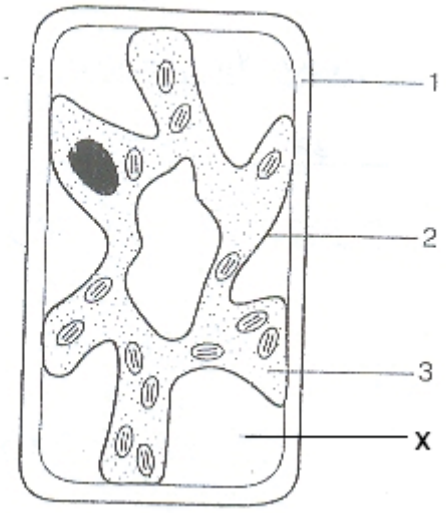
Paper 1
Answer ALL questions in the Multiple Choice Marking Sheet provided.

The diagram below shows a plant cell that has been placed in 20% salt solution for 10 minutes

Use this information to answer questions 1, 2 and 3.



1 Which structure shows that the cell is a plant cell and not an animal cell?

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

2 What substance can be found in region **X**?

A Air
B Water
C 10% salt solution
D 20% salt solution

3 Which structure controls substances into and out of the cell?

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

4 Which of the following term is used to describe a group of cells of similar structure and perform a specific function?

A cell
B clone
C organ
D tissue

5 An actively growing cell is supplied with radioactive amino acids.

Which cell component would first show an increase in radioactivity?

A golgi body
B mitochondrion
C nucleus
D rough endoplasmic reticulum

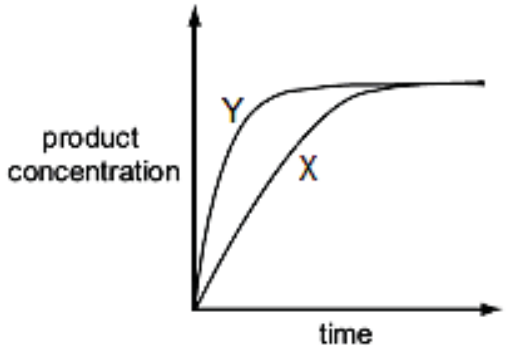
6 Which combination of chemical elements **must** be present in protein molecules?

	Phosphorus	Nitrogen	Oxygen
A	X	X	X
B	X	√	√
C	√	X	√
D	√	√	√

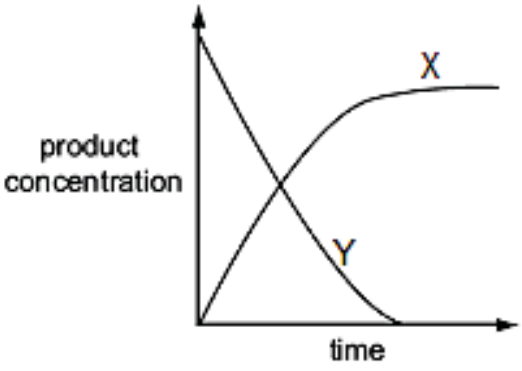
7 Two enzymatic experiments were carried out on pancreatic lipase. The first, experiment X, was carried out at a constant temperature of 37 °C. During the second experiment, Y, the temperature was increased from 37 °C to 80 °C.

Which graph shows the results?

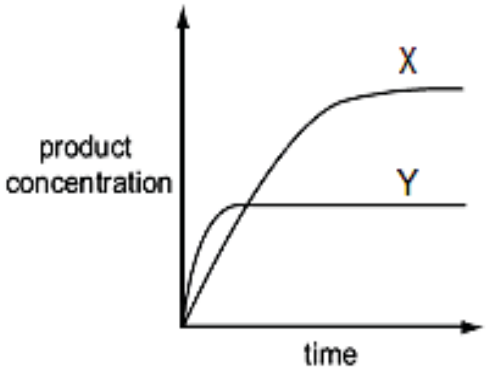
A



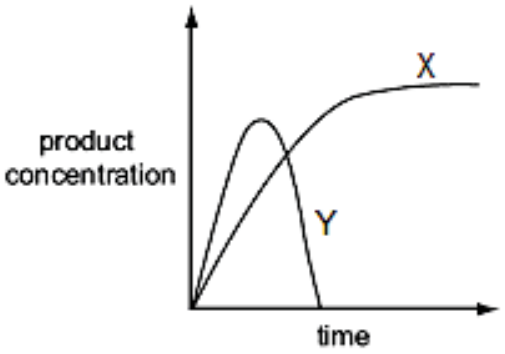
B



C



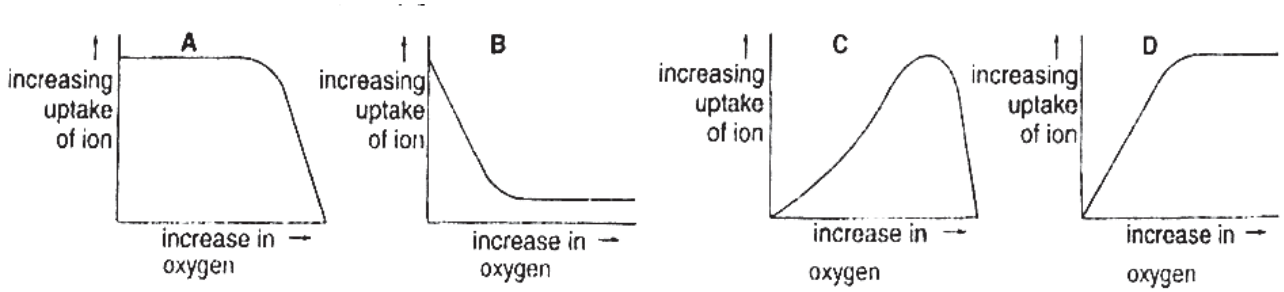
D



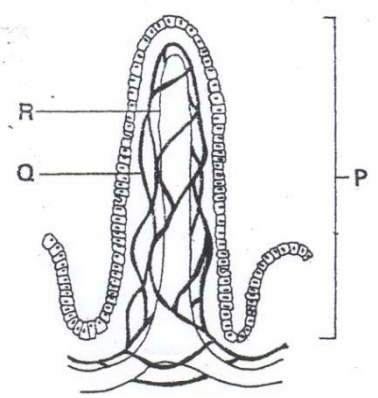
8 Which chemical test shows the presence of an enzyme in a biological washing powder?

A Benedict's test
B Biuret's test
C Ethanol emulsion test
D Iodine test

9 Which of the following represents the rate of ion uptake by a living cell in response to increasing oxygen concentration?



The diagram below which illustrates the structure of a certain part in a human alimentary canal. Use this information to answer Questions **10** and **11**.



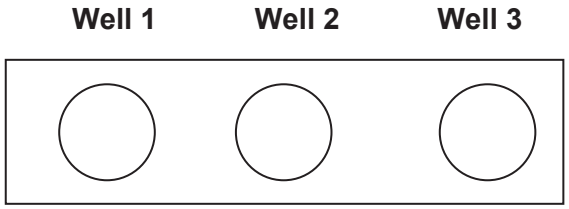
10 Identify structure **P**.

A Duodenum
B Ileum
C Microvilli
D Villi

11 Which of the following food substances are absorbed by structures **Q** and **R**?

	Q	**R**
A	Amino acids and fatty acids	Glucose and glycerol
B	Amino acids and glucose	Fatty acids and glycerol
C	Fatty acids and glycerol	Glucose and amino acids
D	Fatty acids and glucose	Glucose and amino acids

12 Digestive juices were collected from three regions of the alimentary canal. Drops of these juices were added to wells made in an agar of starch as shown below.



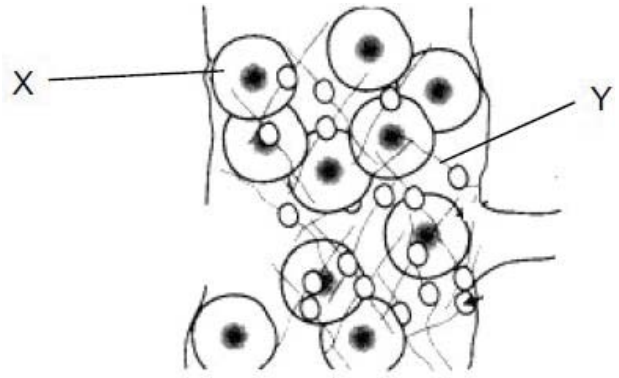
After an hour, the wells were rinsed with distilled water and flooded with iodine solution. The results are shown below:

well	1	2	3
colour of iodine solution	blue-black	brown	brown

Which of the following correctly identifies the regions of the alimentary canal from which the three digestive juices were obtained?

	well 1	well 2	well 3
A	mouth cavity	small intestine	stomach
B	mouth cavity	stomach	small intestine
C	small intestine	mouth cavity	stomach
D	stomach	mouth cavity	small intestine

13 The diagram below shows a blood clot on a hand after it suffers a cut.



What are structures **X** and **Y**?

	X	**Y**
A	Red blood cell	Fibrin
B	Red blood cell	Fibrinogen
C	White blood cell	Fibrin
D	White blood cell	Fibrinogen

14 A person's blood group is determined by antigens present on the red blood cells. Most people have antibodies in their blood plasma even if they have never received a blood transfusion. It is these antibodies in the plasma of the person who receives the blood which makes some blood transfusions unsafe.

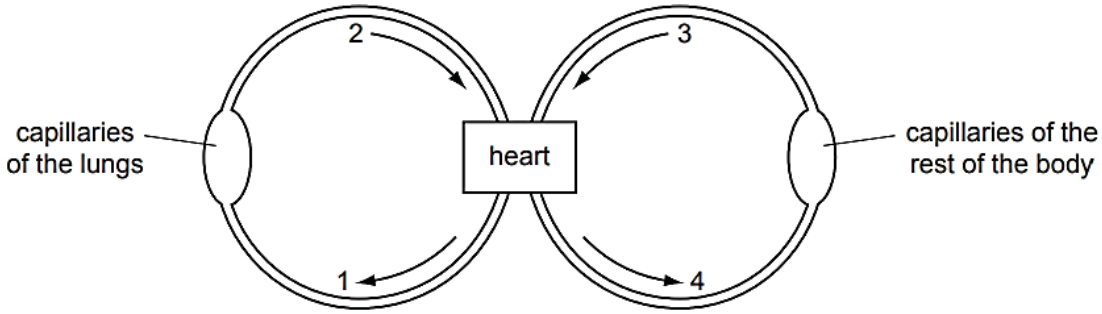
The table shows the antigens and antibodies in the blood of people with different blood groups.

blood group	antigens on red blood cells	antibodies in plasma
A	A	antibodies to B
B	B	antibodies to A
AB	A and B	no antibodies to A and B
O	neither A nor B	antibodies to A and B

Which are the blood groups of people who can safely receive blood from a person who has blood group A?

A AB only
B A and O
C B and O
D A and AB

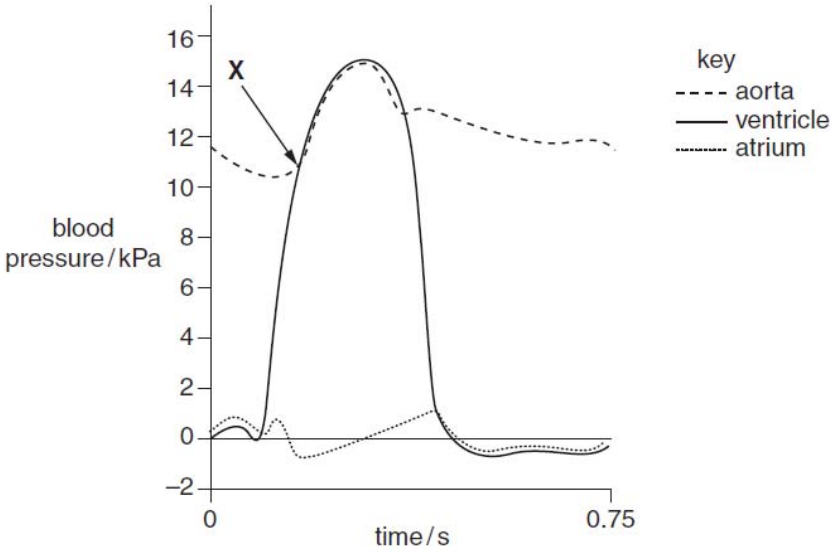
15 The diagram shows a double circulatory system.



Which two vessels carry blood at the highest pressure?

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

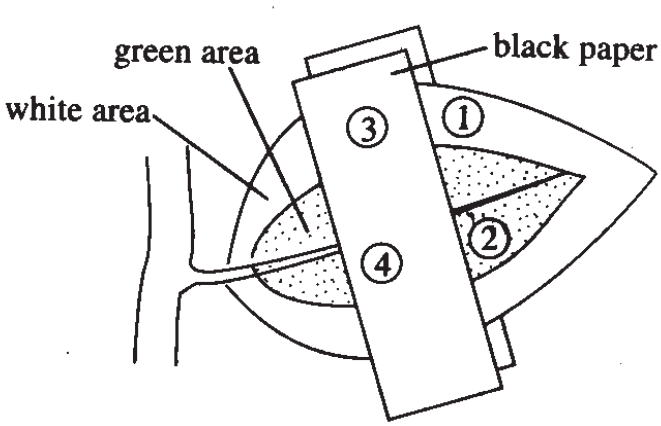
16 The graph shows changes in blood pressure during one cardiac cycle.



What is happening to the ventricle and aortic semilunar valve at **X**?

	ventricle	aortic semilunar valve
A	contracting	closing
B	contracting	opening
C	relaxing	closing
D	relaxing	opening

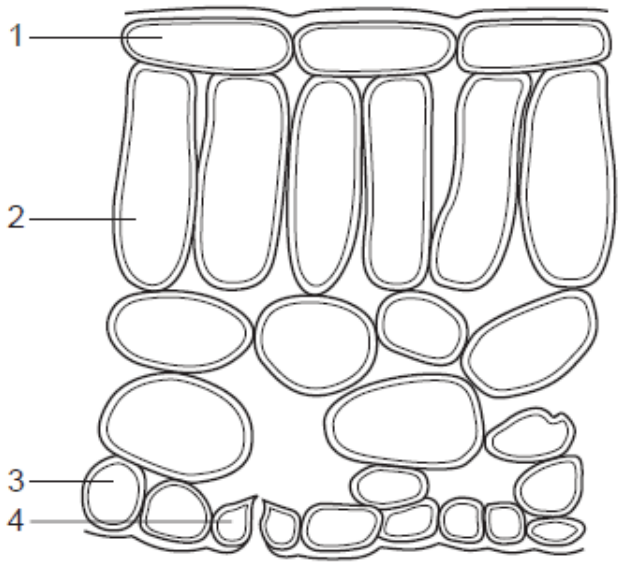
17 The diagram shows a destarched variegated leaf partly covered by black paper. The plant was placed in bright light for several hours. Four discs were then cut from the leaf in the position shown and were tested for starch.



Which discs contained starch?

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

The diagram below shows cells in a section through a leaf of a typical green plant. Use this information to answer questions **18** and **19**.



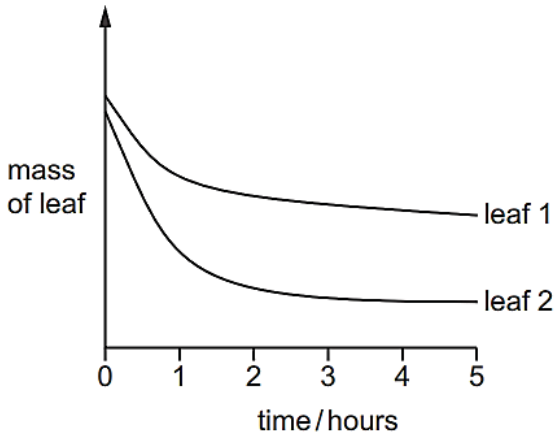
18 Which cells contain chloroplasts?

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

19 Which cell does not have uniform thickness of its cell wall?

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

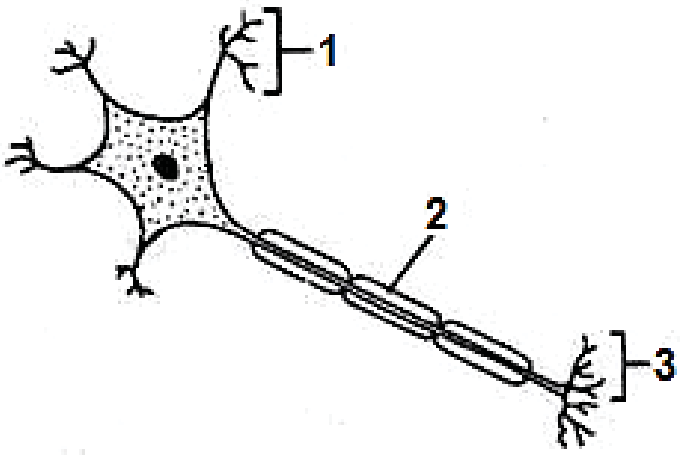
20 The diagram shows the results of an experiment using leaves with the same surface area from two different species. Each leaf was left on a balance in daylight in a closed room and their mass recorded at 1 hour intervals.



What could explain these results?

A Leaf 1 has a thicker cuticle than leaf 2.
B Leaf 1 is thinner than leaf 2.
C Leaf 2 has stomata protected by hairs and leaf 1 does not.
D Leaf 2 has sunken stomata and leaf 1 does not.

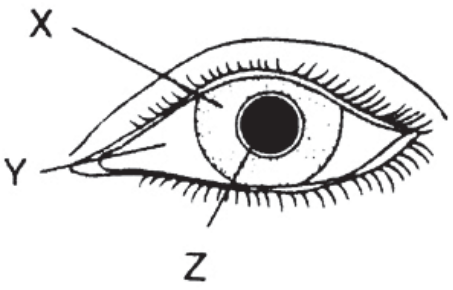
21 The diagram below shows a motor neurone.



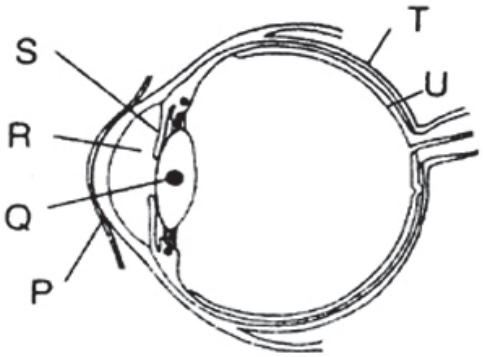
What are the functions of parts **1**, **2** and **3**?

	1	2	3
A	receives impulses	allow impulses to transmit efficiently	transmits impulses
B	receives impulses	secretes neurotransmitter	transmits impulses
C	transmits impulses	allow impulses to transmit efficiently	receives impulses
D	transmits impulses	secretes neurotransmitter	receives impulses

22 The diagrams below show the front view and longitudinal section of the eye.



Front view



Longitudinal section

What structures shown in the front view are similar to the longitudinal section?

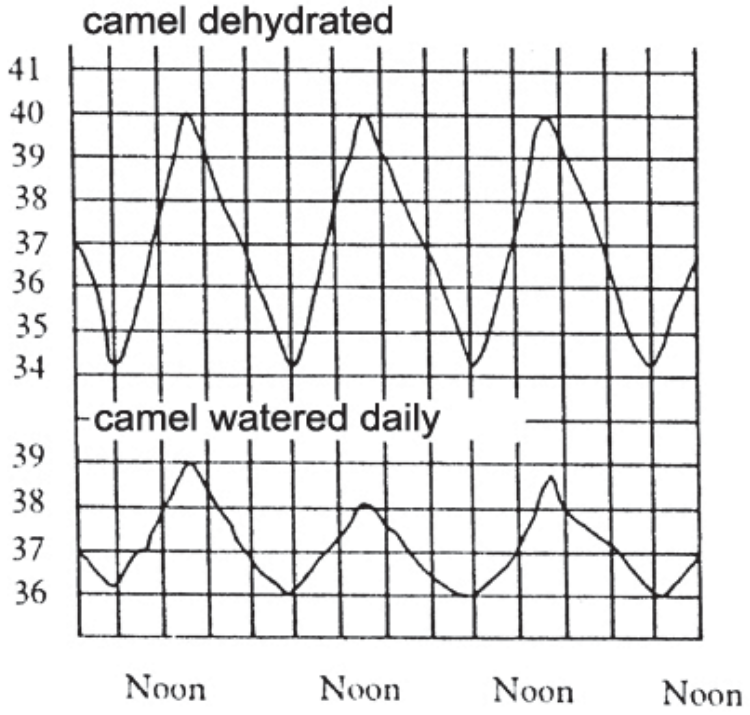
	X	Y	Z
A	**S**	**T**	**R**
B	**P**	**Q**	**S**
C	**R**	**S**	**U**
D	**Q**	**R**	**T**

23 The *tri-germinal nerve* in humans connects the brain with the teeth and with the skin of the face. When the dentist injects a local anaesthetic that targets this nerve, a person cannot feel pain or smile properly.

Which of the following conclusions can be **directly** drawn from the observations above?

A The *tri-germinal nerve* contains only sensory neurones.
B The *tri-germinal nerve* contains only motor neurones.
C The *tri-germinal nerve* contains both sensory and motor neurones.
D The *tri-germinal nerve* contains sensory, relay and motor neurones

The graphs below show the daily variation in body temperatures of camels with and without a daily supply of water. Use this information to answer questions **24** and **25**.



24 What is the time of the day that camels experienced the highest body temperature?

A 0900 hours
B 1200 hours
C 1500 hours
D 1800 hours

25 Which one of the following statements is supported by the graph?

A The daily variation in body temperature is about 6 ^{o}C in dehydrated camels.
B The daily variation in body temperature in dehydrated camels is lesser.
C The minimum body temperature of a camel is lower if water is given daily.
D Dehydrated camels have higher average body temperature than those watered daily.

26 Which word equation represents anaerobic respiration in muscles?

A glucose → lactic acid + energy
B glucose → ethanol + carbon dioxide + energy
C glucose + oxygen → carbon dioxide + water + energy
D glucose + oxygen → lactic acid + water + energy

27 Which of the following chemicals accelerates the deposition of fatty substances on the inner walls of arteries?

A alcohol
B carbon monoxide
C tar
D nicotine

28 Which of the following correctly shows the concentration of protein, urea and glucose in g/100 ml of the blood in the renal vein?

	protein	urea	glucose
A	7	0	0
B	7	0.05	0
C	7	0	0.1
D	0	0	0.1

29 A particular group of begonias, called the rex begonias (Begonia rex cultorum), propagate themselves through leaf cuttings. Unlike other plants that use specific stem portions for reproduction, the rex begonia uses its leaf veins to create new plantlets.

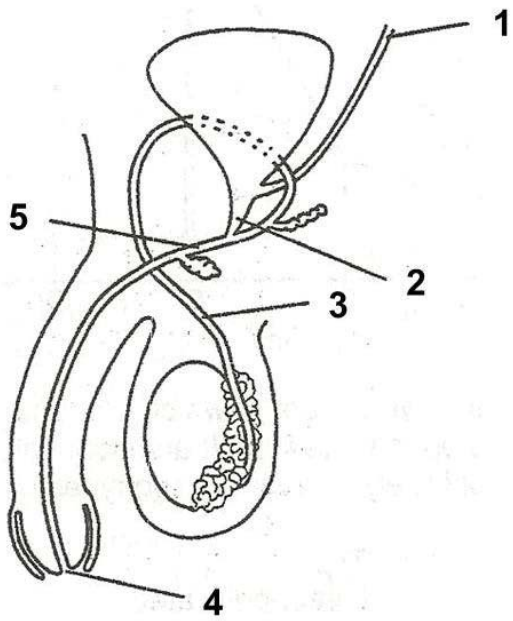
Which of the following describes the reproductive process and the genotypes of the new plantlets?

	Reproduction process	Genotype of the plantlets
A	Asexual	Different
B	Asexual	Identical
C	Sexual	Different
D	Sexual	Identical

30 Which of the following occurs during mitosis?

	Homologous chromosome pair up along equator	Chromosome number remains the same
A	✗	✓
B	✓	✗
C	✗	✗
D	✓	✓

The diagram below shows the male reproductive organ, use this information to answer questions **31** and **32**.



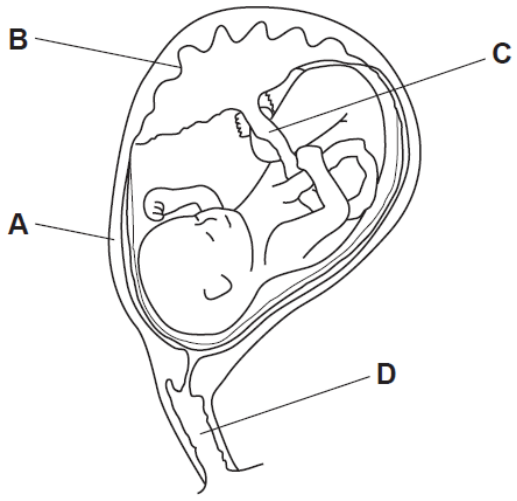
31 Which labelled structure carries both sperms and urine at different times?

A 1
B 2
C 3
D 5

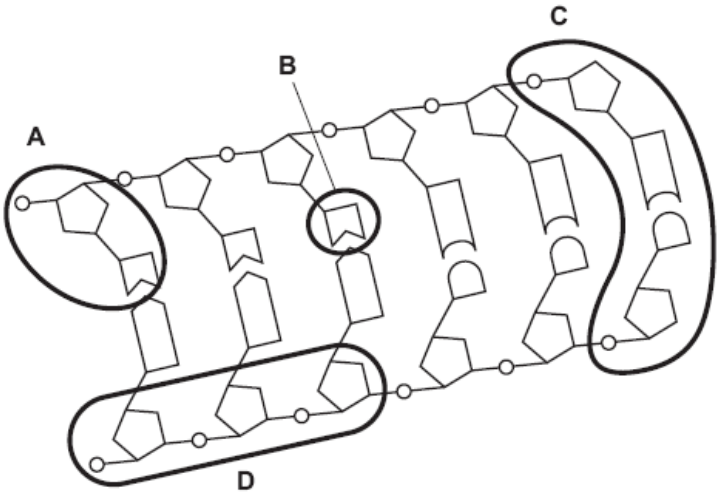
32 Identify the ureter.

A 1
B 2
C 3
D 4

33 The diagram shows a developing fetus.
Where does gaseous exchange between the fetus and its mother occur?

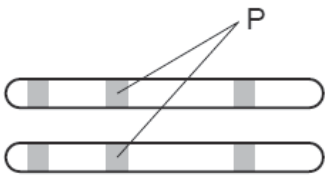


34 The diagram shows part of a DNA molecule.



Which part of the DNA molecule shows a nucleotide?

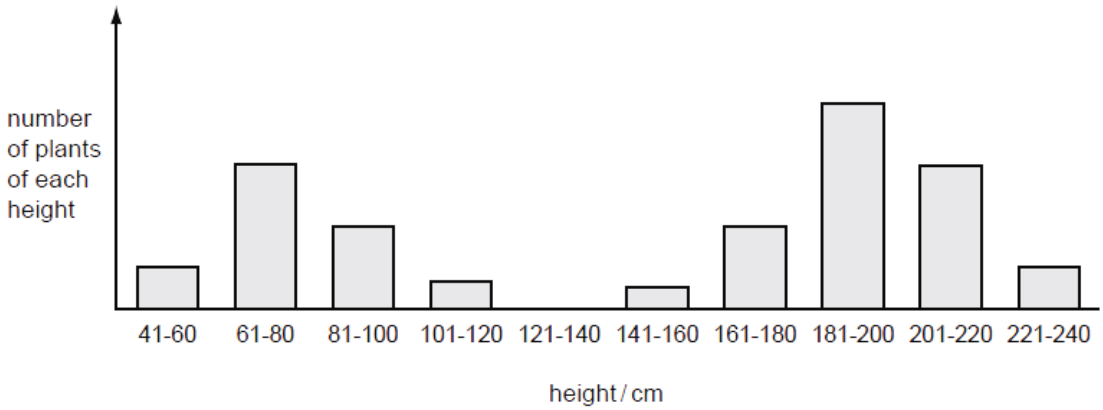
35 The diagram shows a pair of chromosomes from the same cell.



What do the lines labelled P point to?

A Alleles of the same gene which are always the same.
B Alleles of the same gene which might be different.
C Different genes which will give rise to different phenotype.
D Different genes which will give rise to the same phenotype.

36 The heights of 500 pea plants of the same age were measured to the nearest 20 cm. The results are shown in the chart below.



What does the variation in height of these pea plants show?

A Continuous variation only.
B Discontinuous variation only.
C Both continuous and discontinuous variation.
D Neither continuous or discontinuous variation. 7

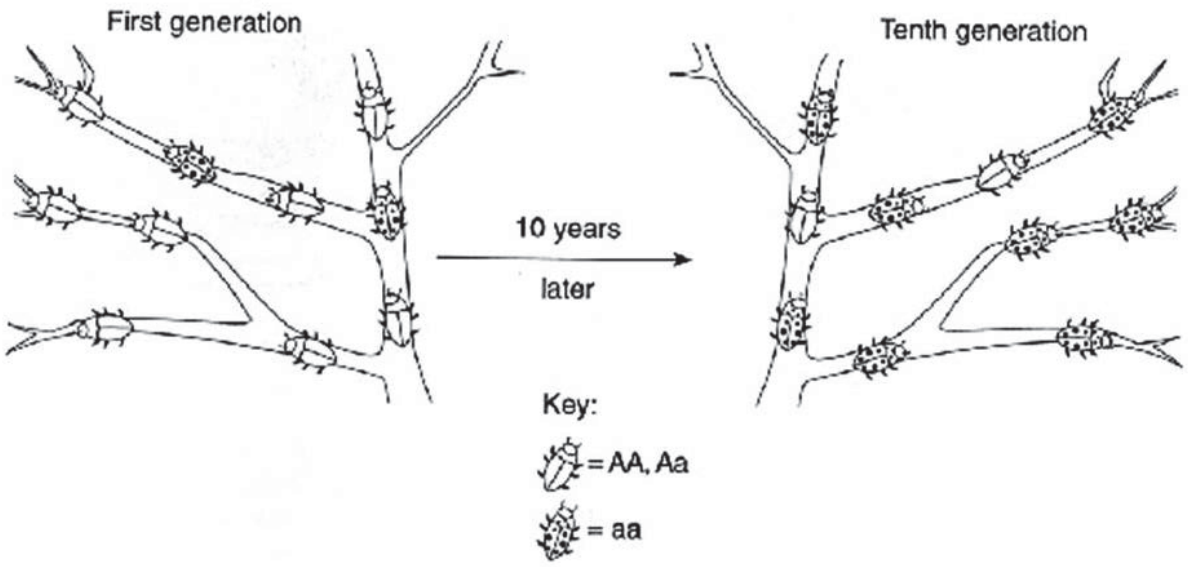
37 In a certain species of flowering plant, the genotype C^RC^R has red flowers and the genotype C^WC^W has white flowers. Heterozygotes, C^RC^W, have pink flowers. If two parents with pink flowers are crossed and 100 seeds obtained, what will be the numbers of red and white flowering offspring?

	White flower offspring	Red flower offspring
A	0	25
B	25	25
C	50	50
D	25	75

38 Which statement is **always** true of dominant alleles?

A They are only carried on the X chromosome.
B They cannot undergo mutation.
C They give the same phenotype in both heterozygotes and homozygotes.
D They have a higher chance of survival.

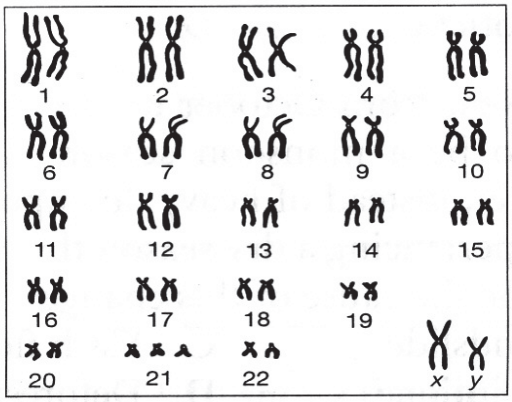
39 The diagram below illustrates the change that occurs in the frequency of phenotypes in an insect population over 10 generations.



Which of the following statement correctly explains the change in this population over time?

A There was a change in environment that cause allele **a** to be selected against.
B There was a change in environment that cause allele **a** to be selected for.
C There was a mutation to allele **a**.
D There was an increase in the population of this insect.

40 The diagram below shows a human karyotype.



Which of the following can be inferred from the karyotype above?

A This individual is a female.
B This individual has Down's Syndrome.
C This individual has sickle cell anaemia.
D This individual loses the ability to reproduce.

End of Paper 1

Name | Reg. No | Class

4EX

BIOLOGY — 6093/02

Paper 2 Theory [80 Marks]

PRELIMINARY EXAMINATION

September 2019

Additional Materials:
Approved calculator

1 hour 45 minutes

INSTRUCTIONS TO CANDIDATES

Do not start reading the questions until you are told to do so.

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

This paper consists of **Section A** and **Section B**.

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

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
Candidates are reminded that **all** quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner.
The use of an approved scientific calculator is expected, where appropriate.

FOR EXAMINER'S USE		
Paper		**Marks**
Paper 1 (MCQ)		/ 40
Paper 2		
A		/ 50
B	**7**	/ 10
	8	/ 10
	9	/ 10
Total		**/ 120**

This question paper consists of **18** printed pages.

Setter: Mrs Marie Huang

Vetter: Mr Ng Tze How

[Turn Over

Section A [50 marks]

Answer **all** questions in this section.
Write your answers in the spaces provided.

1 Figure 1.1 shows the structures found within a mammalian liver cell.

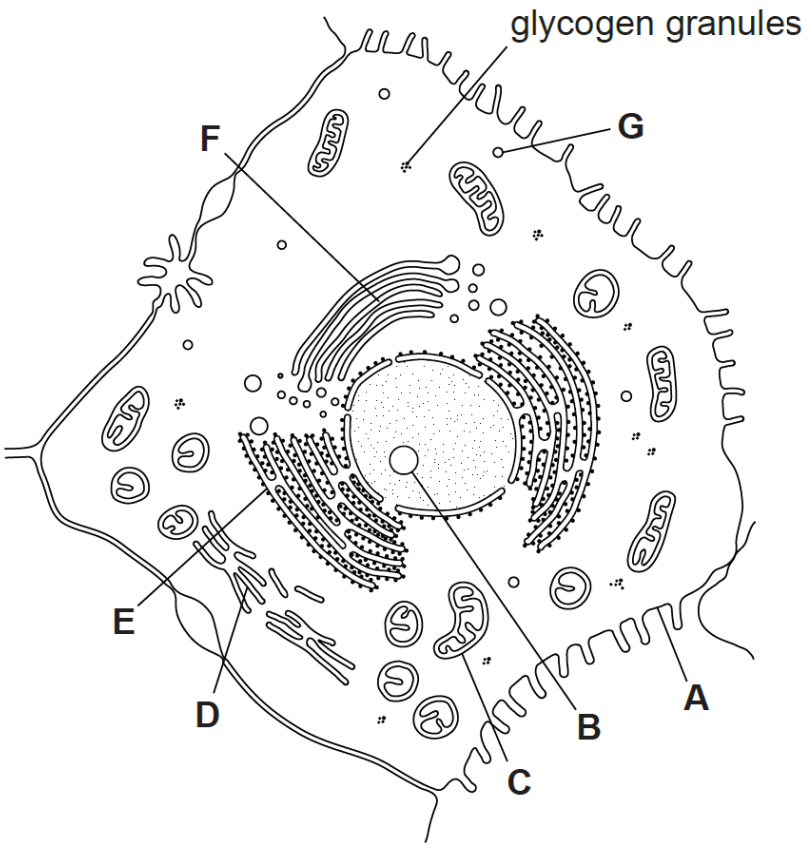


Figure 1.1

(a) Complete the table by naming the structures and stating one function of each. The first structure (**A**) has been completed for you.

	name of organelle	**function**
A	Cell surface membrane	Controls movement of substances into and out of cell
C		
E		
F		

[3]

(b) As shown in Figure 1.1, liver cells contain many storage granules of glycogen.

Figure 1.2 shows a simplified diagram of the structure of glycogen.

Figure 1.2

(i) Describe one feature of the structure of the glycogen molecule that makes it suitable as a storage molecule.

.....

.....[1]

(ii) Explain the importance of glycogen in the regulation of a mammal's internal environment.

.....

.....

.....

.....

.....

.....

.....

.....[4]

[Total = 8]

2 Large trees produce sun leaves on the outside of the canopy and shade leaves inside the canopy. Figure 2.1 shows the rate of carbon dioxide uptake or production of a sun leaf and a shade leaf when exposed to increasing light intensity.

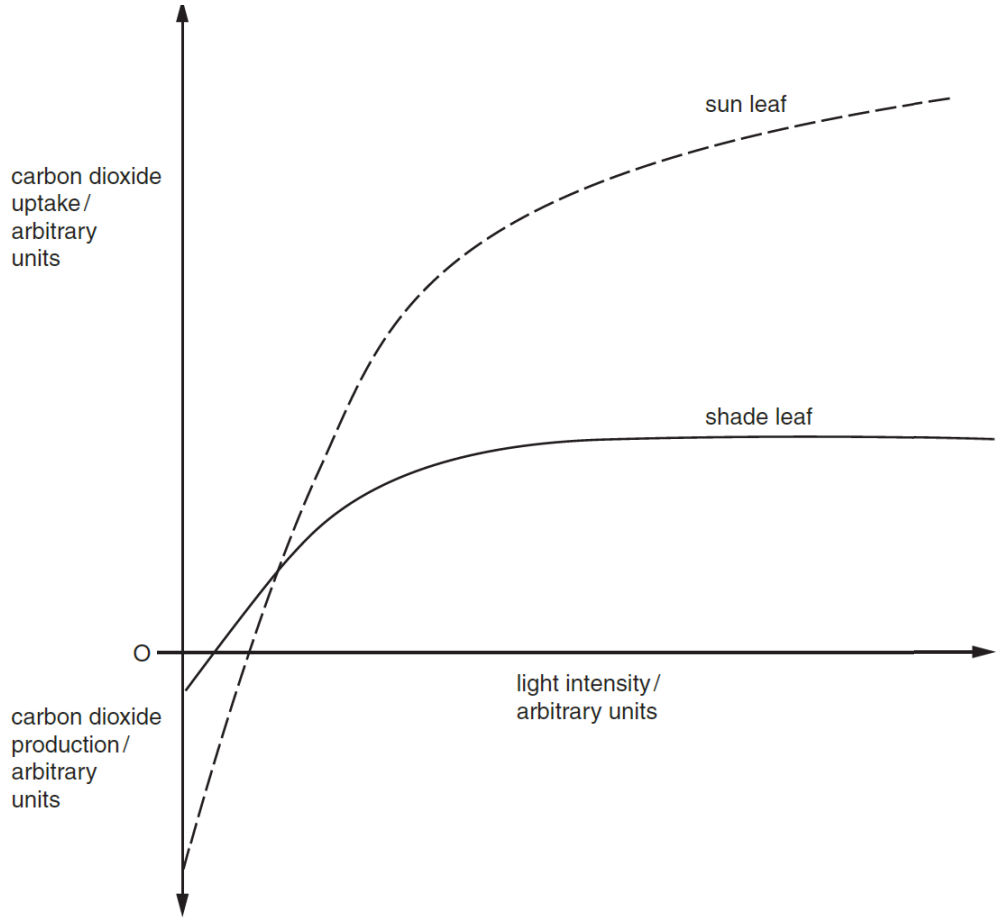


Figure 2.1

(a) State the word equation of the process that results in carbon dioxide uptake in a plant.

……[1]

(b) With reference to Figure 2.1, describe two ways in which the sun and shade leaf differ in their response to increasing light intensity.

1

……..

……..

2

……..

……[2]

(c) Explain why the carbon dioxide uptake levels off in the shade leaf as light intensity increases.

……

……[1]

(d) The rate of photosynthesis can be calculated based on the biomass of the tree. The tree is able to produce different types of carbohydrates that eventually become a part of its biomass.

Explain, by using two named molecules, how different types of carbohydrates can be produced after the process of photosynthesis.

……

……

……

……[2]

(e) Explain why the biomass of a tree may decrease when the leaves of the tree wilt.

……

……

……

……[2]

[Total = 8]

3 In mammalian kidneys, the nephron is closely associated with homeostasis and negative feedback.

(a) Define homeostasis.

……

……[1]

(b) Control systems often work by using negative feedback. These systems require a receptor and an effector. In the process of osmoregulation, identify the receptor and effector.

Receptor ……..

Effector ……

[2]

(c) Describe how osmoregulation occurs in the body to achieve homeostasis when a person takes in large amounts of concentrated sodium chloride solution.

……

……

……

……

……

……

……

……[4]

[Total = 7]

4 Figure 4.1 describes the process of producing herbicide-resistant crop plants by using transgenic bacteria (*E. coli*) which carry the desired gene into the root cells of the plant.

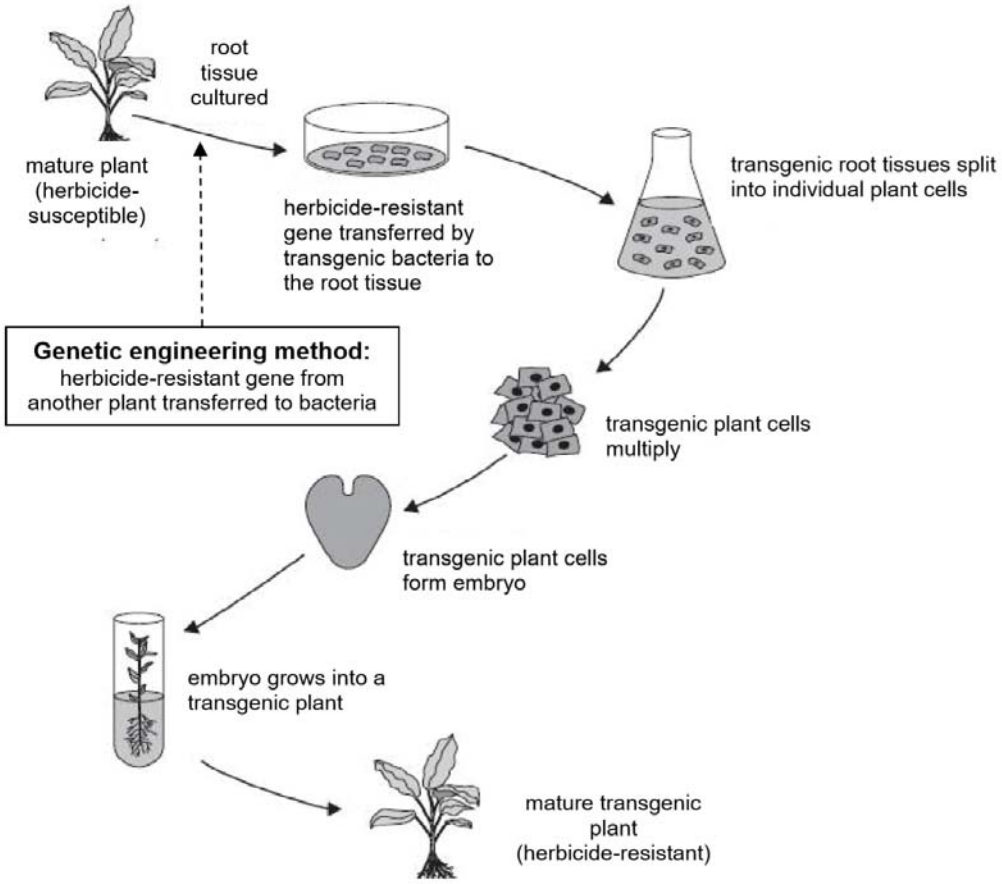


Figure 4.1

(a) Describe how genetic engineering techniques can be used to produce the transgenic bacteria, which carry the herbicide-resistant gene.

……

……

……

……

……

……

……

……[4]

(b) Many people are opposed to the growing of herbicide-resistant crops produced in this way. Suggest one reason for their concern.

……

……[1]

(c) Figure 4.2 shows a Venn diagram on sexual and asexual reproduction in plants.

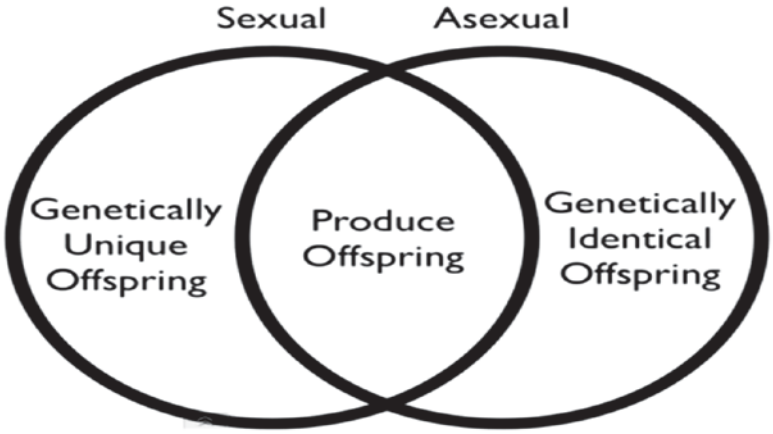


Figure 4.2

With reference to Figure 4.2, explain what causes the difference in the type of offspring produced.

……

……

……

……[2]

(d) In Figure 4.2, mark in appropriate region(s) of the Venn diagram,

(i) X to represent self-pollination

(ii) Y to represent cross-pollination

[1]

[Total = 8]

5 Figure 5 shows part of a DNA molecule.

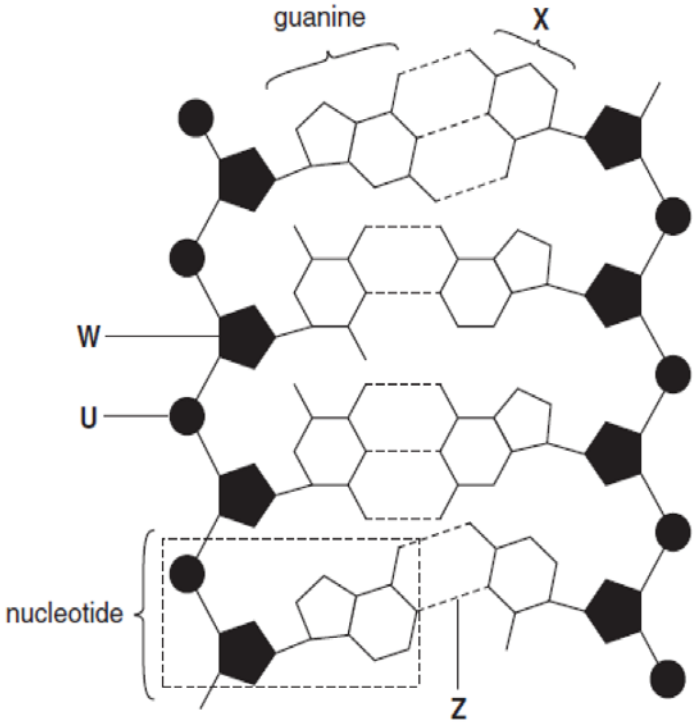


Figure 5

(a) Identify **U**, **W** and **X**.

U ……..

W ……..

X …… [2]

(b) Describe two features of a polypeptide molecule that are different from those found in a DNA molecule.

……

……

……

……[2]

(c) Explain the significance of the order of nitrogenous bases in the DNA molecule.

……

……

……[2]

(d) Bone marrow contains stem cells that divide by mitosis to form blood cells. Each time the cell divides, it forms a replacement stem cell and a cell that develops into a blood cell.

Figure 6.2 shows changes in the mass of DNA in a human stem cell from the bone marrow during three cell cycles.

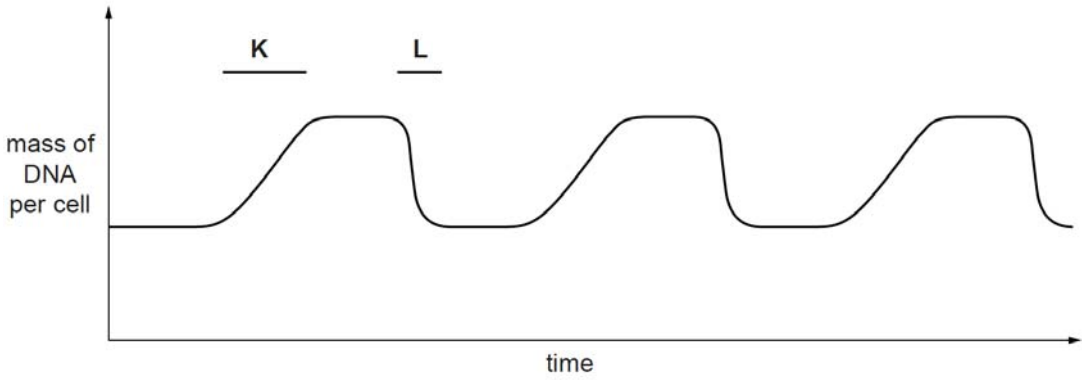


Figure 5.2

With reference to Figure 5.2, state

(i) what happens to bring about the changes in the mass of DNA per cell at **K** and at **L**.

……

……

……..……..…[2]

(ii) the number of blood cells are formed from the stem cell in the time shown

……...……..…[1]

(iii) what happens to the number of chromosomes in the stem cell

……..……[1]

[Total = 10]

6 Figure 6.1 shows the inheritance of an abnormal condition that affects the seeing and distinguishing objects under low light intensities.

This disorder is caused by a mutation in the PDE6B gene that is responsible for producing proteins found in specialised photoreceptor cells on the retina.

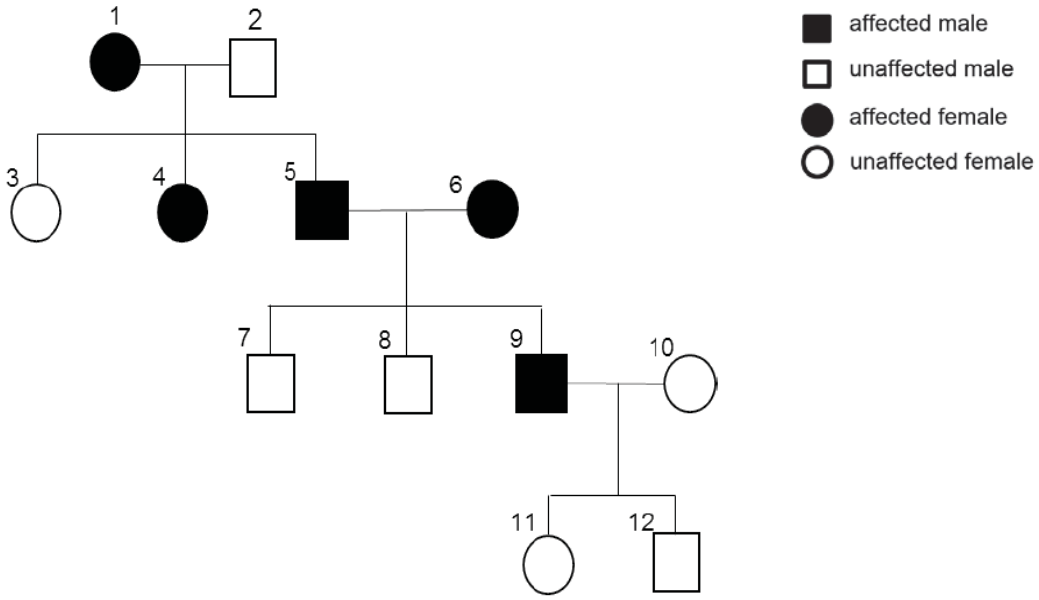


Figure 6.1

(a) Explain, with reference to Figure 6.1, if the abnormal condition is controlled by a dominant or recessive allele.

……

……

……

……

……

……[3]

(b) Individual 11 married an unaffected male. Explain the chance of them having an affected child.

……

……

……

……[2]

(c) **(i)** State the form of mutation that causes this disease.

……[1]

(ii) Suggest how a person is unable to see clearly under low light intensity due to this disorder.

……

……

……

……

……

……[3]

[Total = 9]

---End of Section A ---

Section B [30 marks)

Answer all **three** questions in this section.

7 Catalase is an enzyme found in many tissues. Catalase breaks down hydrogen peroxide, forming water and oxygen.

Figure 7.1 shows the apparatus used by a student to investigate the effect of pH on the activity of catalase. The gas syringe was used to measure the volume of oxygen produced at each pH.

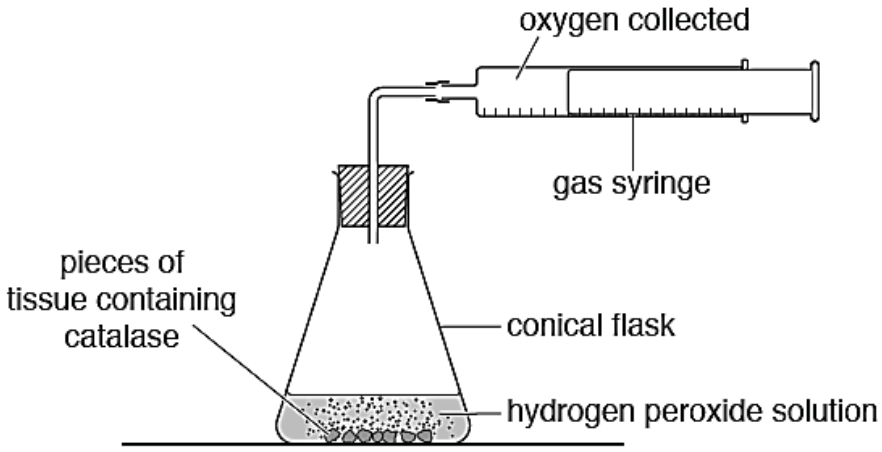


Figure 7.1

The student carried out the experiment at a pH of 7.0 and measured the volume of oxygen produced during a period of five minutes.

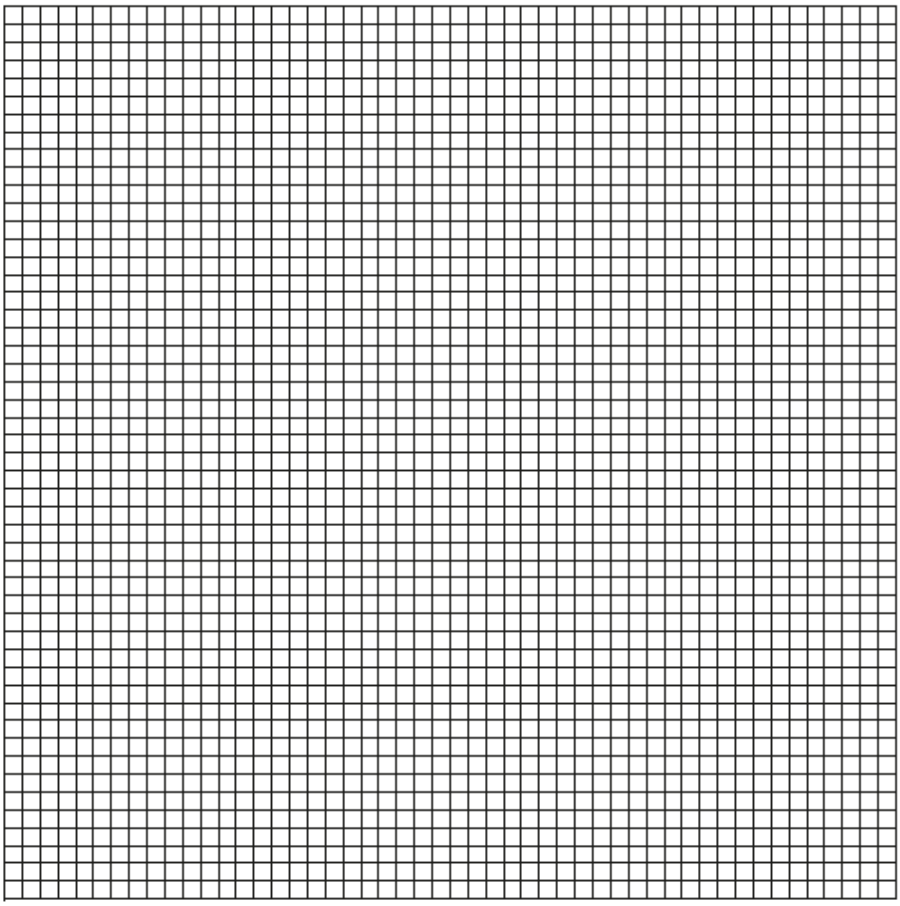
He then mixed fresh samples of tissue containing catalase, and hydrogen peroxide solution at pH values of 5.0, 6.0, 8.0 and 9.0 and measured the volume of oxygen produced during five minutes for each pH.

The results are shown in Table 7.2.

Table 7.2

pH	volume of oxygen produced during five minutes / cm^3
5.0	12
6.0	45
7.0	88
8.0	57
9.0	8

(a) Using the data in Table 7.2, plot a graph to show the effect of pH on the activity of catalase.



[4]

(b) Describe and explain the shape of the graph obtained in **(a)**.

……..

……..

……..

……..

……..

……..

……..

……..

……[4]

(c) State two variables, other than temperature, that should be kept constant in this investigation.

1 .....

2 .....

[2]

[Total = 10]

8 Blood samples were taken from a 29 year old woman each day for a period of 43 days. The concentrations of oestrogen, progesterone and luteinising hormone (LH) in each sample were measured. The results are shown in Fig. 8.1.

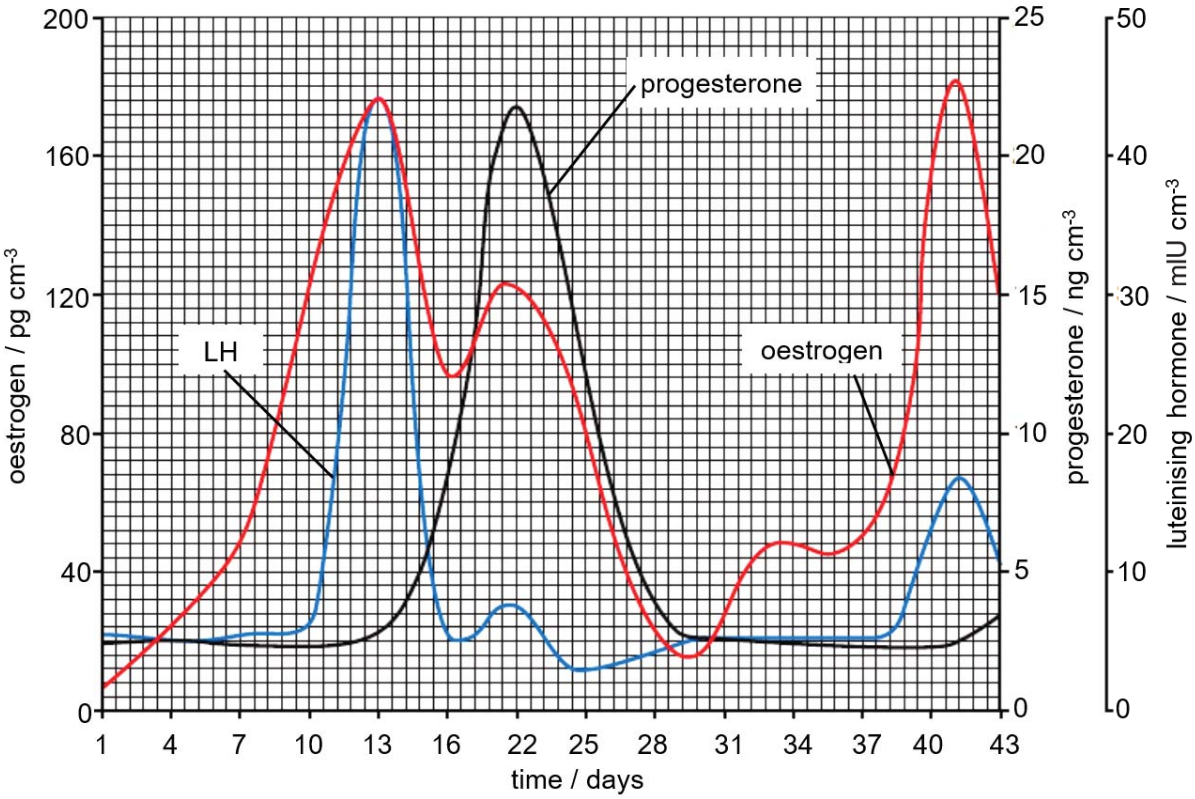


Figure 8.1

(a) With reference to Figure 8.1, estimate the length of the woman's menstrual cycle and explain your answer.

Length of menstrual cycle ..... [1]

Explanation

.....

.....

.....

.....[2]

(b) Describe and explain the changes in oestrogen and progesterone level from day 1 to day 22.

……

……

……

……

……

……

……

……

……

……[5]

(c) Describe and explain how the graph(s) will change if the woman is pregnant.

……

……

……

……[2]

[Total = 10]

9 The effects of strenuous exercise is shown in Table 9.2.

Table 9.2

	Before exercise	After exercise
Breathing rate/breaths per minute	11	22
Ventilation rate (volume of air taken into lungs per min)/dm^3 per minute	6	90
Heart rate/beats per minute	65	170

(a) Explain why the changes shown in Table 9.2 occurs during exercise.

……

……

……

……

……

……

……

……

……

……

……

……[5]

(b) Exercise that occurs over a longer period often involves aerobic respiration as well as anaerobic respiration.

Figure 9.2 shows the oxygen consumed by an athlete during and after a 2.4 kilometres race.

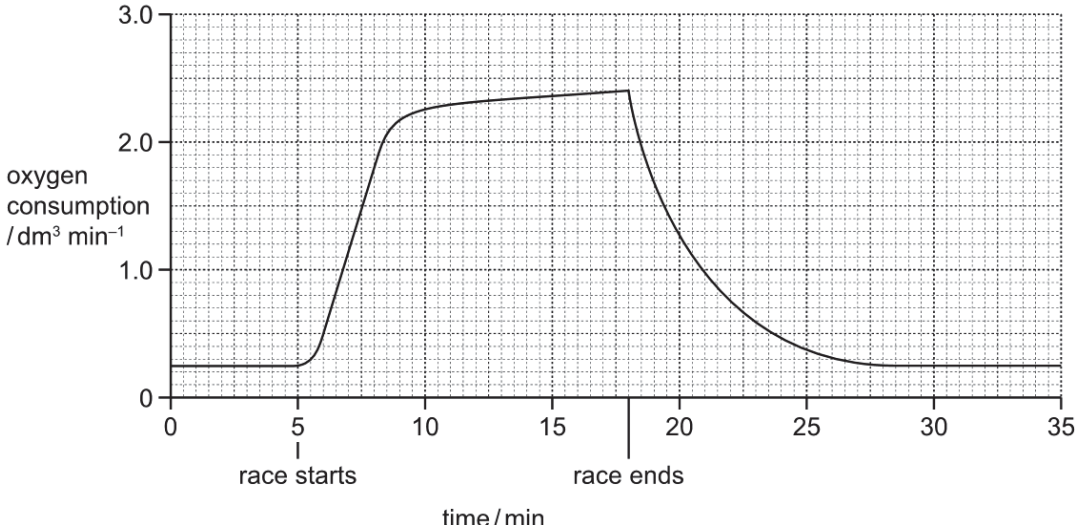


Figure 9.2

Explain why the oxygen consumption does not immediately return to the resting level after the race ends.

……

……

……

……

……

……

……

……

……

……[5]

[Total = 10]

End of Paper

MAYFLOWER SECONDARY SCHOOL
2020 SECONDARY 4 PRELIMINARY EXAMINATIONS MARK SCHEME
BIOLOGY 6093

Paper 1

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

1a [3]

	name of organelle	function
A	Cell surface membrane	Controls movement of substances into and out of cell
C	Mitochondrion	Release energy through aerobic respiration
E	Rough endoplasmic reticulum	Involved in the transport of synthesized proteins by ribosomes
F	Golgi apparatus	Involved in the chemical modification and packing of substances into vesicles for export

1bi [1]

Compact and branched – can be used to pack large numbers of glucose molecules for storage

Insoluble – does not affect the water potential of cell cytoplasm and hence affect osmosis within the cell

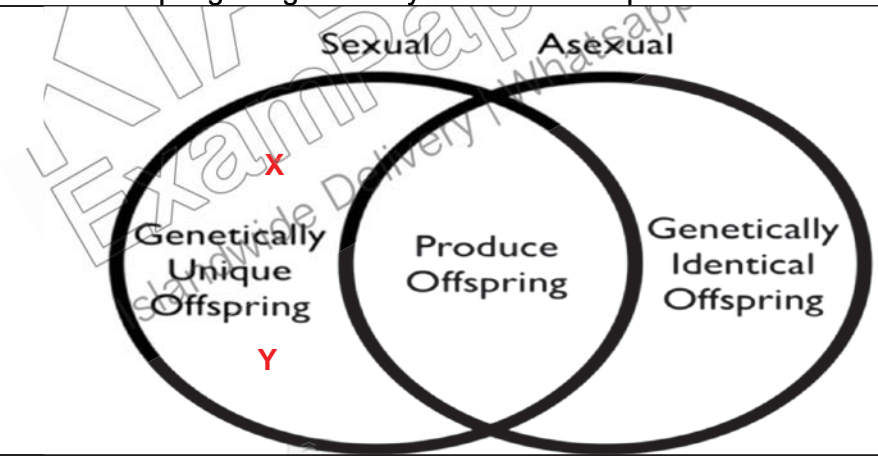
1bii [1] [1] [1]

When the blood glucose concentration is above the norm, insulin can be secreted by the Islets of Langerhans to be transported to the liver.

The liver cells will then absorb the glucose molecules from the bloodstream, converting the glucose into glycogen in the presence of insulin. This would lower the concentration of blood.

When the blood glucose concentration is below the norm, glucagon can be secreted by the Islets of Langerhans to be transported to the liver.

	Glucagon then converts glycogen to form glucose to raise the blood glucose concentration back to the norm.	[1]
2a	Carbon dioxide + water → glucose + oxygen + water In the presence of sunlight and chlorophyll	[1]
2b	Any two of the following: 1. At low light intensity, the shade leaf took in carbon dioxide at a higher rate than the sun leaf. 2. As light intensity increases, the shade leaf does not take in more carbon dioxide but the sun leaf continues to take in more carbon dioxide. 3.The sun leaf is able to take in twice as much of carbon dioxide compared to the shade leaf at high light intensities.	2[1]
2c	As the light intensity increases, light intensity no longer is a limiting factor for the shade leaf.	[1]
2d	Glucose is formed as a product of photosynthesis. Any 2 of the following: • It can be converted to cellulose, a polysaccharide used for the production of cell walls of plant cells. • Glucose can be converted to sucrose to be transported via translocation through the phloem to other parts of the plant for storage. • Glucose can be converted to starch to be stored within the plant cells (as granules) to be used as an energy store.	2[1]
2e	• When the leaves of a tree wilt, the rate of photosynthesis will decrease as the stomata close, taking in less carbon dioxide. Any one of the 2 points: • Hence, the rate of carbohydrate production will decrease, reducing the plant's increase in biomass. • Also, the plant will be using up its carbohydrate stores in the form of starch, and hence decreasing the biomass within the plant.	2[1]
3a	Homeostasis is the maintenance of a constant internal environment independent of external changes in the external environment.	[1]
3b	Receptor: Osmoreceptors in hypothalamus Effector: Collecting duct	2[1]
3c	• With the intake of large amounts of concentrated sodium chloride solution, the water potential of blood decreases below the norm. • Hence, the decrease in water potential of blood is detected by the (osmoreceptors) in the hypothalamus and the (anterior) pituitary gland secretes more Anti-Diuretic Hormone (ADH)	4[1]

	• The increase in ADH secretion causes the increase in selective reabsorption of water at the collecting duct by osmosis. • Producing low volumes of concentrated urine/high in concentrations of salt.	
4a	• By using a restriction enzyme to cut the herbicide-resistant gene (rej: gene of interest NSE) from the chromosome of a cell of the mature plant • And using the same restriction enzyme to cut the plasmid of a vector like E.coli • Form a recombinant plasmid using DNA ligase and the herbicide-resistant gene and the plasmid • Using heat shock at 42^{O}C in the presence of Ca^{2+} ions or electroporation, allow the E.coli cell to go through transformation to take in the recombinant plasmid to become a transgenic bacteria cell.	4[1]
4b	Any one of the following: • Introduction of other genes into the plant that can lead to allergies or toxic reactions in humans when consumed. • Changes in the ecosystem when consumers consume such herbicide-resistant plants – possibility of bioaccumulation of toxins • Widening of rich-poor divide when wealthier countries are able to make use of such technology to improve their crop yield.	[1]
4c	• Production of genetically varied gametes during meiosis in addition to random fertilisation in sexual reproduction causes the production of genetically unique offspring. • In asexual reproduction, there is no fusion of gametes involved and henc, the offspring are genetically identical to the parental cells.	2[1]
4d		2[1]
5a	**U:** phosphate group **W**: deoxyribose sugar **X**: cytosine (rej: nitrogen-containing base)	3[1]
5b	Any 2 of the following: 1. The bonds found within a polypeptide are peptide bonds but the bonds found within a DNA molecule are phosphodiester bonds.	2[1]

	2. The polypeptide is made of repeating units of amino acids but the DNA molecule is made of repeating units of nucleotides. 3. The DNA molecule is a a double-helix shape but the polypeptide is a linear chain of amino acids. 4. Complementary bp exist between the 2 polynucleotide chains in DNA but no complementary bp exist within a polypeptide chain.	
5c	• The sequence of bases control the sequence of amino acids within a polypeptide synthesized. • 3 bases code for one amino acid in a triplet code.	2[1]
5di	• At K, the mass of DNA doubles due to DNA replication in Interphase. • At L, the mass of DNA doubles due to cytokinesis splitting the contents of the cell into two cells.	2[1]
5dii	2^3=8 cells produced 3 blood cells produced	1
5diii	• Remains the same at 46 chromosomes	1
6a	• Dominant allele • Individual 4 and 5 are heterozygous for the condition, having inherit one recessive allele from 2 but express the condition. • Individual 5 and 6 are both able to produce offspring 7 and 8 who do not have the condition as 7 and 8 inherit a recessive allele from each parent.	3[1]
6b	• 0% • Individual 11 is homozygous recessive for the condition and marrying an unaffected male who is also homozygous recessive for the condition means that there is no dominant allele inherited by their children that can cause this condition	2[1]
6ci	• Gene mutation	1
	• The mutation leads to the photoreceptors/cones not being able to be stimulated under low light intensity. • Hence, the sensory neurones cannot be triggered properly to send nerve impulses to the brain. • No or little imagery can then be intepreted under low light as the brain lacks the sensory input.	3[1]

Section B

7a	Axes correctly labelled with units – 1 Scale (start from pH 5) – 1 Plotting – 1 Best Fit Curve – 1	4[1]
7b	• D1: The optimum pH for catalase activity is pH 7, where the volume of gas produced in 5 minutes is the highest at 88cm^3 • D2: As pH decreases from pH 7 to pH 2 (pH becomes increasingly acidic), the volume of gas produced in 5 minutes decreases from 88 to 12 cm^3. • D3: As pH increases from pH 7 to 9 (pH becomes increasingly alkaline), the volume of gas produced in 5 minutes decreases from 88 to 8cm^3.	2[1] – description of trend 2[1] - explanation

	• E1: At pH 7, the 3D conformation of the catalase is at its optimum and the activte site is able to fit the shape of the hydrogen peroxide molecule to form the highest rate of e-s complex. Hence, the highest rate of enzyme activity occurs at pH 7. • E2: As the pH deviates from optimum/becomes more acidic and alkaline, the 3D-conformation of catalase is altered as the bonds maintaining the 3D structure become disrupted. The catalase is said to be denatured and the active site is lost. The formation of e-s complex decreases and hence, the rate of enzyme activity decreases.	
7c	Any 2 of the following • Volume of hydrogen peroxide • Concentration of hydrogen peroxide • No of potato discs/tissue used • Source of potato	2[1]
8a	28 days[1] Explanation (any one of the following) – 2[1] **Data to be quoted for full credit to be given** 1. The peak of estrogen occurs at day 13 and day 41 and since there is only 1 peak of estrogen per cycle, each menstrual cycle has a duration of 28 days. 2. The level of progesterone drops to basal level by day 28 and it resumes the same trend as day 1 to 13 from day 28 to day 41.	3[1]
8b	• D1: From day 1 to day 13, the level of estrogen increases from 8 to 176pg cm^{-3} • D2: From day 13 to day 22, the level of estrogen decreases from 176 to 96 pg cm^{-3} • E1: The level of estrogen increases as the production of estrogen occurs in the follicle cells of the growing follicle. This is to enable the repair of the uterine lining to prepare for implantation. • D3: From day 1 to day 13, the level of progesterone remains at a low of 3 ng cm^{-3} • D4: From day 13 to day 22, the level of progesterone increases from 3 to 22.5 ng cm^{-3} • E3: The level of progestrone increases after ovulation occurs on Day 13 as the corpus luteum remaining in the ovary produces progesterone. The function of progesterone is to maintain the thickening and vascularisation of the uterine lining for implantation and placenta development.	Max 3 – Data 2[1] – explanation
8c	• If the woman is pregnant, the level of progesterone will remain high after day 22 instead of dropping to basal levels. • This is to allow for the continued thickening of the uterine lining to allow the pregnancy to be viable.	2[1]

9a	State the changes in the table without explanation – 1m max • The breathing rate increases from 11 to 22 breaths per minute. • The ventilation rate increases from 6 to 90 dm3 per minute. • The heart rate increases from 65 to 170 beats per minute. Explanation: 1. As a person exercises, vigorous muscular contractions require large amounts of energy and hence a higher rate of aerobic respiration needs to occur. 2. With a higher rate of aerobic respiration, the demand for oxygen increases and hence breathing rate and ventilation increases to bring in more oxygen into the body. 3. The rate of production of carbon dioxide also increases as a result of respiration and hence, the higher breathing rate and ventilation helps to remove carbon dioxide from the body more quickly. 4. The rate of ventilation increases also to increase the efficiency in which gaseous exchange occurs at the alveoli and bloodstream (respiratory surface) 5. The heart rate increases in order to circulate oxygenated blood to all parts of the body more quickly to support aerobic respiration.	5[1]
9b	• When the race started, the athlete uses aerobic respiration for his energy demands. • As the race continues, the heartrate and breathing rate cannot continue to increase further to supply more oxygen to the respiring muscle cells. • The muscle cells go into oxygen debt and hence, utilise anaerobic respiration, in addition to aerobic respiration, to release more energy in the absence of oxygen. • Lactic acid is produced as a result of anaerobic respiration. • When the race stops, the demand for energy decreases as the muscles are no longer contracting vigorously and hence, the additional oxygen take in is used to convert lactic acid to glucose. • Hence, the oxygen debt is repaid when all the lactic acid is fully converted back to glucose for aerobic respiration.	5[1]