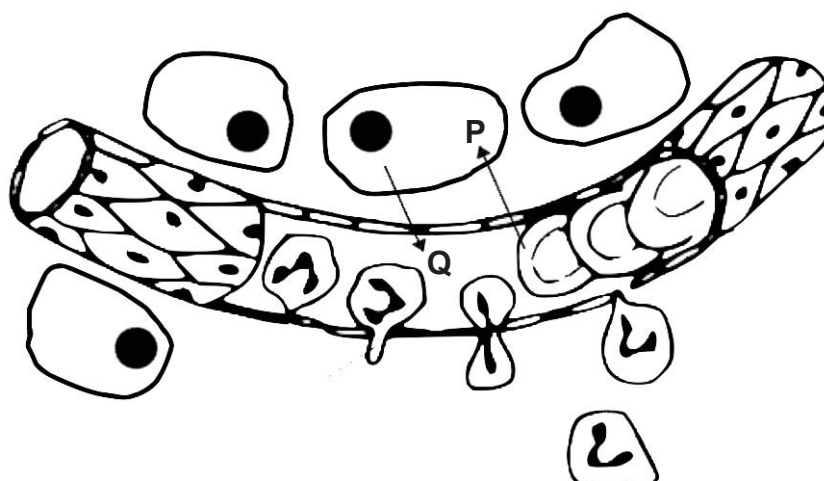
- 1 Mature red blood cells have no nucleus and no mitochondria. Which of the following processes can be carried out by a mature red blood cell?
- A Aerobic respiration
 - B Anaerobic respiration
 - C Cell division
 - D Protein synthesis
- 2 Strips of potato tuber tissue were immersed in distilled water or in sucrose solutions of different concentrations. The graph shows the percentage change in length of the strips.



Which statement best explains the change that occurred in the potato strips immersed in 0.1 mol dm⁻³ sucrose solution?

- A Sucrose molecules diffused into the potato cells.
- B Sucrose molecules were actively transported into the potato cells.
- C The water potential of the sucrose solution was less than the water potential inside the cells.
- D The water potential of the sucrose solution was higher than the water potential inside the cells.

- 3 The diagram shows a blood capillary among tissue cells.



Which of the following best describes the movement of key substances in the directions of the arrows **P** and **Q**?

	P	Q
A	CO ₂ ; through diffusion	oxygen; through diffusion
B	water; through osmosis	oxygen; through diffusion
C	oxygen; through diffusion	CO ₂ ; through diffusion
D	oxygen; through diffusion	water; through osmosis

- 4 A student carried out four food tests on a sample. The results are shown below.

test	appearance of sample after test
iodine test	blue black
biuret test	light blue
emulsion test	white emulsion
Benedict's test	green

What did the sample contain?

- A** glucose and protein
- B** glucose and sucrose
- C** starch and proteins
- D** starch and fats

- 5 The enzyme lactase, which breaks down lactose into glucose and galactose, was added to a test tube containing cow's milk.

What would be the result of food tests conducted on this mixture?

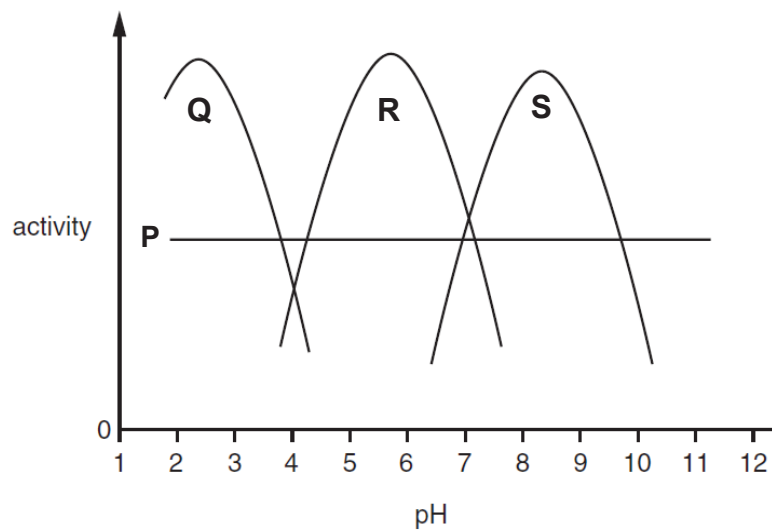
solution	Benedict's test	emulsion test	iodine test	biuret test
A	x	✓	x	✓
B	✓	x	x	✓
C	x	✓	✓	x
D	✓	x	✓	x

key

✓ = positive result

x = negative result

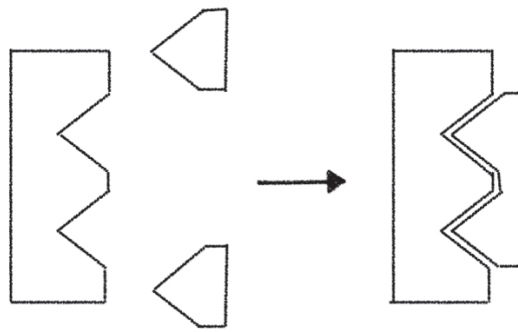
- 6 The graph shows the effect of pH on the activity of four different enzymes.



Which pair of enzymes includes one from the stomach, and one that is **not** affected by pH?

- A P and Q
- B P and S
- C R and Q
- D R and S

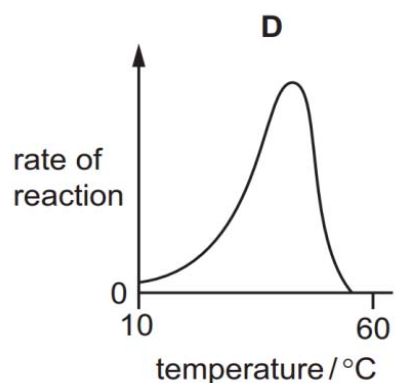
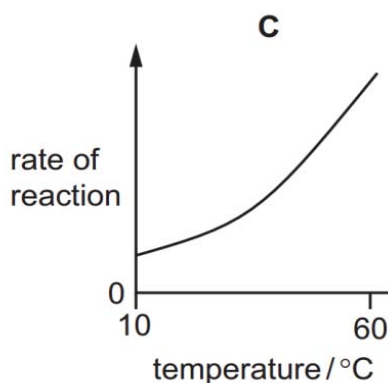
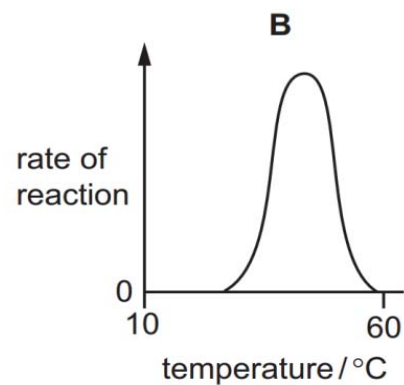
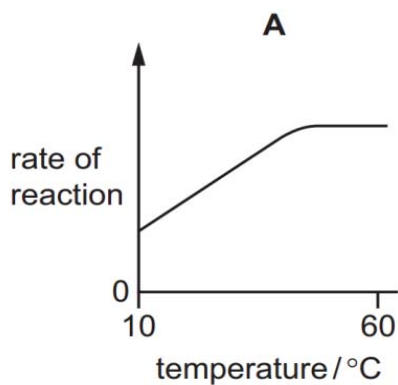
7 The diagram shows an enzymatic reaction.



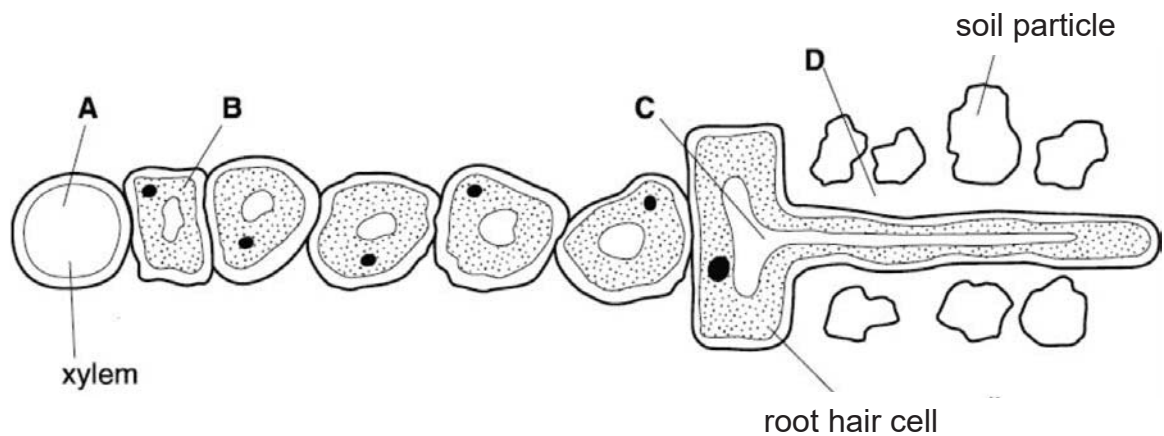
Which of the following biological processes can be illustrated by this diagram?

- A The fermentation of sugar by yeast.
- B The hydrolysis of fats by lipase.
- C The oxidation of glucose in respiration.
- D The synthesis of cellulose cell walls in a plant cell.

8 An enzyme needed for respiration was extracted from bacteria living in natural hot water springs where the water temperature is between 85°C and 95°C. Which graph would represent the relationship between temperature and the rate of bacterial respiration?

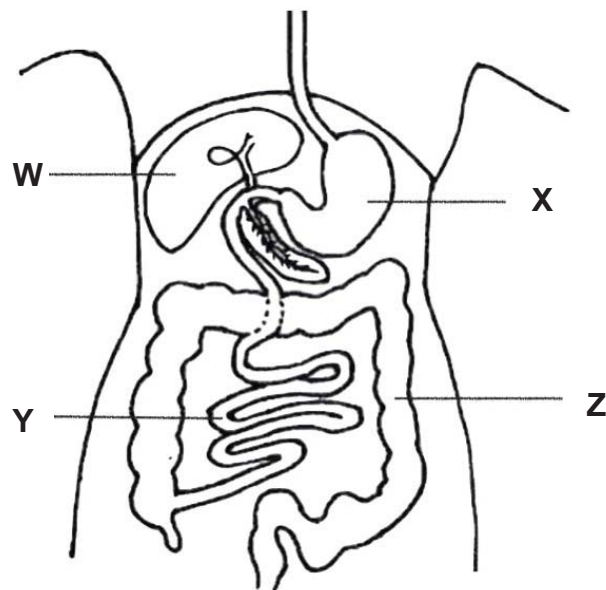


- 9 The diagram below shows part of a plant root in the soil. At which labelled point is the water potential highest?



Use the diagram below to answer questions 10 and 11.

The diagram shows part of the human alimentary canal.



- 10 Which of the following is **not** an accurate match of the organ to its function?

	Organ	Function
A	W	Regulation of blood glucose concentration
B	X	Get rid of bacteria and pathogens in food
C	Y	Absorption of water
D	Z	Absorption of fats

11 Which of the following correctly describes how Organ **Y** is adapted for its function?

	structural feature	function
A	acidic pH	provides optimum pH for intestinal enzymes to function
B	long	maximises time for absorption
C	presence of villi	decreases surface area for absorption
D	one-celled thick epithelium	increases distance between intestinal lumen and blood vessels for diffusion

12 Samples of digestive juices were obtained from 3 patients' small intestines, which were then tested for the presence of fats. The conditions faced by each patient is shown below.

	Patient 1	Patient 2	Patient 3
Pancreatic duct blocked	No	Yes	Yes
Bile duct blocked	No	No	Yes

Which of the following shows the most probable results from the test for the presence of fats?

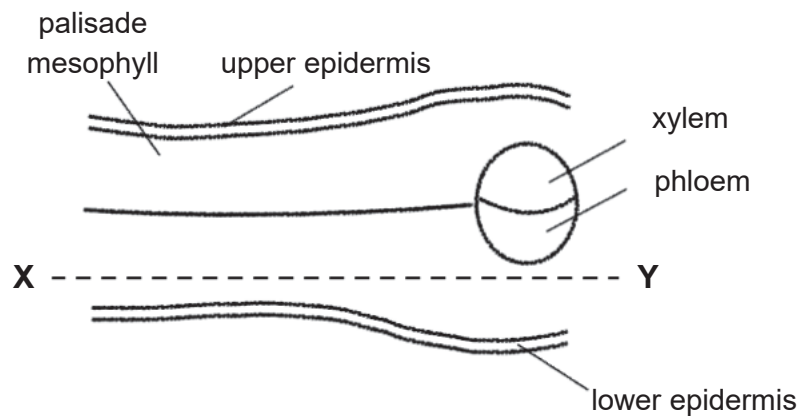
	Patient 1	Patient 2	Patient 3
A	negative	positive	positive
B	positive	positive	negative
C	positive	negative	positive
D	negative	negative	positive

13 Which of the following explains why plants have a lower rate of photosynthesis during wilting?

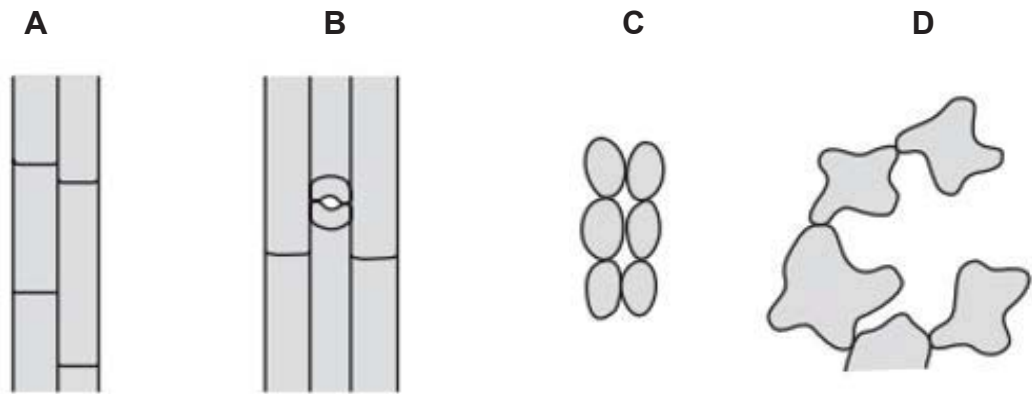
- I. Wilted leaves have less surface area exposed to sunlight
- II. Stomata size is reduced due to guard cells becoming turgid
- III. Less water is available for photosynthesis

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

- 14** The diagram below shows the tissues in a leaf as seen under the microscope.

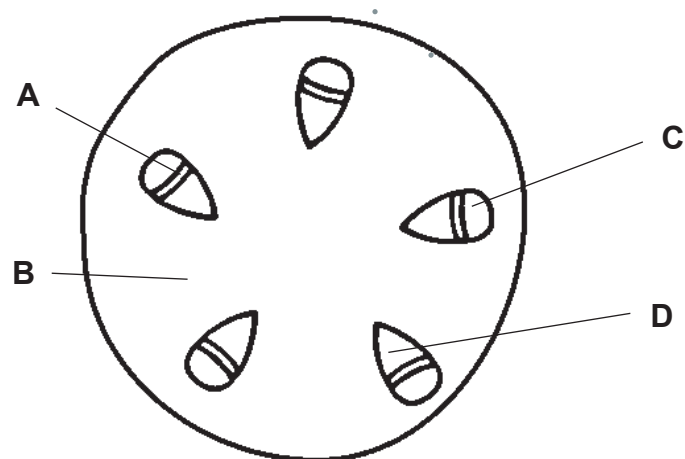


If a cut were made along the line **X—Y**, what would the arrangement of cells look like?

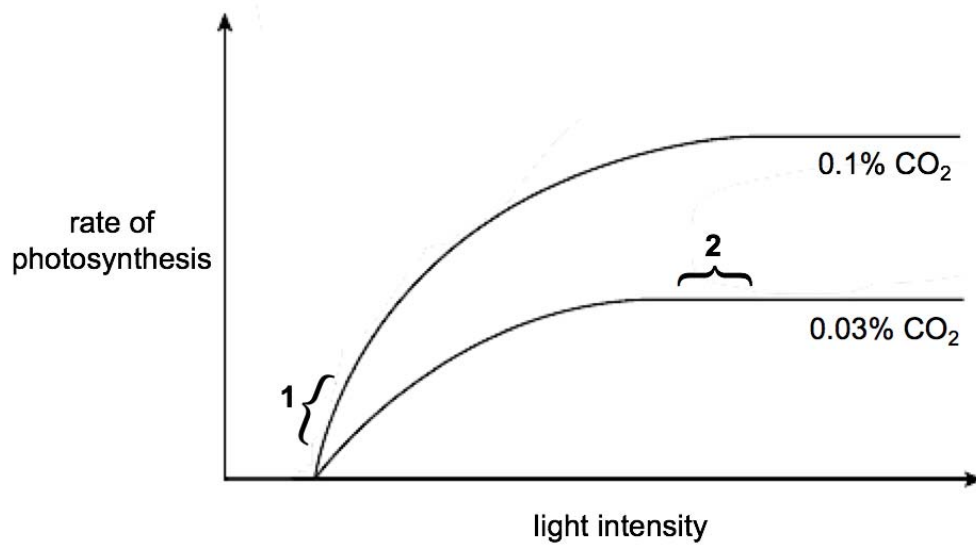


- 15** The diagram shows a section through the stem of a dicotyledonous plant.

Which tissue transports amino acids up the stem?



16 The diagram shows the graph of photosynthetic rate against light intensity.



What are the limiting factors of photosynthesis at regions 1 and 2?

	Region 1	Region 2
A	CO ₂ concentration	Light intensity
B	CO ₂ concentration	Temperature
C	Light intensity	CO ₂ concentration
D	Light intensity	Temperature

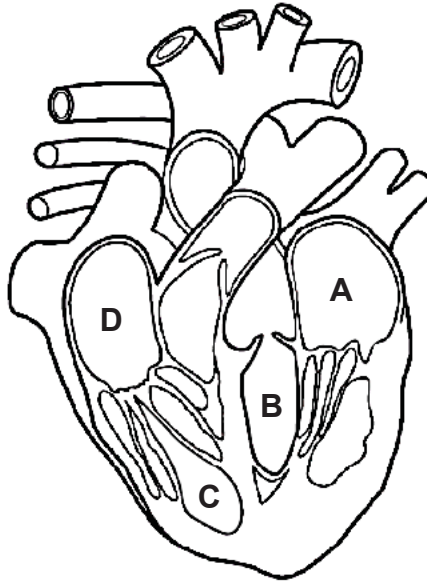
17 Which of the following features allow an artery to withstand the pressure of blood flowing through it?

- I. smooth endothelium
- II. thick elastic layer in the artery wall
- III. thick layer of muscles in the artery wall

- A** I and II only
- B** I and III only
- C** II and III only
- D** I, II, and III.

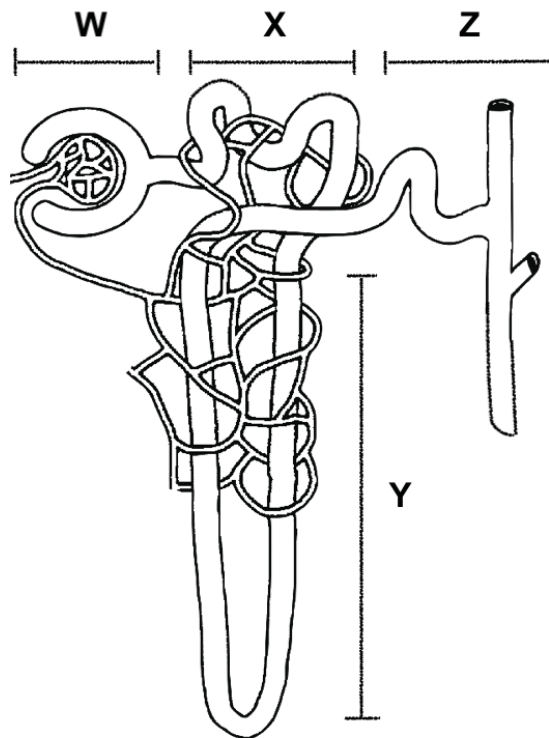
- 18 In a medical investigation, a dye was injected into the renal artery of a patient. The dye was not filtered out of the blood in the kidneys.

Which chamber of the heart would be the first to receive blood with this dye in it?

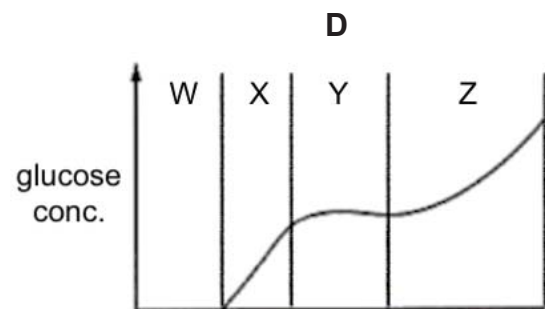
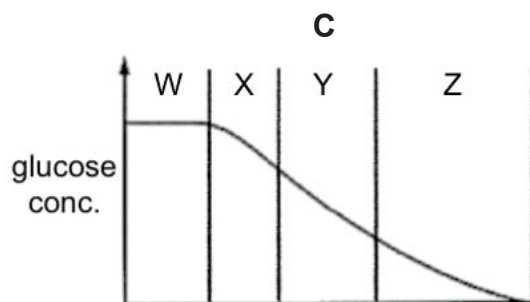
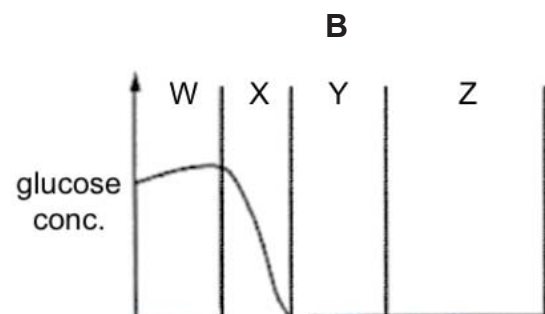
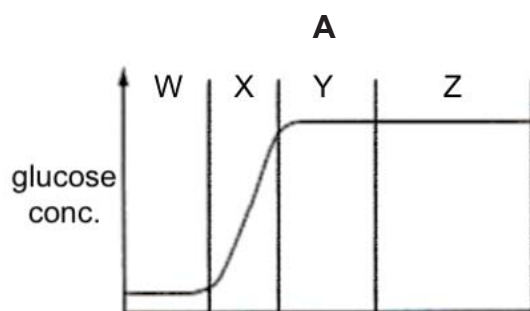


- 19 A drug has been found to **inhibit** the effects of antidiuretic hormone (ADH). What would be the consequence of administering this drug to a healthy person?
- A A smaller volume of urine would be formed.
 - B More proteins would be present in the urine.
 - C The person will become dehydrated.
 - D The urine concentration will increase.
- 20 Where does most reabsorption of water occur in the kidney?
- A collecting duct
 - B distal convoluted tubule
 - C loop of Henle
 - D proximal convoluted tubule

21 The diagram shows a nephron and its associated blood vessels.



Which graph shows the concentration of glucose present in each part of the kidney tubule in a healthy individual?



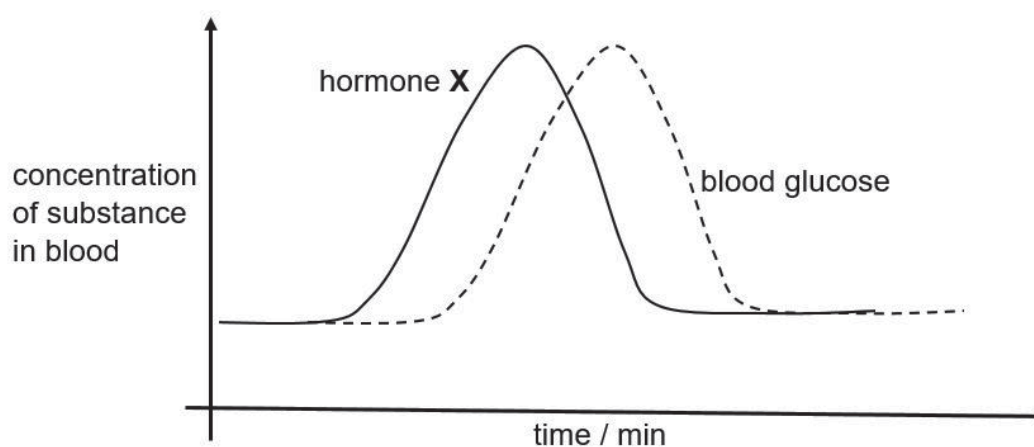
22 Four processes that take place in the human body are listed.

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

Which two processes are directly controlled by negative feedback?

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

23 The graph shows the relationship between the level of hormone **X** and blood glucose within the human body.



Which of the following correctly identifies hormone **X** and explains its relationship to blood glucose?

	hormone X	explanation
A	insulin	stimulates conversion of glycogen into glucose
B	insulin	stimulates the conversion of glucose into glycogen
C	adrenaline	stimulates conversion of glycogen into glucose
D	adrenaline	stimulates the conversion of glucose into glycogen

24 What is the function of the iris in the mammalian eye?

- A** to alter the shape of the lens
- B** to control the amount of light entering the eye
- C** to focus light rays on the retina
- D** to protect the cornea from damage

25 The following events occur when a person is focusing on a near object.

1. lens become thicker
2. nerve impulses travel along optic nerve to the brain
3. photoreceptors are activated and nerve impulses are produced
4. nerve impulses transmitted to ciliary muscles via motor neurons
5. ciliary muscles contract and suspensory ligaments relax

What is the correct order of these events?

	first	→			last
A	3	2	5	4	1
B	3	5	2	4	1
C	3	4	5	2	1
D	3	2	4	5	1

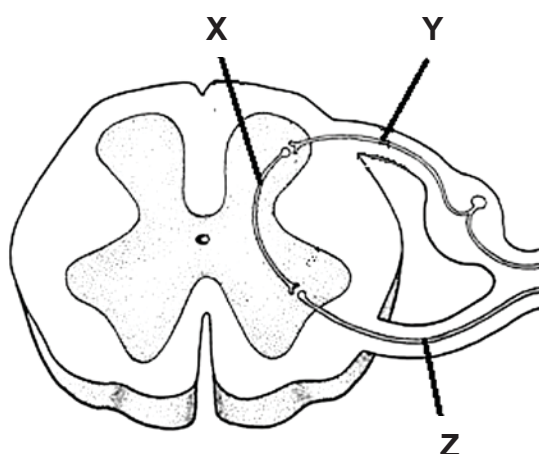
26 Last night, Jane's sister turned off the lights while the family was watching television. Jane felt that the screen got brighter even though the actual brightness had not been changed.

Which of the following accounts for Jane's perception of the increase in brightness of the screen?

- A** relaxation of the circular muscle of the iris
- B** relaxation of the radial muscle of the iris
- C** relaxation of ciliary muscles
- D** contraction of ciliary muscles

Use the diagram below to answer questions **27** and **28**.

The diagram shows part of the spinal cord and some neurones which are connected to the leg of a patient.



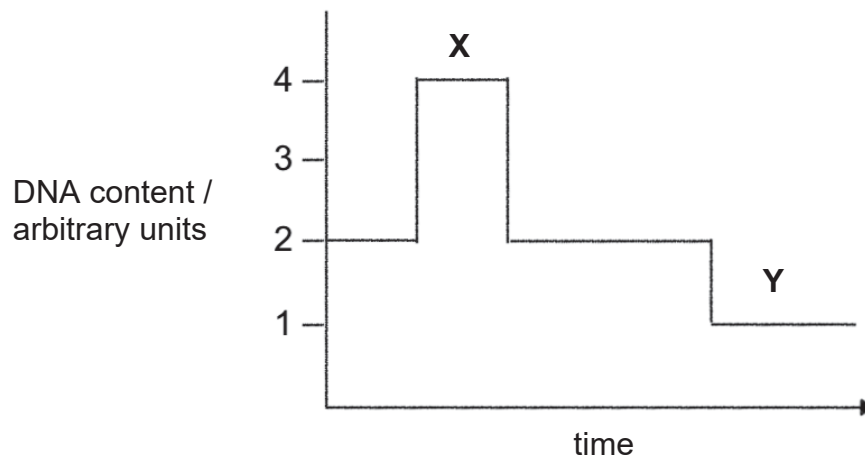
27 Which of the following correctly describes the functions of **X**, **Y** and **Z**?

	X	Y	Z
A	Relay impulses within the central nervous system	Transmits impulses out of the spinal cord	Connects receptor to the spinal cord
B	Connects receptor to the spinal cord	Transmits nerve impulses out of the spinal cord	Relay impulses within the central nervous system
C	Relay impulses within the central nervous system	Connects receptor to the spinal cord	Transmits nerve impulses out of the spinal cord
D	Transmits nerve impulses out of the spinal cord	Connects receptor to the spinal cord	Relay impulses within the central nervous system

28 An anaesthetic which blocks nerve impulses in neurone **Z** is applied on the patient. Which of the following best describes the effect on his leg?

- A** He cannot feel a pinprick but can move his leg.
- B** He can feel a pinprick and move his leg.
- C** He can feel a pinprick but cannot move his leg.
- D** He cannot feel the pinprick and cannot move his leg.

29 The graph shows the amount of DNA in the nuclei of cells dividing via meiosis.

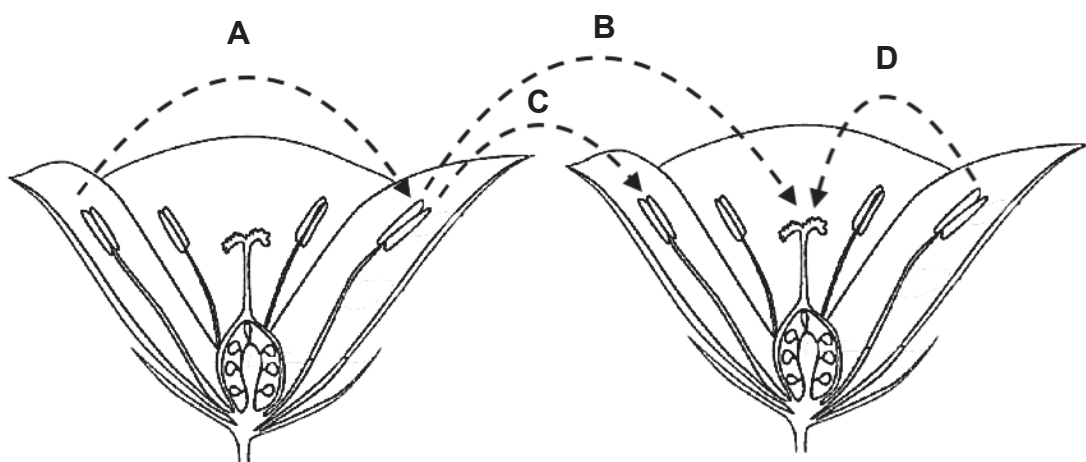


Which stages do **X** and **Y** represent respectively?

- A** Metaphase I and Telophase I
- B** Prophase I and Telophase II
- C** Telophase I and Metaphase II
- D** Telophase I and Telophase II

30 The diagram below shows two flowers of the same species.

Which arrow represents cross-pollination?



31 What is/are some of the advantage(s) of plants that undergo cross-pollination?

- I. Results in greater variation of offspring.
- II. Bisexual flowers are no longer necessary for pollination.
- III. Chances of offspring surviving changes to environment are higher.
- IV. Beneficial qualities are passed on from both parents to offspring.

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

32 For which process is the pollen tube essential?

- A** for the cross-pollination of the flower
- B** for the dispersal of pollen grains from the anther
- C** to allow the male gamete to reach the ovule
- D** to provide a site for fertilisation to occur

33 The diagram shows a human sperm cell.

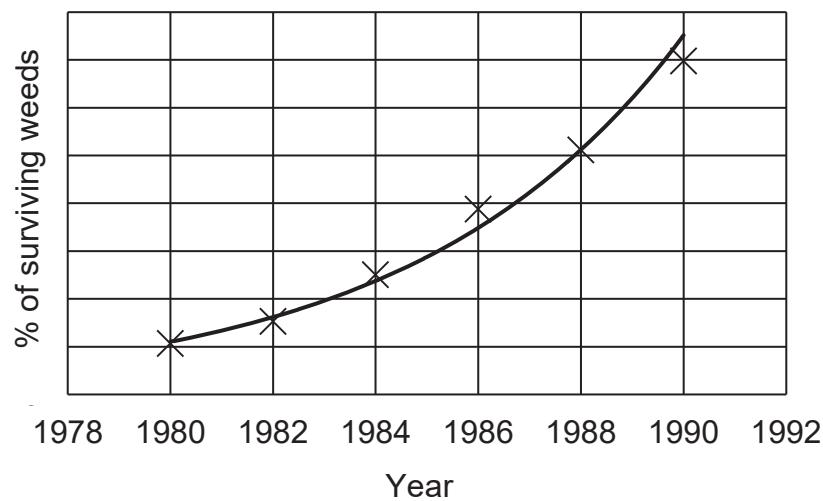


What does structure **P** always contain?

- A** an X chromosome
- B** a Y chromosome
- C** either an X or a Y chromosome
- D** both an X and a Y chromosome

- 34** A 1:1 phenotypic ratio in the offspring in a test cross for a monohybrid trait indicates that _____.
- A** the alleles are dominant
 - B** the alleles are co-dominant
 - C** one parent must have been homozygous dominant
 - D** one parent must have been a heterozygote
- 35** A study was done to evaluate the effectiveness of an herbicide over 6 years. A fixed amount of herbicide was sprayed onto a field of weeds in January and the percentage of weeds that survived was recorded in June.

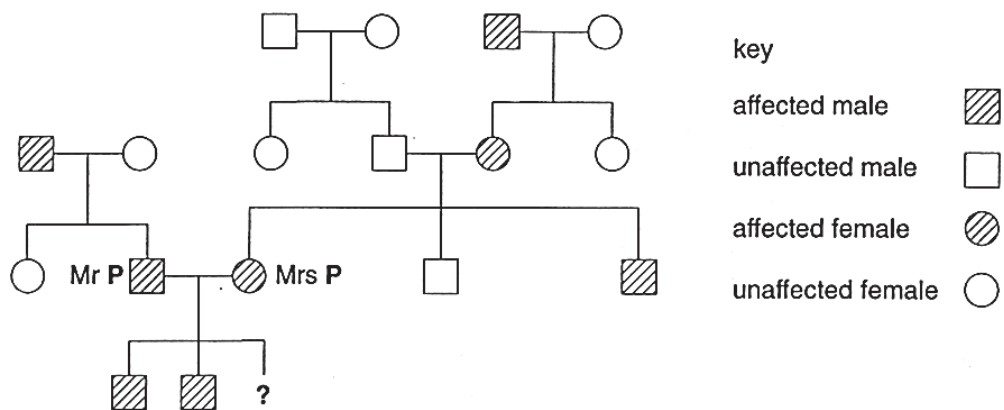
The graph below shows the results of the study.



Which of the following processes explains the results?

- A** artificial selection
- B** genetic engineering
- C** natural selection
- D** mutation

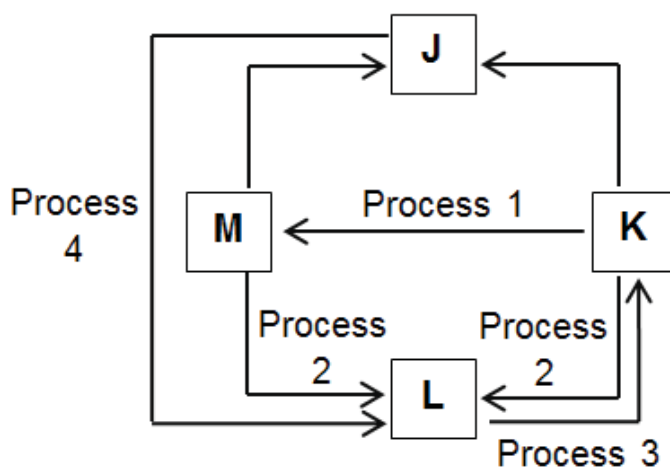
- 36 A woman with blood group O and a man with blood group AB had children together. Which statement about their children's blood groups is correct?
- A None of their children will have the same blood group as either parent.
 - B 50% of their children will have the same blood group as their mother.
 - C 50% of their children will have the same blood group as their father.
 - D All their children will have the same blood group.
- 37 Mr and Mrs P both suffer from a rare heart disease. Children who inherit two copies of the dominant allele rarely survive beyond puberty.



- What is the probability that their third child will **not** be affected?
- A 0 %
 - B 25 %
 - C 75 %
 - D 100%
- 38 Which of the following best explains why a food chain will usually not contain more than five trophic levels?
- A The amount of biomass is insufficient to support more levels.
 - B The amount of energy is insufficient to support higher levels.
 - C The number of organisms at higher levels will be too small.
 - D There are very few organisms that feed on carnivores.

The carbon cycle can be illustrated using the following diagram. Processes **1**, **2**, **3** and **4** represent the processes involved in the flow of carbon compounds.

Refer to the diagram to answer questions **39** and **40**.



39 Which one of the following shows what each letter (**J**, **K**, **L** and **M**) could represent?

	J	K	L	M
A	atmosphere	grass	decomposers	sheep
B	decomposers	sheep	atmosphere	grass
C	decomposers	grass	atmosphere	sheep
D	sheep	atmosphere	grass	decomposers

40 Which one of the following would be likely to happen if process **4** does not occur?

- A** The population of the grass would increase.
- B** Carbon cycling would occur in the reverse direction.
- C** Carbon dioxide levels in the atmosphere would decrease.
- D** The rate at which carbon dioxide is released would increase.

***** END OF PAPER *****

Name	Class	Index Number

UNITY SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2019

SECONDARY FOUR EXPRESS



BIOLOGY 6093/02

18 SEPTEMBER 2019

PAPER 2

1 HOUR 45 MIN

**Additional
Materials :** Nil

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number in the spaces provided on the writing papers.

Answer both **Section A** and **Section B**.

Section A:

Answer **all** the questions.

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

Section B:

Answer **all** the questions.

Question **10** is in the form of an **Either/Or** question and only one alternative should be attempted.

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

The total mark for this paper is 80 marks.

This paper consists of **21** printed pages, including this cover page.

Section A: Structured Questions (50 marks)

- 1 In the past, the insulin protein was derived from pigs and cattle. Currently, bacterial plasmids are being utilised to produce human insulin for medical use.

Fig. 1.1 shows the stages involved in the insertion of the human insulin gene into a bacterial plasmid.

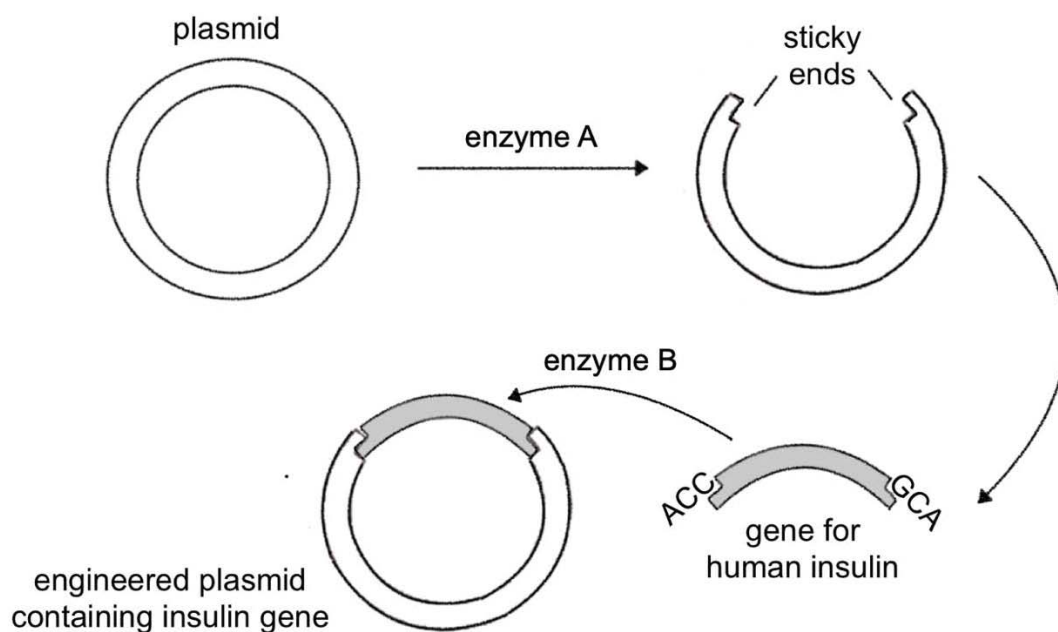


Fig. 1.1

- (a) (i) State the substance that makes up the plasmid.

..... [1]

- (ii) Name enzyme **A** and describe its role in insulin production.

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

- (iii) The sticky ends of the bacterial plasmid are complementary to the sticky ends found on the human insulin gene.

With reference to Fig. 1.1, state the pair of base sequences on the plasmid that would enable ligation of the human insulin gene.

..... [1]

- (iv) Suggest **one** advantage of using bacterial plasmids to produce insulin as compared to retrieving insulin from animal sources.

.....
..... [1]

- (b) Purified insulin from bacterial cells is injected into diabetic patients.

Explain how diabetic patients would benefit from this treatment.

.....
.....
.....
.....
.....
..... [3]

[Total: 8]

2 Fig. 2.1 shows the different stages in the life cycle of a plant.

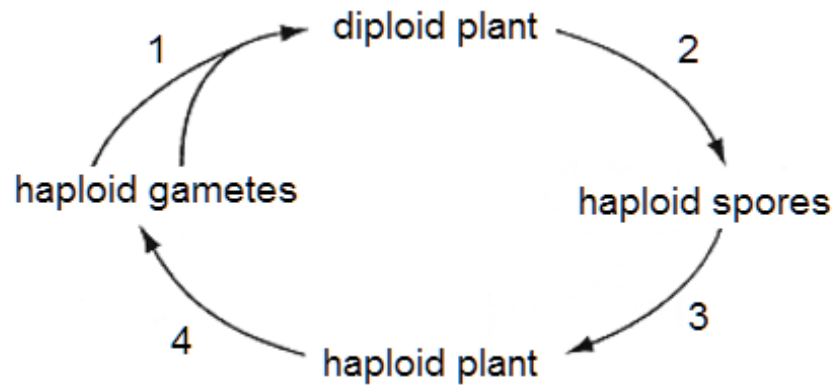


Fig. 2.1

(a) (i) Identify the stage(s) at which meiosis has taken place.

..... [1]

(ii) Explain **2** reasons why meiosis is important in reproduction.

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

(b) Fig. 2.2 shows an animal cell undergoing nuclear division.

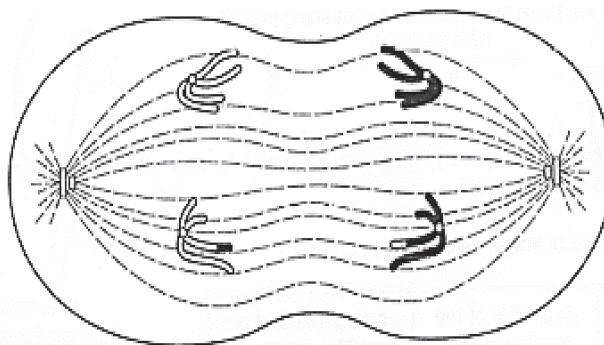


Fig. 2.2

(i) Identify the stage of nuclear division that is taking place in Fig. 2.2.

..... [1]

(ii) Give a reason for your answer in (i).

.....
..... [1]

(iii) How would this process differ if it were occurring in a plant cell?

.....
..... [1]

[Total: 6]

- 3 Fig. 3.1 shows the rate of oxygen production in a plant at varying temperatures.

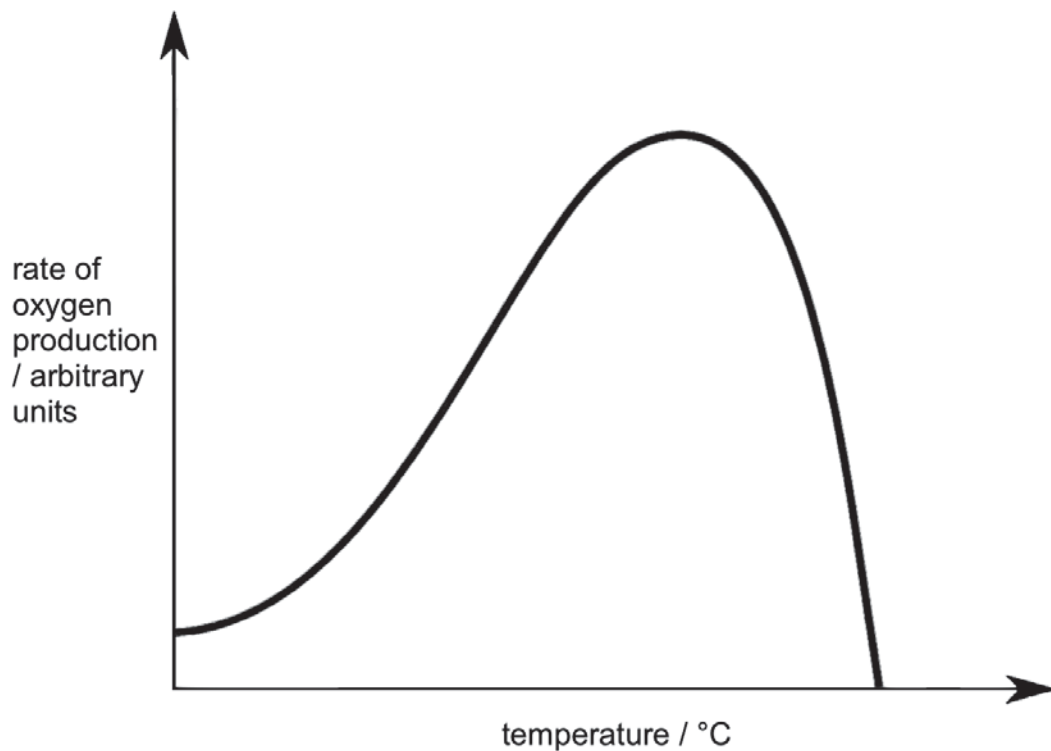


Fig. 3.1

- (a) (i) State the word equation for photosynthesis.

..... [1]

- (ii) Describe **and** explain the shape of the graph in Fig. 3.1.

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

(b) The temperature of the air surrounding the plant has an effect on transpiration rate.

(i) Explain how temperature affects the rate of transpiration.

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

(ii) Explain **two** ways through which wilting affects the rate of photosynthesis.

1
.....
2
..... [2]

[Total: 7]

- 4** Cystic fibrosis (CF) is a serious genetic condition in humans that results from the failure to inherit the dominant allele of a particular gene. CF patients produce excessive mucus that leads to respiratory infections and digestive problems.

Mrs Tan is a CF patient and genetic analysis of Mr Tan shows that he is a carrier of the recessive CF allele. While they wished to have children, they were discouraged by their doctor from doing so.

- (a) (i)** Use a fully labelled genetic diagram to show how cystic fibrosis may be inherited by the children of Mr and Mrs Tan.

Use the letter **D** to represent the dominant allele and **d** to represent the recessive allele.

[3]

- (ii)** With reference to the expected ratio of phenotypes in their children, explain the doctor's recommendation to Mr and Mrs Tan.

.....

.....

..... [2]

- (b) Fig. 4.1 shows a section of the human alimentary canal and its accessory organs.

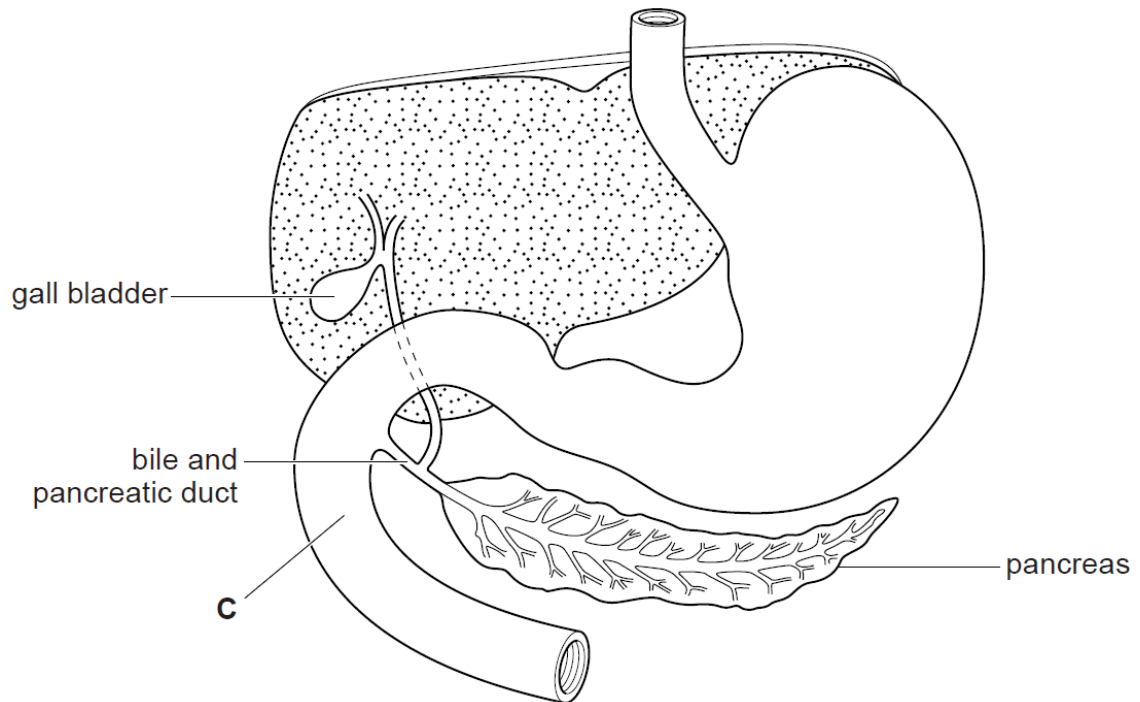


Fig. 4.1

- (i) Name the region of the small intestine labelled **C**.

..... [1]

- (ii) One effect of cystic fibrosis is that the bile and pancreatic duct becomes blocked with mucus.

Suggest why a person whose bile and pancreatic duct is blocked may find it difficult to gain weight despite eating a balanced diet.

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

[Total: 8]

- 5 (a) Fig. 5.1 shows the pressure changes in the left side of the heart for a single heartbeat.

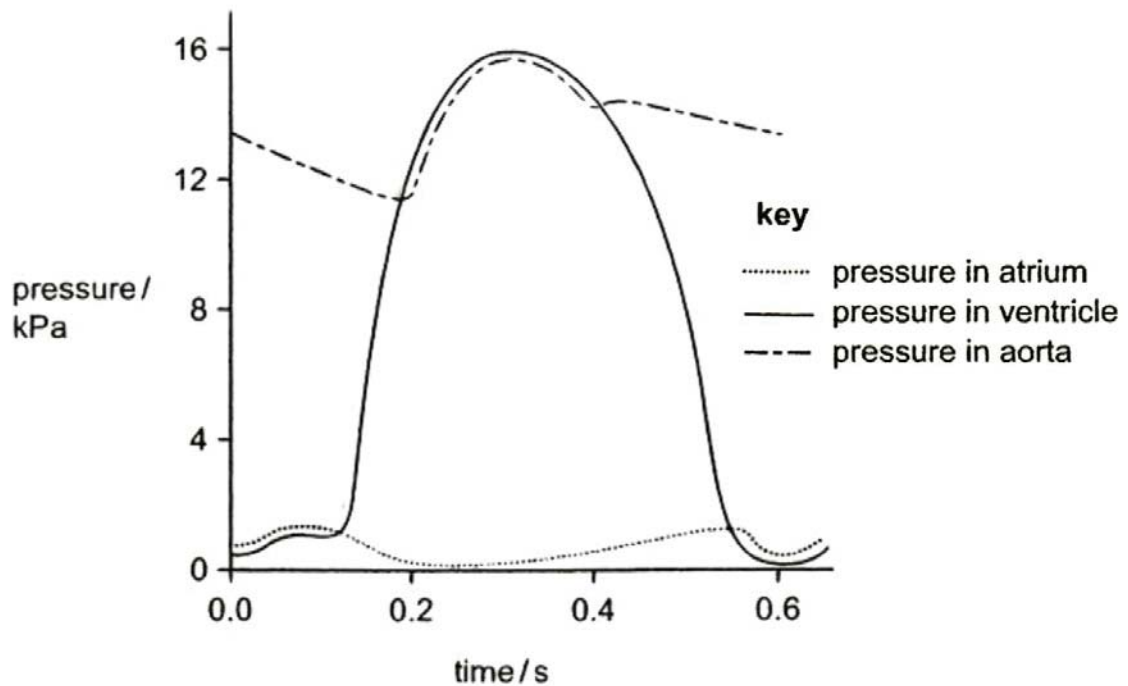


Fig. 5.1

- (i) State the time when the aortic valve starts to open.

..... [1]

- (ii) With reference to Fig. 5.1, describe **and** explain the pressure changes in the left ventricle from 0.1 s to 0.3 s.

.....

.....

.....

..... [3]

- (iii) Explain why the ventricular pressure in the right side of the heart is much lower during contraction as compared to the left side.

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

- (b) Fig. 5.2 shows the left side of a normal heart and the heart of a patient with diastolic heart failure.

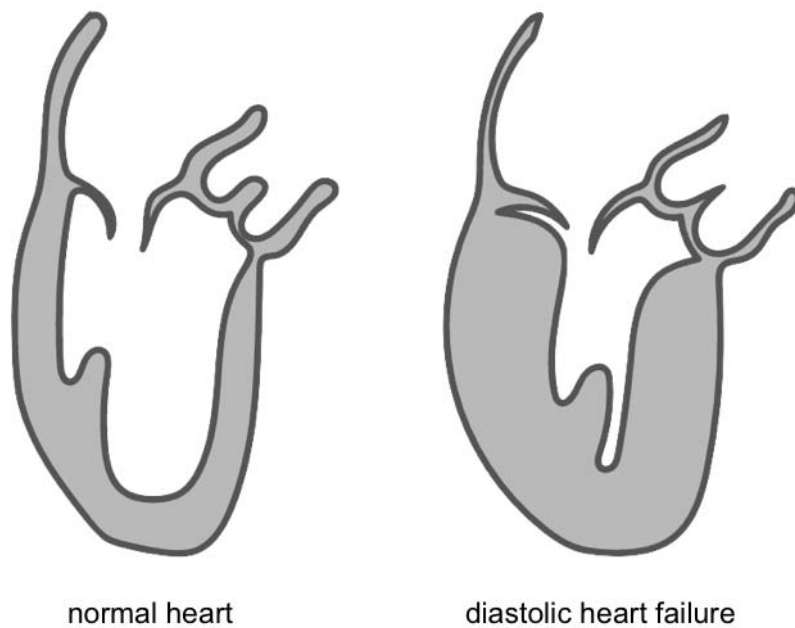


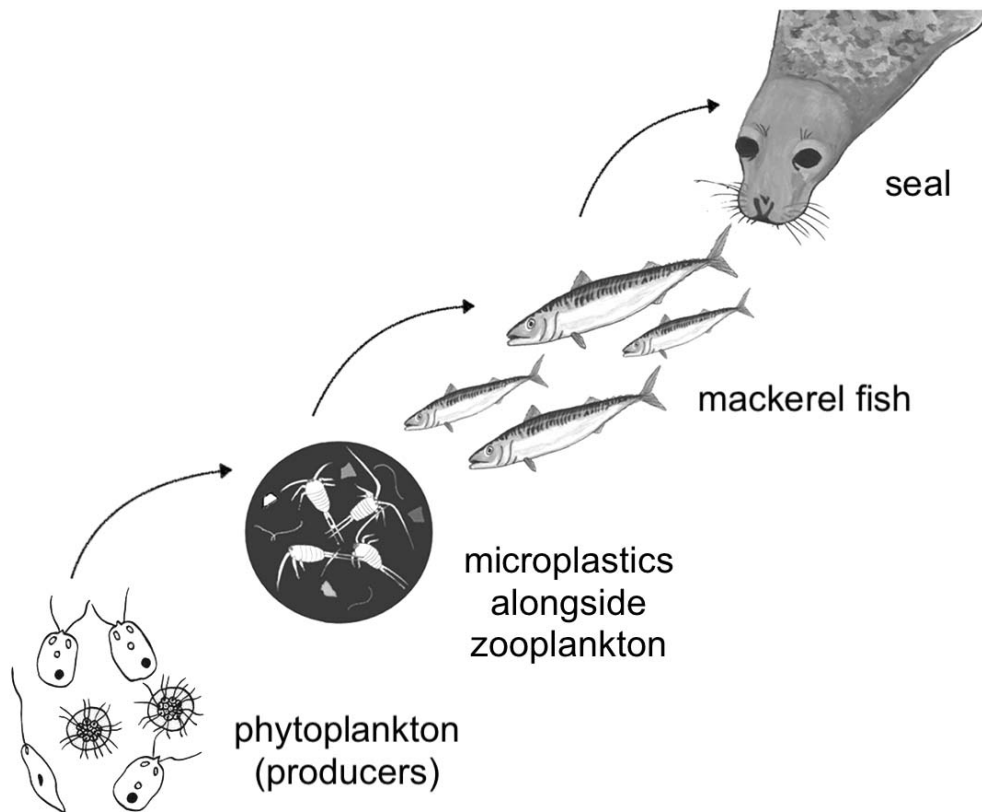
Fig. 5.2

Suggest why patients with diastolic heart failure often complain of excessive tiredness.

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..... [2]

[Total: 8]

- 6 Recently, microplastics have become a pollution concern for marine organisms. Fig. 6.1 shows the interactions between organisms in a North American sea.



Nelms et. al., 2018. <https://www.sciencedirect.com/science/article/pii/S0269749117343294>

Fig. 6.1

- (ii) Draw a **labelled** diagram of a pyramid of biomass for the food chain depicted in Fig. 6.1.

[2]

- (a) (i) With reference to at least **one** organism in Fig. 6.1, explain what is meant by the term *trophic level*.

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- (b) Small fishes that directly consume these non-biodegradable microplastics along with zooplankton are generally unaffected by it.

However, organisms higher up the food chain, such as seals and humans, are at risk of toxic effects caused by the presence of microplastics in their bodies.

Explain why this is so.

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[Total: 7]

- 7 Fig. 7.1 shows the changes in the concentration of urine and the concentration of anti-diuretic hormone (ADH) in the blood plasma changes.

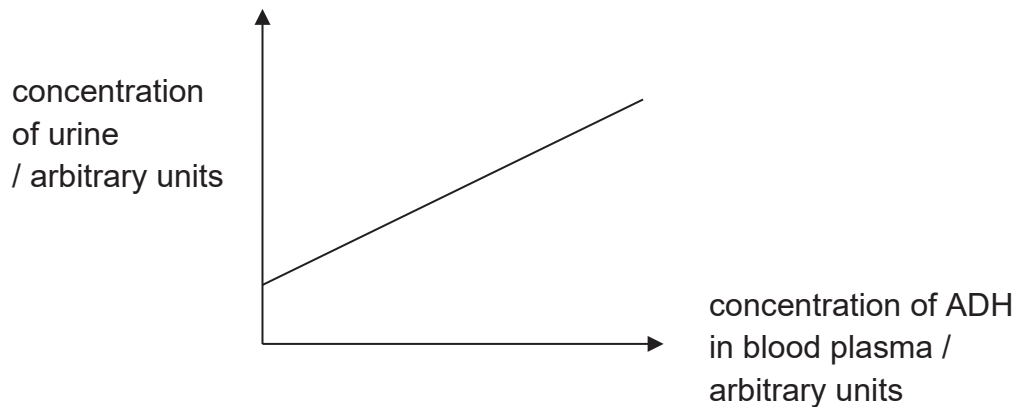


Fig. 7.1

- (a) With reference to Fig. 7.1, describe **and** explain the relationship between the concentration of ADH in the blood plasma and the concentration of urine.

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- (b) Explain how vigorous exercise may alter the concentration of ADH in the blood.

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[Total: 6]

Section B: Free Response Questions (30 marks)

Answer all questions.

Question **10** is in the form of an **Either/Or** question and only **one** alternative should be attempted.

Write your answers in the spaces provided.

- 8** An experienced sprinter was asked to run rapidly on a treadmill for eight minutes.

Fig. 8.1 shows the number of breaths per minute the sprinter took over the course of the experiment.

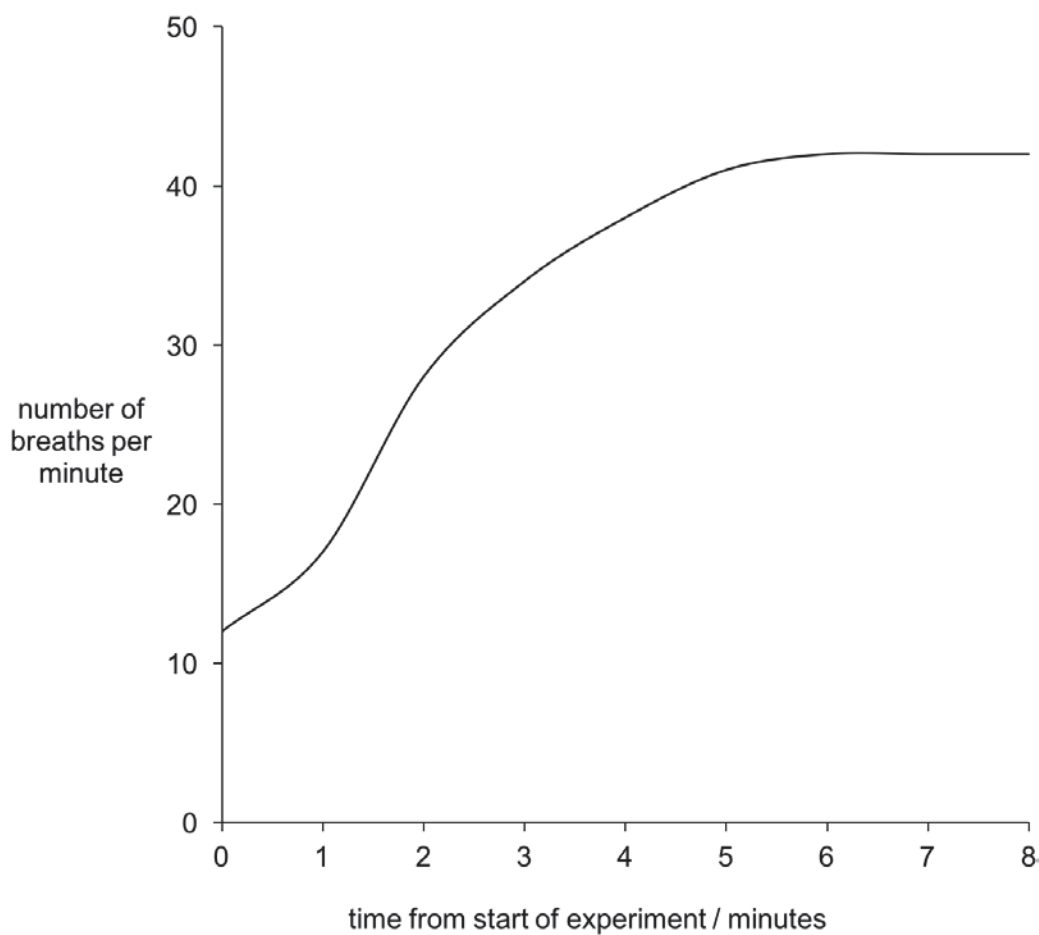


Fig. 8.1

(a) Compare the differences between aerobic and anaerobic respiration.

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(b) At the end of the experiment, the athlete reported that he was out of breath, his heart was beating fast, and his leg muscles were aching.

With reference to Fig. 8.1, explain the athlete's symptoms.

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[Total: 10]

- 9 Two patterns of response by the human body towards stimuli of different nature are outlined below.

Pattern A

stimulus → receptor → central nervous system → effector → action

Pattern B

stimulus → receptor → gland → effector → action

(a) With reference to one or both of the two patterns,

- (i) describe the pathway of nerve impulses when a barefoot person steps on a sharp nail.

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- (ii) describe the sequence of events which occur after a man consumes a heavy meal rich in carbohydrates.

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- (b) Suggest the advantages that pattern **B** has over pattern **A**.

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[Total: 10]

10 Either

- (a) (i)** The menstrual cycle is controlled by several hormones.

Use your knowledge of the role of these hormones in the menstrual cycle to suggest why progesterone is a component of contraceptive pills.

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- (ii)** The pill is ineffective in preventing the transmission of HIV. Why is this so?

Suggest **one** way HIV transmission can be prevented during sexual intercourse.

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- (b)** The placenta is an organ that develops in the uterus during pregnancy. It attaches to the wall of the uterus, and gives rise to the umbilical cord.

- (i)** Explain why blood does not pass directly from the mother to the foetus in the placenta.

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(ii) Describe the role of the placenta during pregnancy.

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[Total: 10]

10 Or

Antibodies are proteins secreted by specialised cells in the immune system to fight pathogens that enter our bloodstream.

(a) Briefly outline the process of how an antibody protein is synthesised from DNA.

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- (b) Describe the pathway taken by an antibody protein from the site of production to the outside of the specialised cells.

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[Total: 10]

******* End of Paper *******

