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.

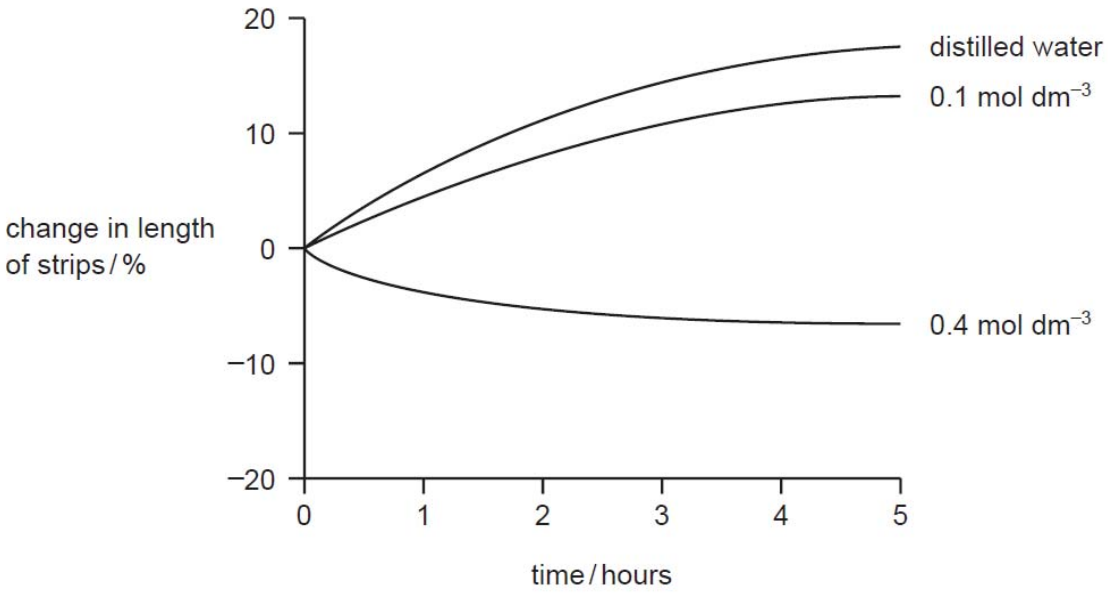
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Section A: Multiple Choice Questions (40 Marks)

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.

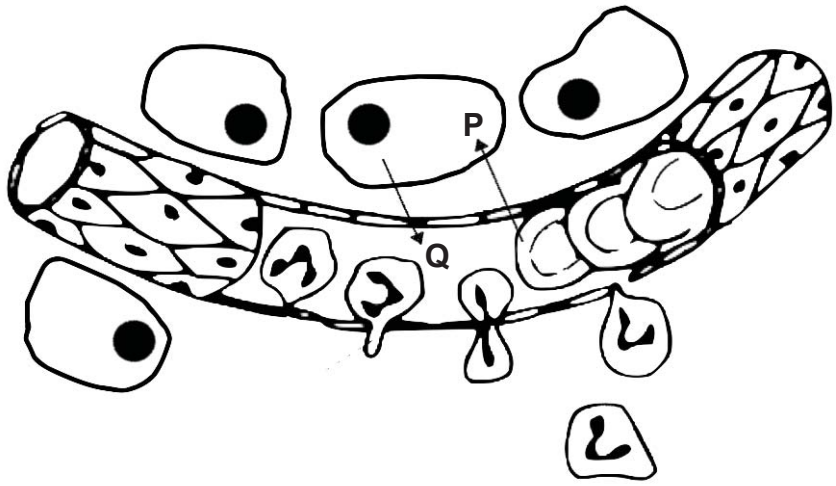


Which statement best explains the change that occurred in the potato strips immersed in 0.1 mol dm^{-3} sucrose solution?

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.

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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

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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?

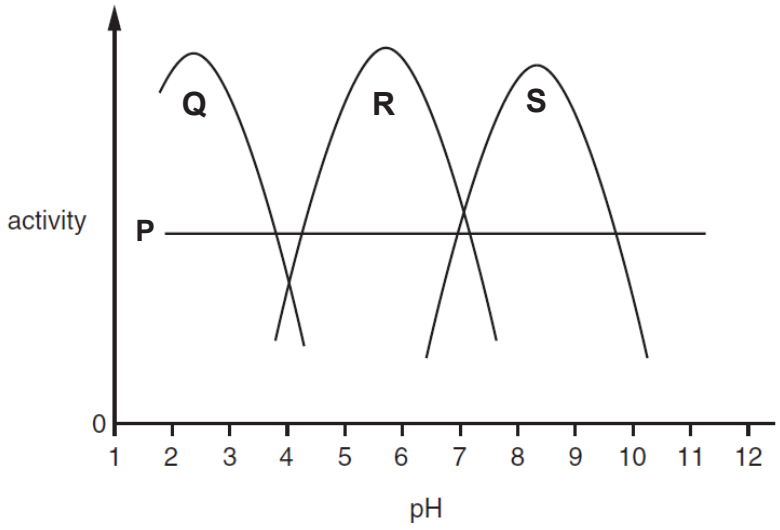
solution	Benedict's test	emulsion test	iodine test	biuret test
A	×	✓	×	✓
B	✓	×	×	✓
C	×	✓	✓	×
D	✓	×	✓	×

key

✓ = positive result

× = 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**

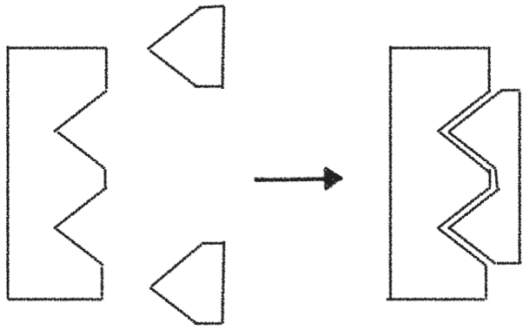
B **P** and **S**

C **R** and **Q**

D **R** and **S**

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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.

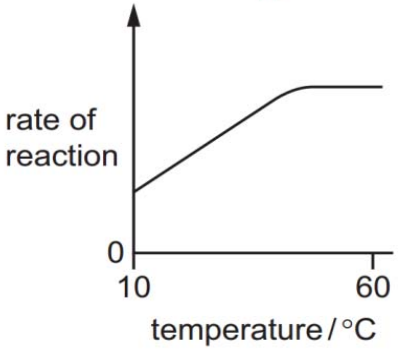
B The hydrolysis of fats by lipase.

C The oxidation of glucose in respiration.

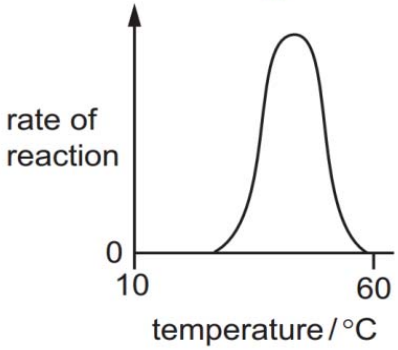
D The synthesis of cellulose cell walls in a plant cell.

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?

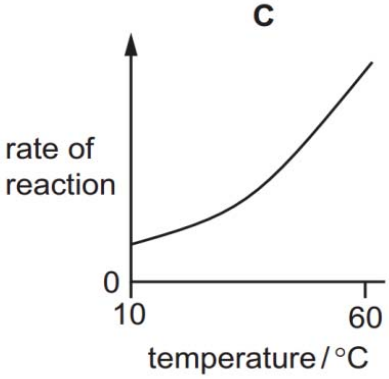
A



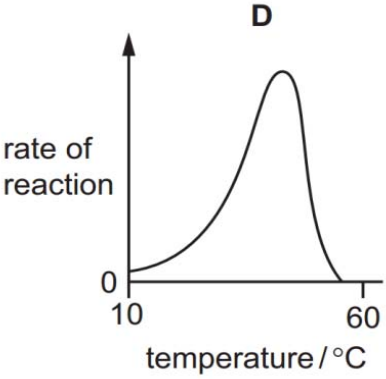
B



C

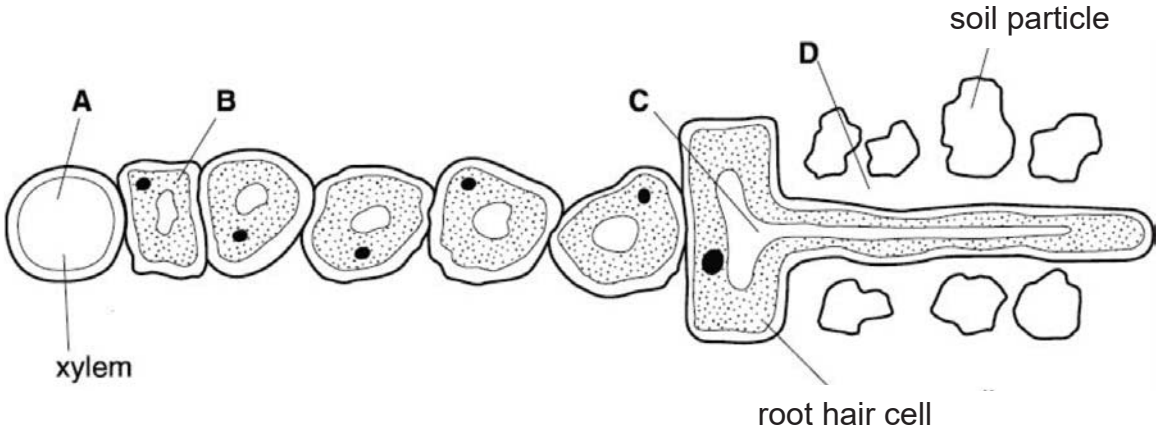


D

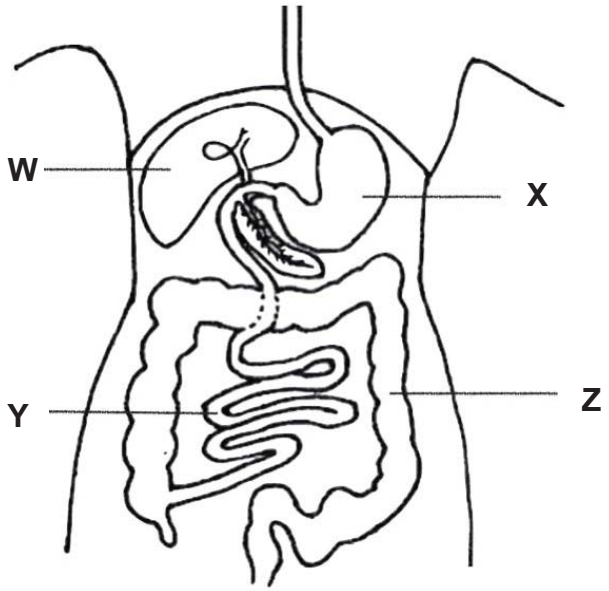


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9 The diagram below shows part of a plant root in the soil. At which labelled point is the water potential highest?



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

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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

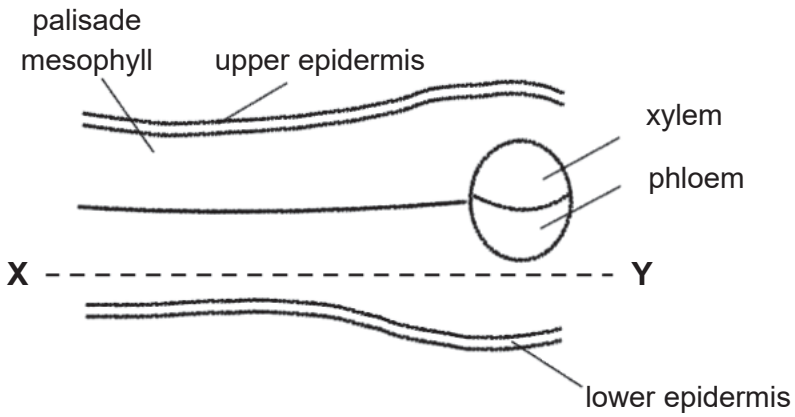
B I and II only

C I and III only

D I, II, and III

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

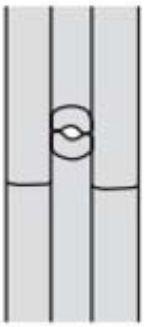


If a cut were made along the line **X—Y**, what would the arrangement of cells look like?

A



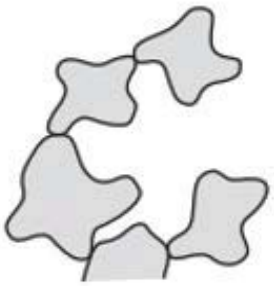
B



C

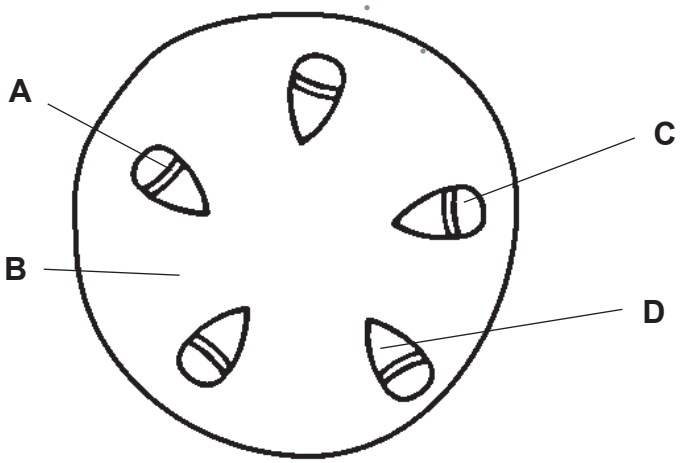


D



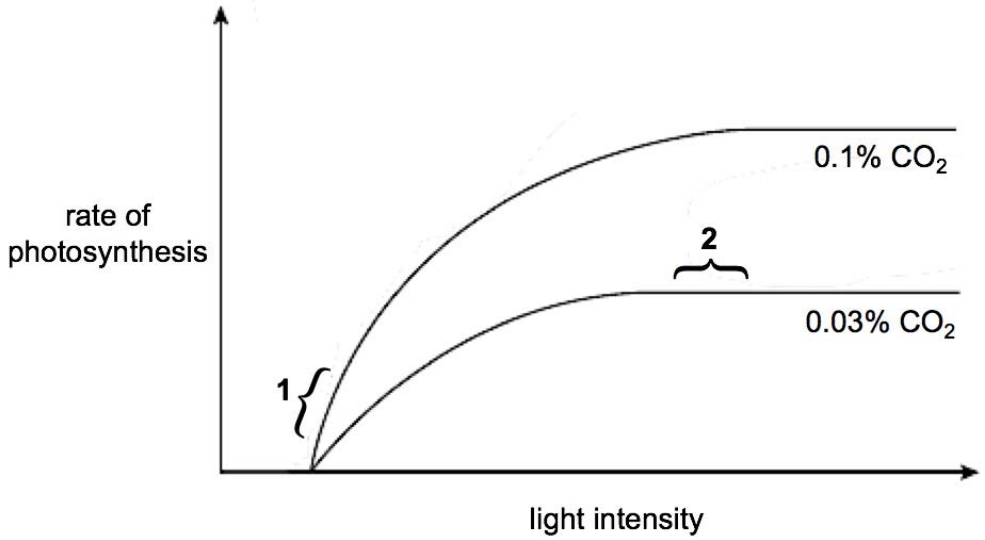
15 The diagram shows a section through the stem of a dicotyledonous plant.

Which tissue transports amino acids up the stem?



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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?

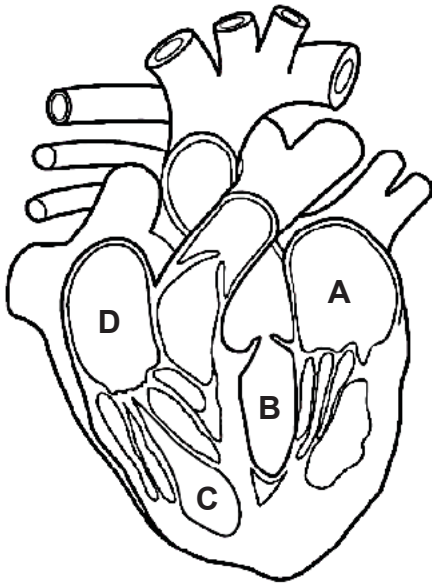
I. smooth endothelium
II. thick elastic layer in the artery wall
III. thick layer of muscles in the artery wall

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

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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

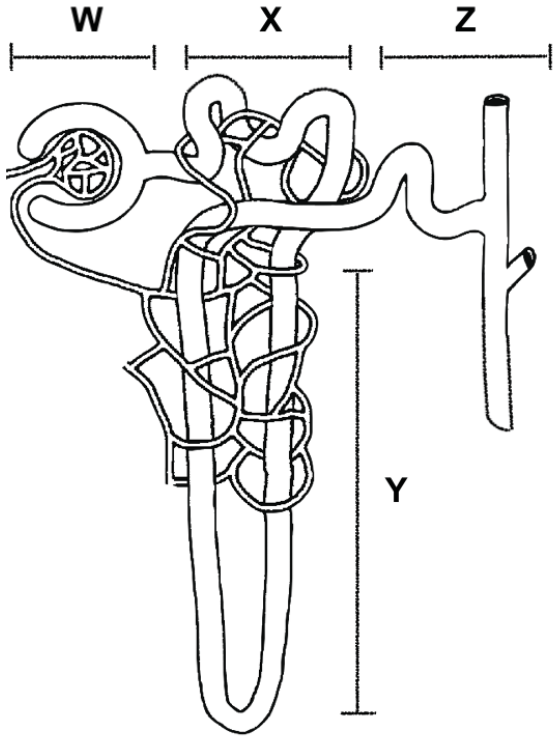
B distal convoluted tubule

C loop of Henle

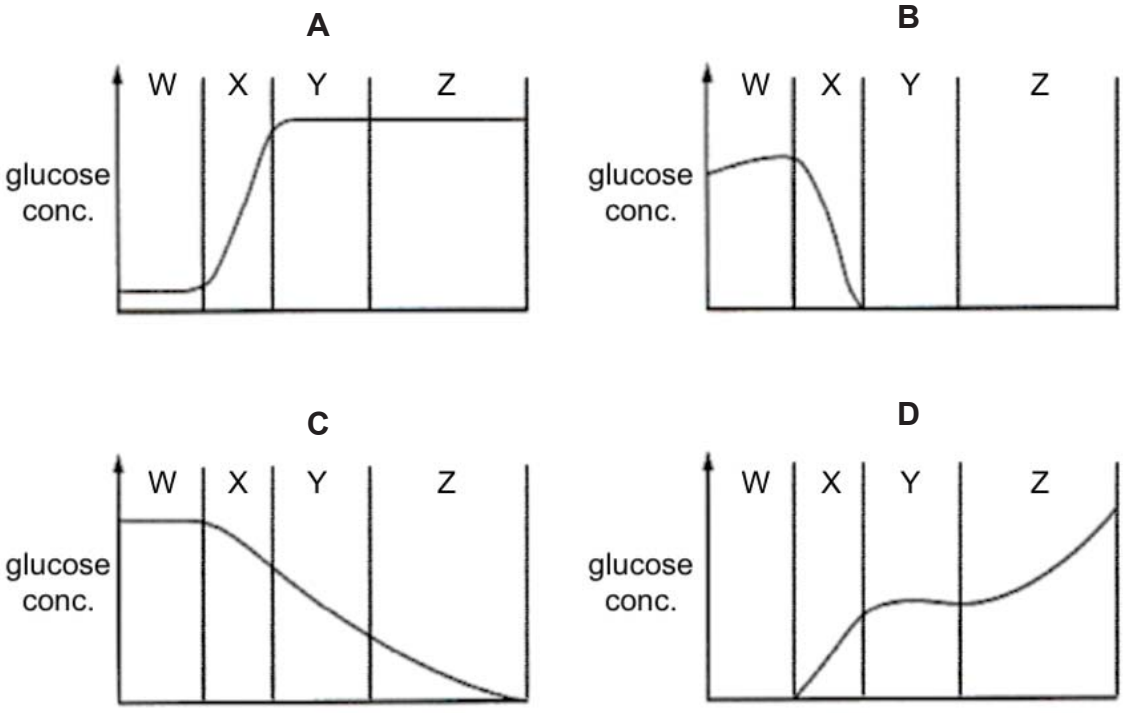
D proximal convoluted tubule

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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?



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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?

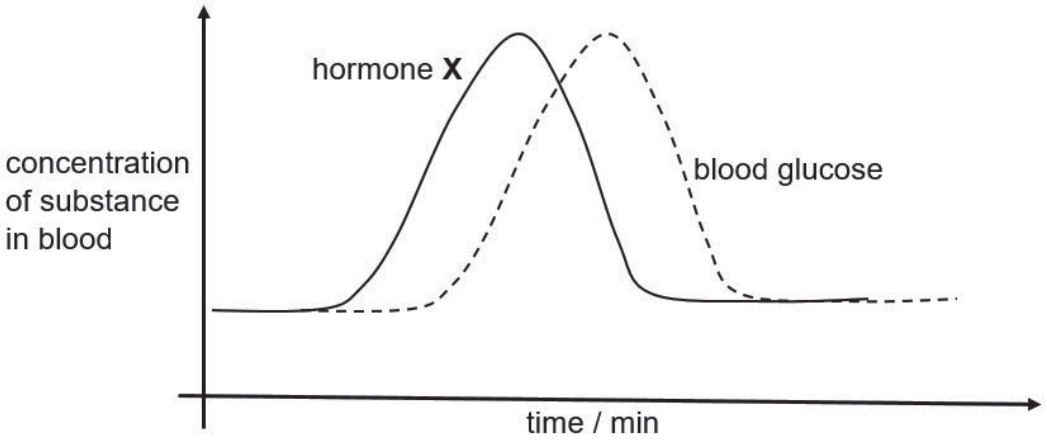
A I and II

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

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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

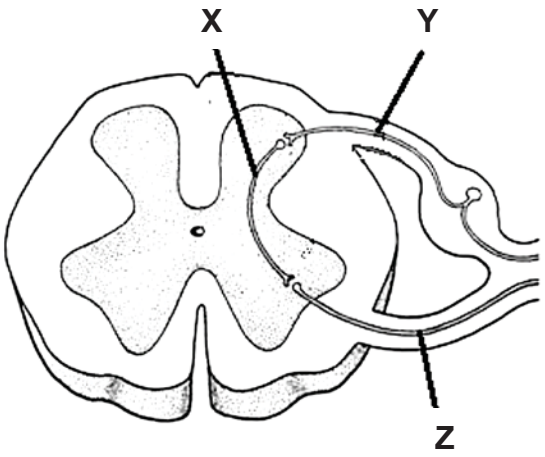
C relaxation of ciliary muscles

D contraction of ciliary muscles

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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 anaesthestic 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.

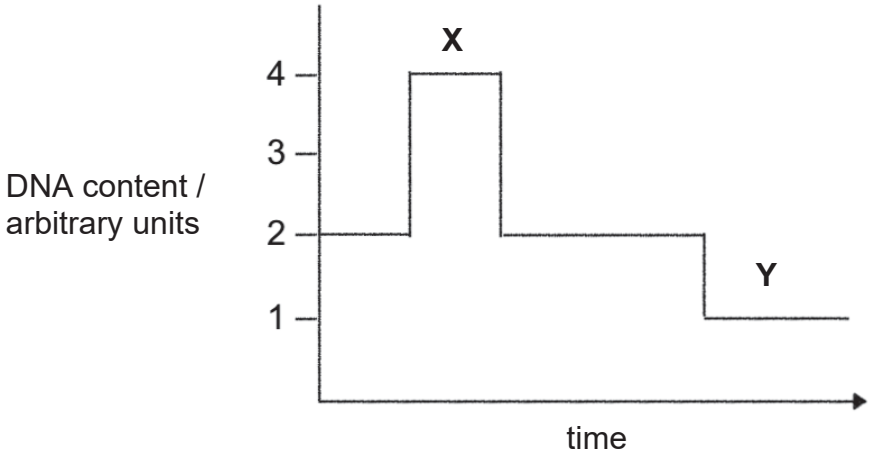
B He can feel a pinprick and move his leg.

C He can feel a pinprick but cannot move his leg.

D He cannot feel the pinprick and cannot move his leg.

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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**

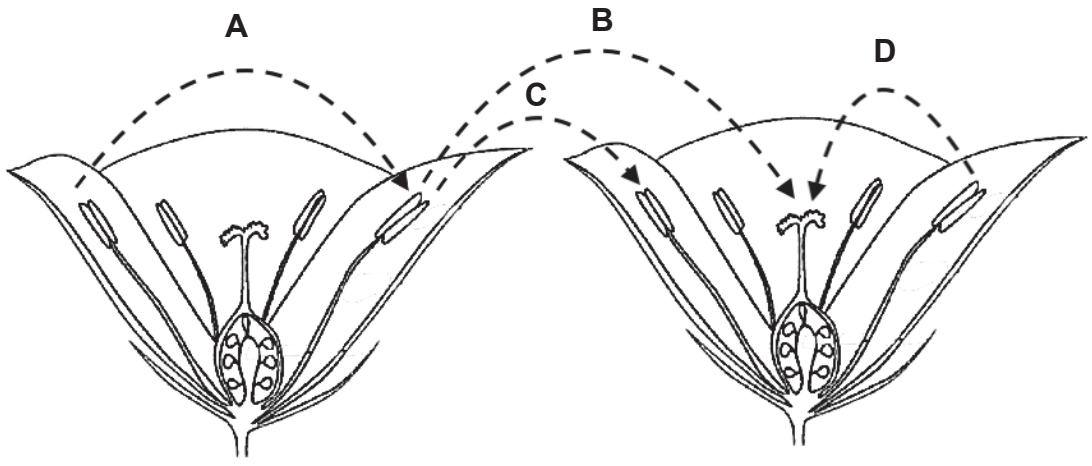
B Prophase **I** and Telophase **II**

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?



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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

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34 A 1:1 phenotypic ratio in the offspring in a test cross for a monohybrid trait indicates that _____.

A the alleles are dominant

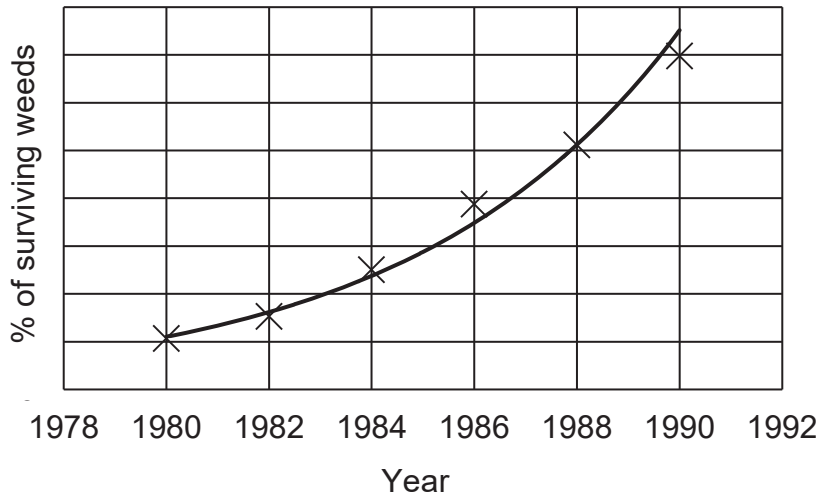
B the alleles are co-dominant

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

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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?

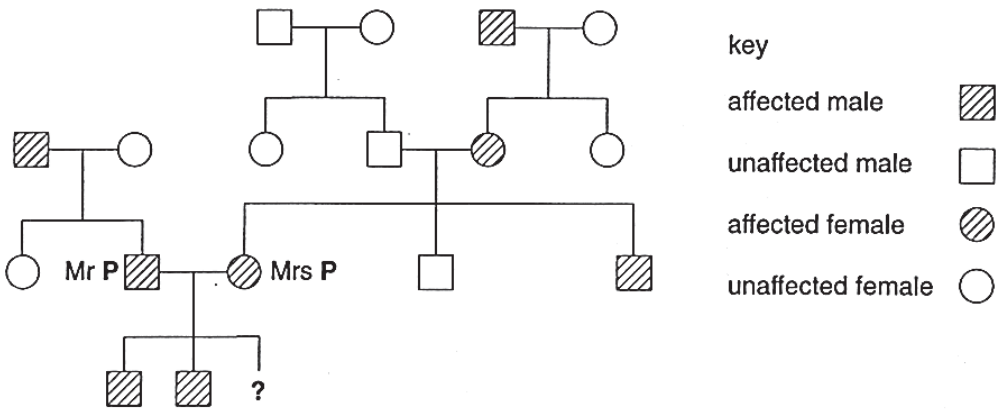
A None of their children will have the same blood group as either parent.

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.

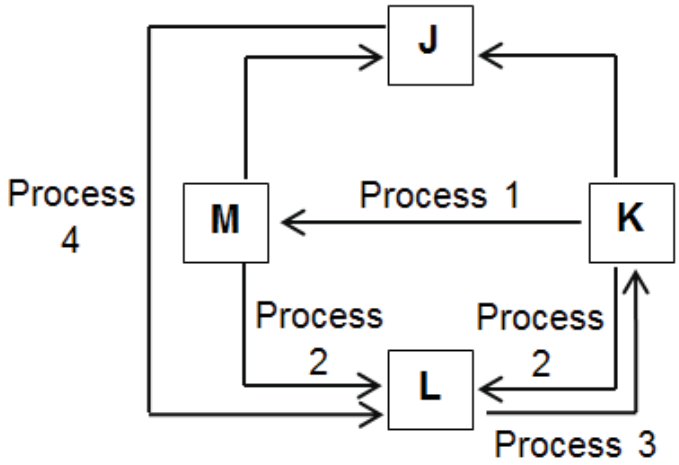
C The number of organisms at higher levels will be too small.

D There are very few organisms that feed on carnivores.

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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 *****

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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.

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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.

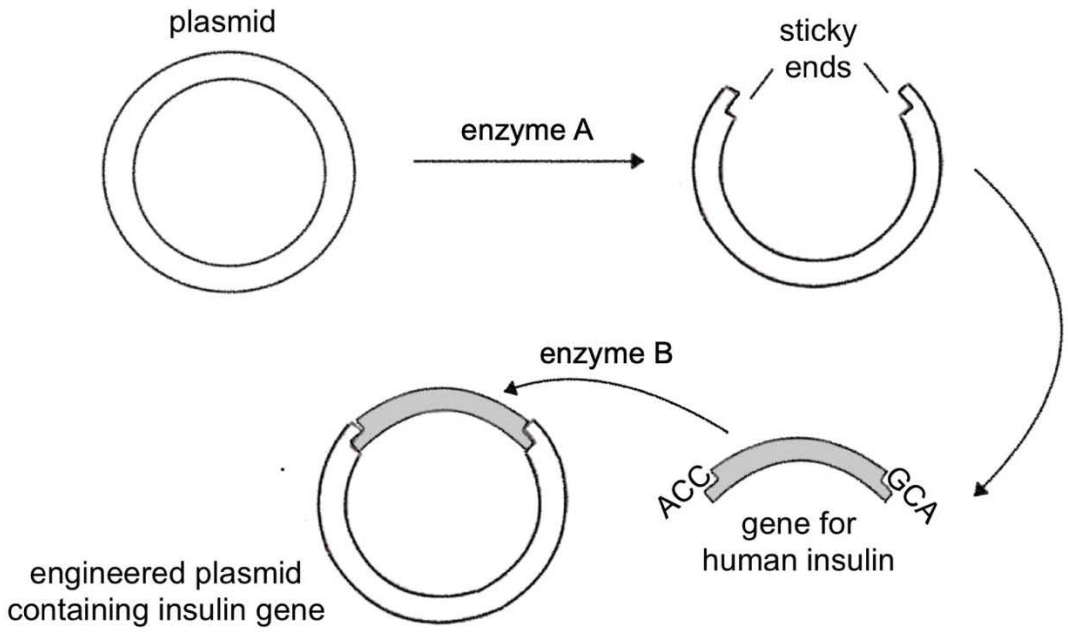


Fig. 1.1

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

…… [1]

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

……

……

……

…… [2]

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(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.

.....

.....

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.....

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……..... [3]

[Total: 8]

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

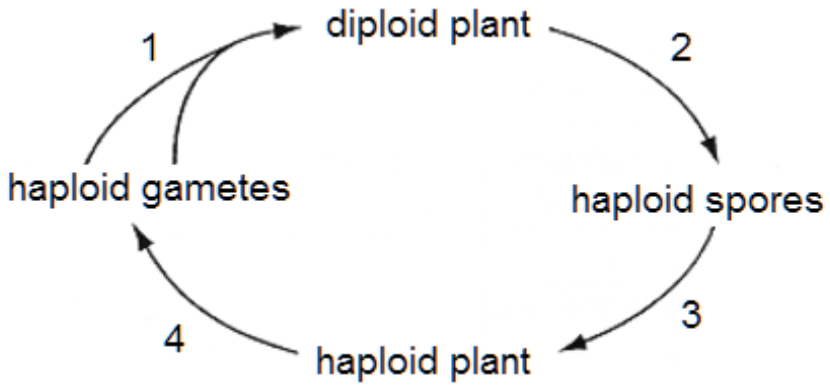


Fig. 2.1

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

..... [1]

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

.....

.....

.....

.....

..... [2]

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

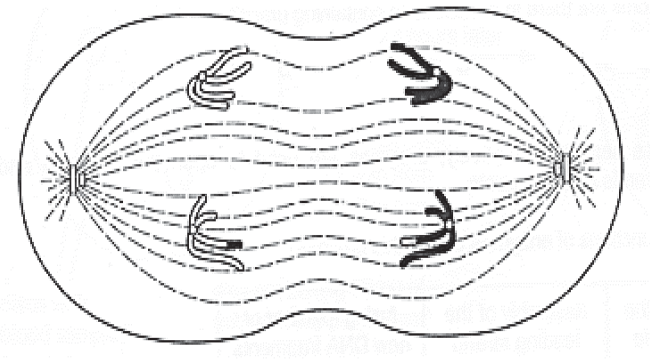


Fig. 2.2

(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]

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

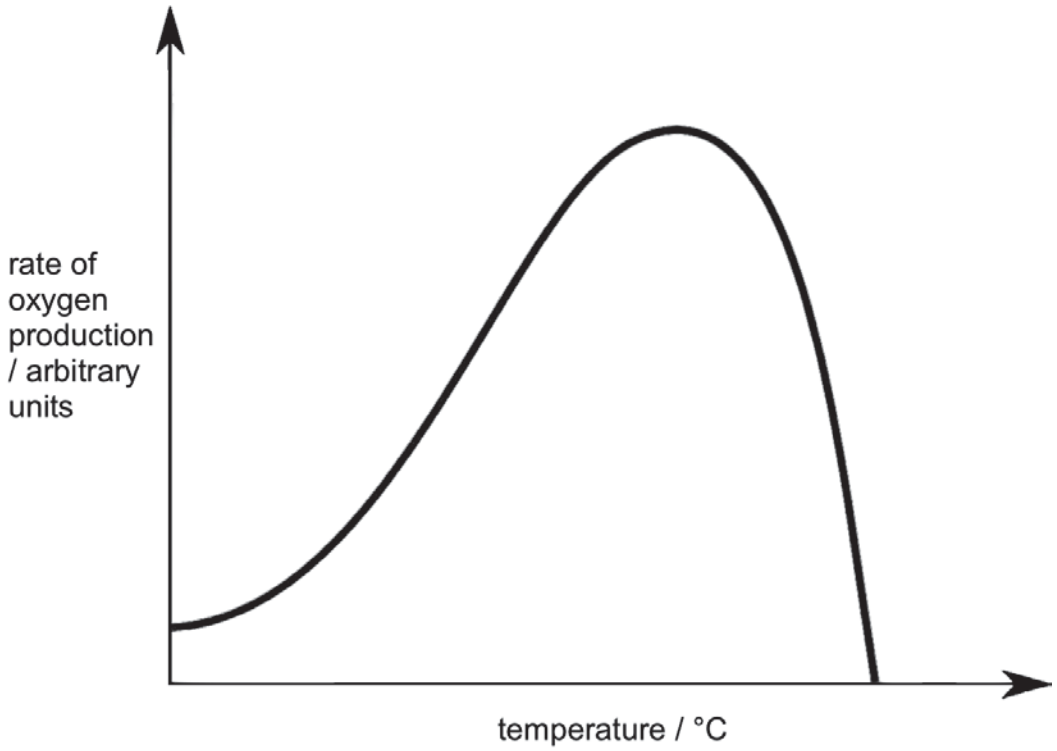


Fig. 3.1

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

..... [1]

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

.....

.....

.....

.....

.....

..... [2]

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(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]

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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]

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

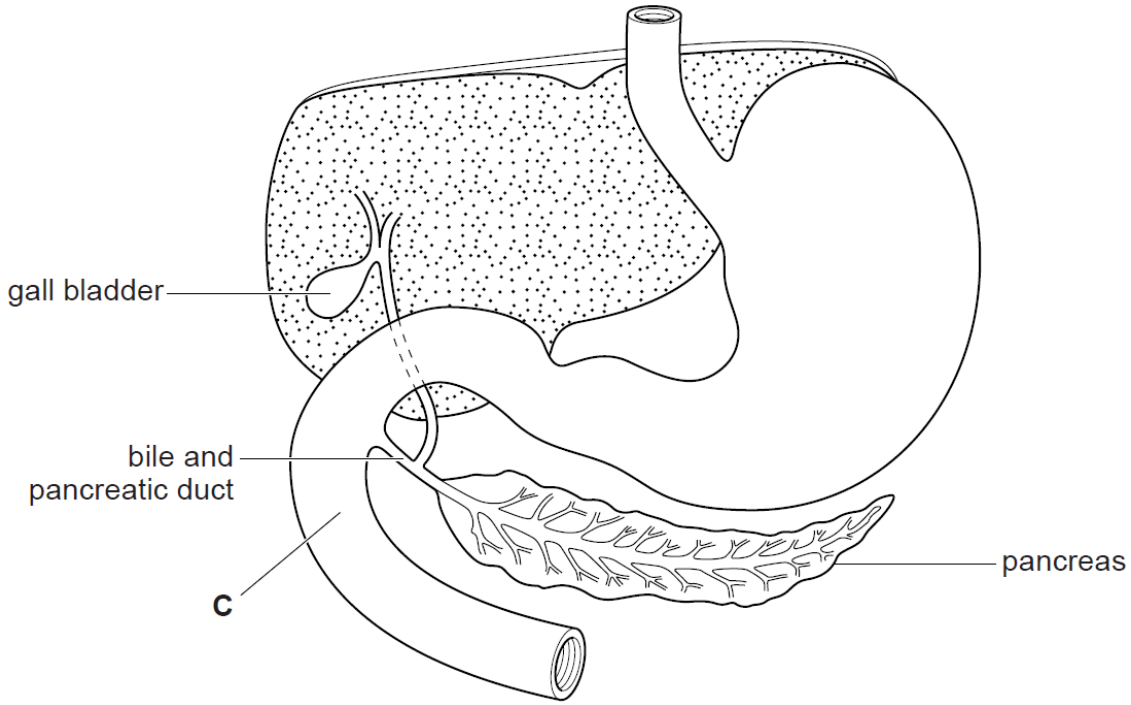


Fig. 4.1

(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]

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

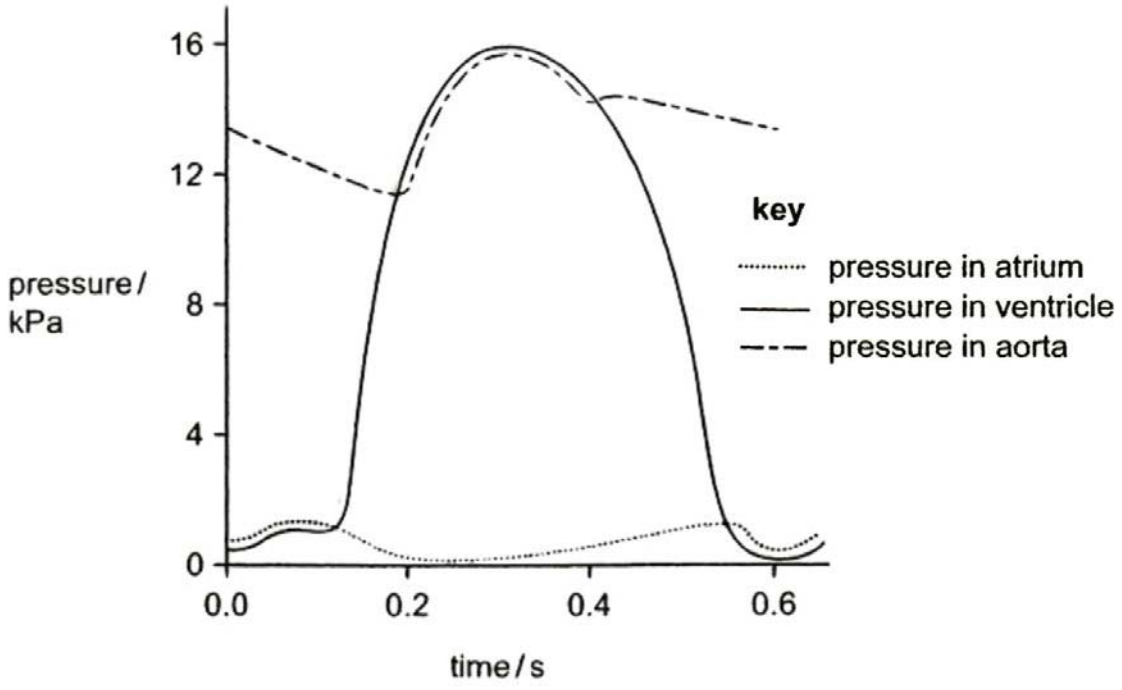


Fig. 5.1

(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]

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(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.

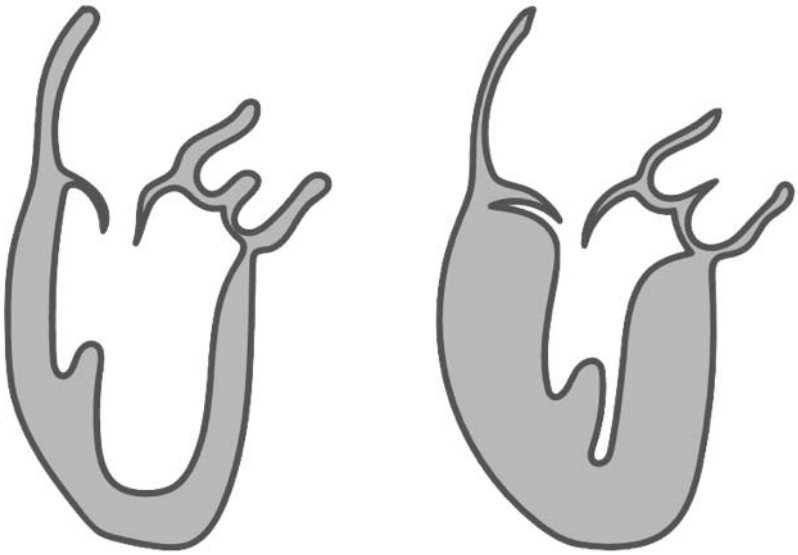


Fig. 5.2

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

.....

.....

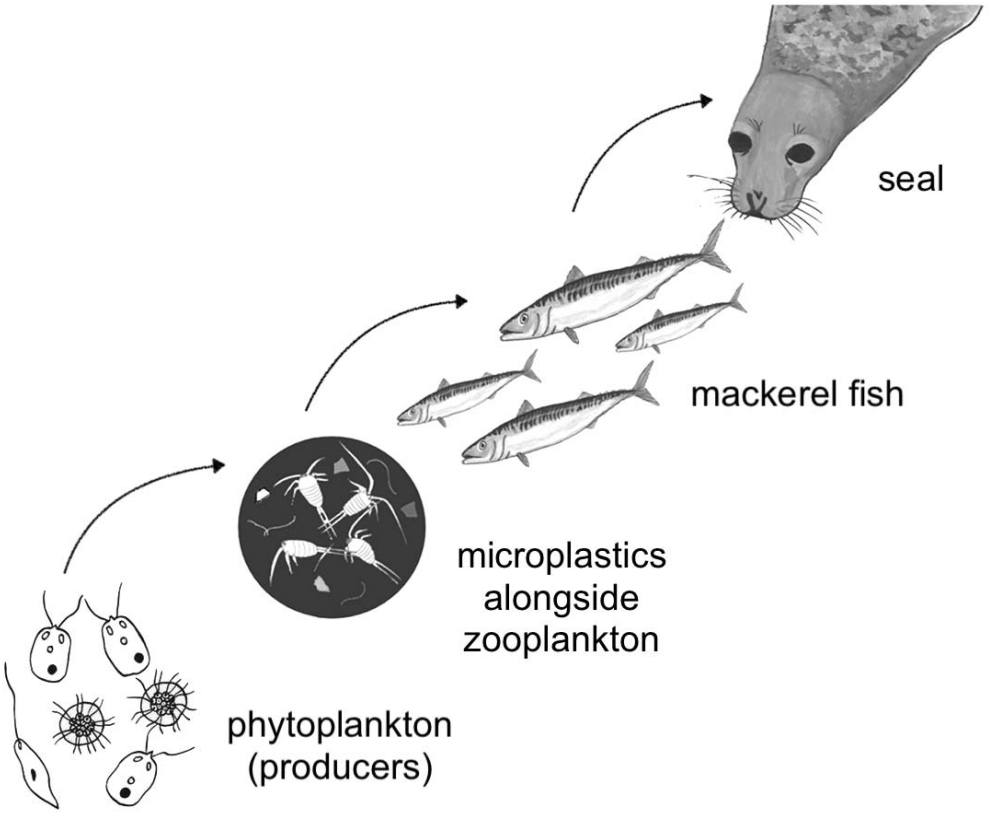
.....

..... [2]

[Total: 8]

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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]

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

.....

.....

.....

..... [2]

(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.

.....

.....

.....

.....

.....

..... [3]

[Total: 7]

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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.

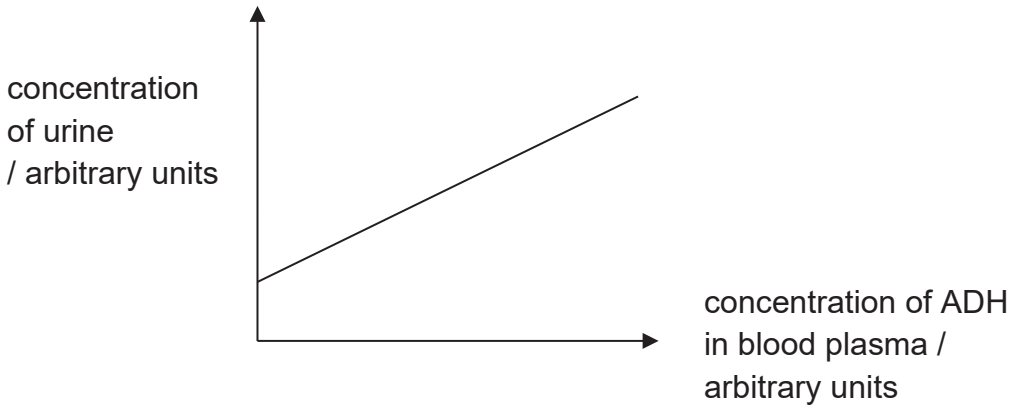


Fig. 7.1

(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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..... [3]

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

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..... [3]

[Total: 6]

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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.

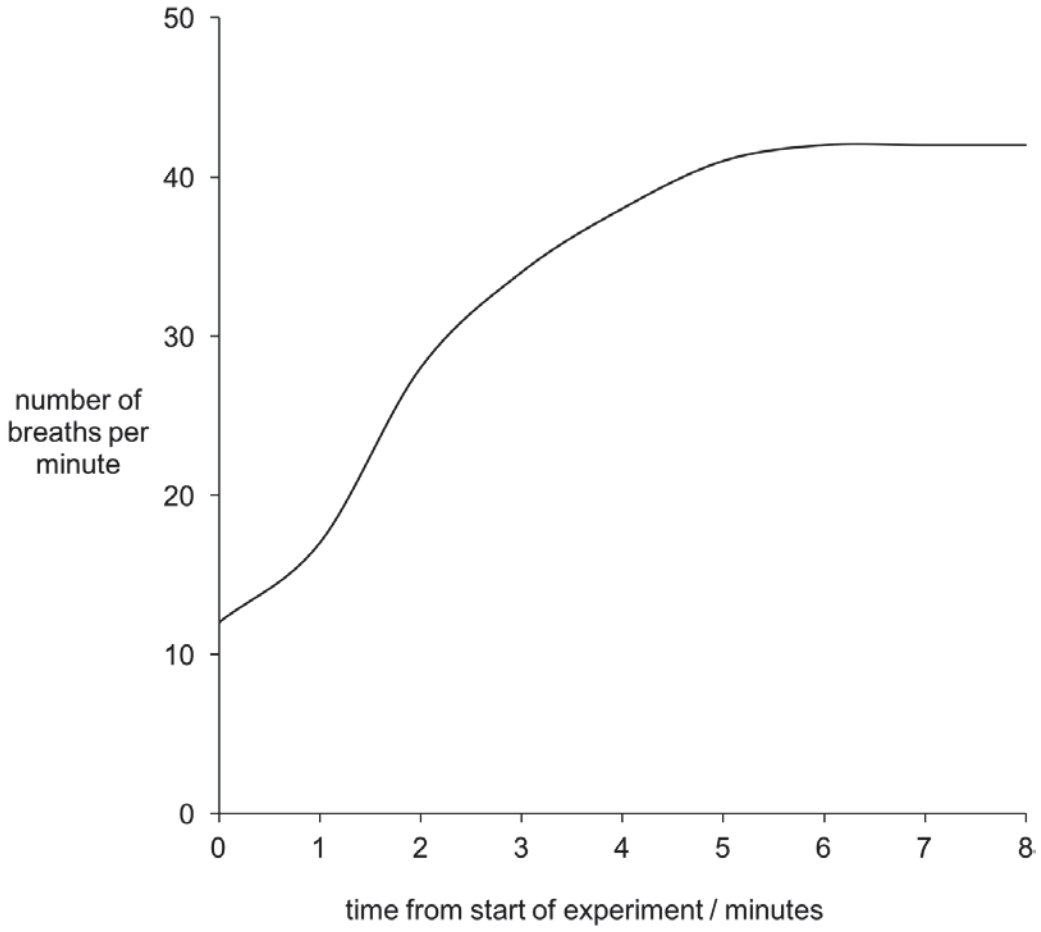


Fig. 8.1

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

.....

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..... [4]

(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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..... [6]

[Total: 10]

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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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..... [4]

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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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..... [4]

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

.....

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.....

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..... [2]

[Total: 10]

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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.

.....

.....

.....

..... [2]

(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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.....

..... [2]

(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.

.....

.....

.....

..... [2]

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

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.....

..... [4]

[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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..... [6]

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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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..... [4]

[Total: 10]

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

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Pure Biology Prelims 2019 Answer key

Paper 1

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

Paper 2 (Section A)

Q1	**a**	**i)**	DNA / Deoxyribonucleic acid / nucleotides;	1
		ii)	• Enzyme A is a restriction enzyme / endonuclease; • It cuts the plasmid at specific nucleotides to create sticky ends which are complementary to the insulin gene;	2
		iii)	TGG, CGT;	1
		iv)	• More rapid / efficient; • Lowered rejection/immune reaction as it is human insulin; • Less ethical issues; • Less manpower required *(max 1m)*	1
	b		• Insulin increases the membrane permeability of liver and muscle tissues to glucose; • This increases rate of absorption of glucose/promotes conversion of glucose to glycogen for storage; • Thus reducing overall blood glucose level;	3

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Q2		**a**	**i)**	Stage 2;	1
			ii)	• to form gametes with half the number of chromosomes as the parent cell ; • to ensure that the diploid number of chromosomes will be restored after fertilisation ; • meiosis give rise to genetic variation through crossing over and independent assortment ; • give rise to genetic variation through random fusion of gametes produced ; *(Any 2)*	1 1 1 1
		b	**i)**	Anaphase I	1
			ii)	Homologous chromosomes are being separated and pulled to opposite ends of the cell ;	1
			iii)	Centrioles would be absent/cell plate is formed	1
Q3	**a**	**i)**		$\text{carbon dioxide} + \text{water} \xrightarrow[\text{chlorophyll}]{\text{light energy}} \text{glucose} + \text{oxygen}$	1
		ii)	• As temperature increases, rate of oxygen production increases because enzyme activity in photosynthesis increases; • Beyond optimum temperature, rate of oxygen production drops drastically as enzymes are denatured;		1 1

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	b	**i)**	• As temperature increases, <u>rate of evaporation</u> from the <u>film of water</u> surrounding <u>spongy mesophyll cells</u> increases; • More water molecules travel from the xylem via <u>osmosis</u> to the spongy mesophyll cells thus <u>increasing</u> the rate of transpiration;	1 1
		ii)	• Wilted leaves have <u>less surface area</u> exposed to sunlight → <u>less light energy</u> can be trapped by <u>chlorophyll,</u> rate of photosynthesis decreases; • <u>Stomata size</u> is reduced → less <u>CO_2</u> absorbed for photosynthesis, rate of photosynthesis decreases; • <u>Less water available</u> → <u>water is needed for photosynthesis</u>, rate of photosynthesis decreases; *(Any 2)*	1 1 1
Q4	**a**	**i)**	Parental phenotype: CF X Normal / Carrier Parental genotype: dd X Dd Gametes: d d D d F1 Genotype: Dd dd Dd dd F1 Phenotype: Normal CF Normal CF F1 Phenotypic ratio: 1 Normal : 1 CF	1 1 1

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		ii)	• The couple's children have a high risk of contracting cystic fibrosis; • As the expected phenotypes of their children are 1 CF : 1 Carrier / 50% CF to 50% Carrier;	1 1
	b	**i)**	Duodenum;	1
		ii)	• Reduction in enzymes (lipase)/ bile entering duodenum, leading to reduced digestion/emulsification of fats; • Less nutrients absorbed for growth / storage;	2
5	**a**	**i)**	• Any answer from 0.18s - 0.2s *(R: answers without units)*	1
		ii)	• From 0.1s to 0.3s, pressure in the ventricle increases • From 1 kPa to 16 kPa; • As the muscles of the ventricle contract; *(-1m if no data quoted)* *(R: ventricle contracts)*	1 1 1
		iii)	• The right ventricle only pumps blood to the lungs over a shorter distance; • Has thinner muscular walls compared to left ventricle;	1 1
	b		• The left ventricle is unable to relax and fill with sufficient blood / smaller volume in left ventricle; • Less blood / oxygen is pumped around the body;	1 1

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Q6	**a**	**i)**	 *(1m for correct shape; 1m for labelling in correct order)*	2
		ii)	• A trophic level represents the feeding position of an organism in a food chain / food web ; o The first trophic level refers to producers like the phytoplankton which produce their own food; o The second trophic level refers to primary consumers such as the zooplankton that feed on producers like phytoplankton; o The third trophic level refers to secondary consumers such as mackerel that feed on primary consumers like zooplankton ; o The fourth trophic level refers to tertiary consumers like the seal that feed on secondary consumers; o *(Max 1m out of the above 3)* *(-1m if no reference is made to any organism in Fig. 6.1)*	1 1
	b		• Microplastics cannot be excreted and is thus passed along in food chains; • Concentration of microplastics increases with each trophic level/Bioamplification with each trophic level; • Resulting in bioaccumulation of microplastics in top consumers;	1 1 1

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Q7	**a**	• The concentration of urine <u>increases</u> as concentration of ADH increases; • <u>ADH increases the permeability of collecting ducts to water</u>; • More <u>water re-enters the blood</u> from the urine/filtrate; (*R: ADH "changes" permeability of collecting ducts)*	1 1 1
	b	• Profuse <u>sweating</u> from vigorous exercise would cause <u>water loss</u>; • <u>Water potential of the blood drops</u>; • Hypothalamus is stimulated to <u>release more ADH</u> into the bloodstream;	1 1 1

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Paper 2 (Section B)

<table>
<tr>
<td>Q8</td>
<td>a</td>
<td>
<table>
<tr><th>Aerobic respiration</th><th>Anaerobic respiration</th></tr>
<tr><td>Takes place in the presence of oxygen</td><td>Takes place in the absence of oxygen</td></tr>
<tr><td>Oxidises glucose
OR
Uses oxygen and glucose as substrates</td><td>Does not oxidise glucose
OR
Glucose is the only substrate</td></tr>
<tr><td>Produces carbon dioxide and water</td><td>Produces lactic acid</td></tr>
<tr><td>Releases a large amount of energy</td><td>Releases an additional small amount of energy</td></tr>
<tr><td>Takes place in mitochondria</td><td>Takes place in cytoplasm</td></tr>
</table>
(1m for every valid point-to-point comparison)
</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>

At first, the muscle cells of the legs respire aerobically;
Breathing rate increases from 12 to 42 breaths per minute to take in more O_2 and remove CO_2 faster;
Heart rate also increases to transport glucose and O_2 to respiring cells faster;
However, there is a limit to heart rate & breathing rate,
At ~5mins the athlete's breathing rate has reached a maximum/plateau of 42 breaths per minute;
To continue the exercise, muscle cells have to start respiring anaerobically, releasing a small amount of energy and lactic acid as a by-product.
Accumulation of lactic acid to high concentrations leads to muscle aches

(any 6)
(-1m for no data/insufficient data quoted)
</td>
<td>6</td>
</tr>
<tr><td colspan="4"></td></tr>
</table>

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Q9	**ai**	• Pain receptor in skin stimulated and produce impulses; • Nerve impulses travel along sensory neurone to spinal cord (central nervous system) • Nerve impulses transmitted across synapse to relay neurone and then across another synapse to motor neurone; • Nerve impulses travel along motor neurone to leg muscle (effector); • Leg muscle contracts and withdraws foot from nail (action) *(max 4m; -1m if no mention of keywords in pattern A)*	4
	aii	• Blood glucose concentration increases (stimulus) • Islets of Langerhans (receptor) in pancreas stimulated and release insulin into bloodstream • Insulin carried by blood to liver (effector) • Liver converts glucose into glycogen /Uptake of glucose by cells / usage of glucose in respiration (action) • Blood glucose concentration returns to normal levels *(max 4m; -1m if no mention of keywords in pattern B)*	4
	b	• Endocrine control can have long-lived or short-lived responses while nervous control has only short-lived responses; • Endocrine control can affect more than one target organ while nervous control is usually localised; • *Medical conditions under endocrine control can be more easily treated by medication which alter hormone levels* • *(or any other reasonable answer)*	2

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Q10 E	**ai**	• Progesterone inhibits FSH secretion by the anterior pituitary gland by negative feedback; • When FSH is low, primary follicles are not developed in the ovary and thus ovum will not be released, preventing fertilisation;	2
	aii	• The pill is a chemical contraceptive that does not prevent the exchange of bodily fluids during sexual intercourse; • Males could wear condoms/ practice abstinence / fidelity to one partner	6
	bi	• High blood pressure of the mother would kill the foetus; • Maternal and foetal blood may be incompatible, i.e. different blood group when mixed, would lead to agglutination;	
	bii	• Allows useful substances, e.g. oxygen and glucose, to diffuse from the mother's blood to foetus' blood; • Allows metabolic waste products, e.g. urea and carbon dioxide, to diffuse from foetus' blood to mother's blood; • Allows protective antibodies to diffuse from mother's blood to foetus' blood that would protect the baby against disease-causing organisms; • Produces progesterone to maintain the thickness of the endometrium during pregnancy;	

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Q10 Or	**ai**	• A gene found on the DNA codes for the antibody protein; • Every 3 DNA nucleotides / codon codes for an amino acid; • The template strand of the gene is used to make mRNA; • Which is transported out of the nucleus into the cytoplasm; • The mRNA attaches to a ribosome; • Which translates the message in mRNA into a sequence of amino acids; • By recruiting tRNAs containing anti-codons that are complementary to the mRNA; • Amino acids are joined by peptide bonds to form polypeptide chains; *(any 6)*	6
	b	• Ribosomes on the RER synthesise the antibodies / vesicles containing the antibodies pinch off from the RER; • To fuse with the Golgi apparatus which stores and modifies the protein/antibody; • Secretory vesicles containing the protein/antibody pinch off from the Golgi apparatus; • And move to fuse with the cell surface membrane, releasing the antibody outside of the cell;	4

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