SMILE Tutor
EFFICIENT . EFFECTIVE . EASY

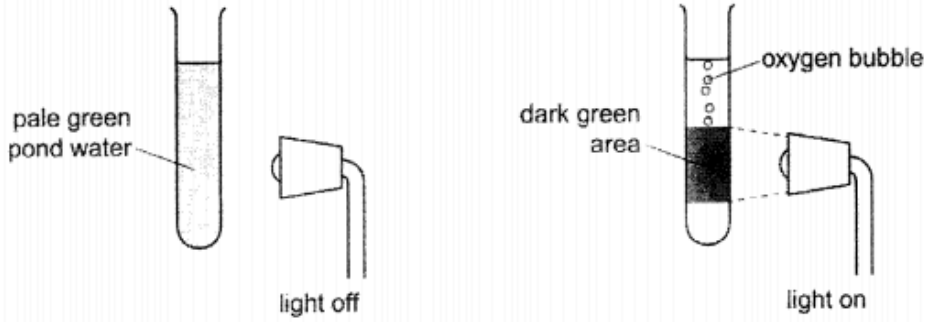
2022

SECONDARY 4 PURE BIOLOGY TEST PAPERS

Table of Contents

DUNEARN SECONDARY SCHOOL SA2 PAPER

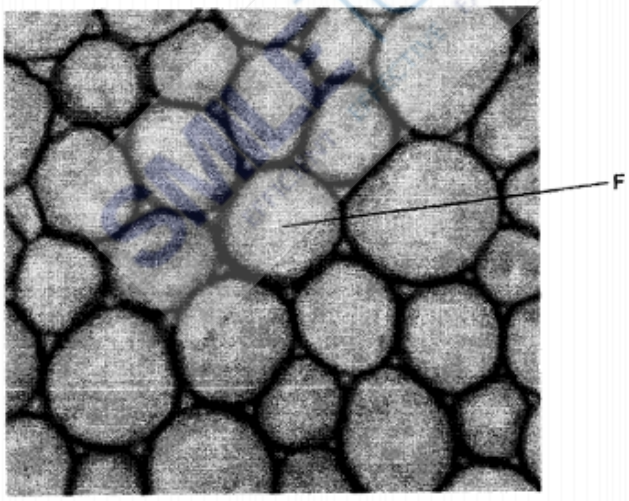
1 The diagrams show a test-tube containing pond water. The green colour is caused by microorganisms that have chloroplasts.



Which characteristics of living organisms are shown?

A excretion, growth and movement
B movement, nutrition and sensitivity
C nutrition, reproduction and respiration
D reproduction, sensitivity and growth

2 Some students were asked to look at the photomicrograph of a cross-section of unfamiliar material and describe what they could observe.



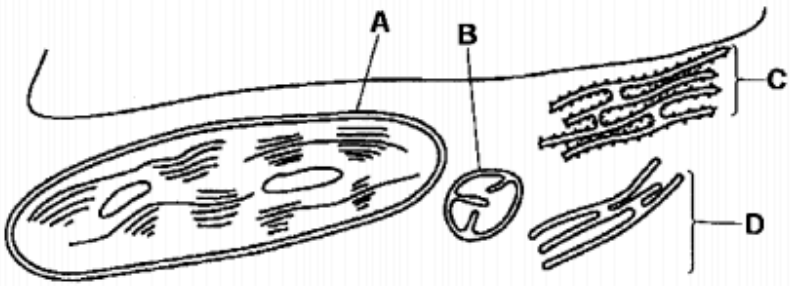
The students described the cross-section of F as:

1 circular
2 a hollow tube
3 spherical.

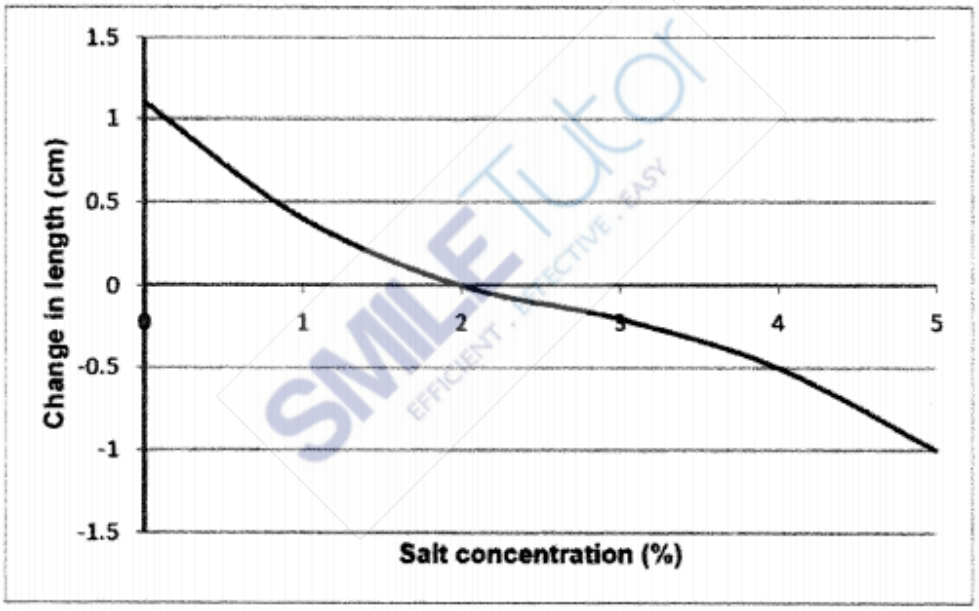
Which descriptions of the cross-section of F correctly state what the students could actually observe?

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

3 The diagram shows a drawing made from an electron micrograph of a leaf cell. Which organelle carries out detoxification?



4 Potato strips were soaked in salt solutions of different concentrations and the change in length was measured after 1 hour. The graph below shows the results that were obtained.



What can be concluded from the graph?

A When soaked in salt solutions 0-2%, salt molecules diffused into the potato cells.

B When soaked in 2% salt solution, the amount of water entering the potato cells equals to the amount of salt leaving the potato cells.

C There is no movement of salt into or out of the potato cells at any of the salt concentrations.

D When soaked in salt solutions of 2-5%, salt molecules diffused out of the potato cells.

5 Ethanol emulsion test and biuret test were carried out separately on peanuts. Which of the following correctly describes the results?

	ethanol emulsion test		biuret test	
	observation	**conclusion**	**observation**	**conclusion**
A	remains clear	fats are absent	blue solution remains	proteins are absent
B	remains clear	fats are present	violet mixture observed	proteins are present
C	white emulsion formed	fats are absent	blue solution remains	proteins are absent
D	white emulsion formed	fats are present	violet mixture observed	proteins are present

6 Which substances are made by linking together glucose molecules only?

A cellulose, glycogen and starch
B fats, cellulose and proteins
C proteins, oils and glycogen
D starch, fats and oils

7 The table shows some properties of enzyme molecules.

Which row is a correct description of enzymes?

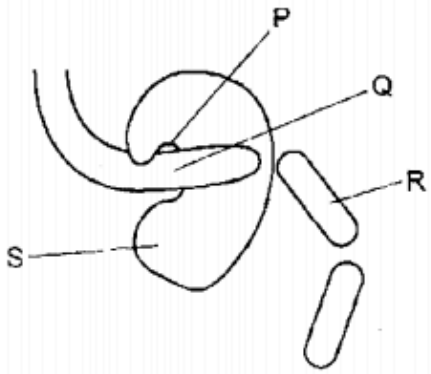
	chemical elements present	effect of changing temperature	enzyme activity
A	C, H and O only	can increase reaction rate	enzyme can be reused
B	C, H and O only	has no effect	enzyme is used up
C	C, H, O and N	can increase reaction rate	enzyme can be reused
D	C, H, O and N	can decrease reaction rate	enzyme is used up

8 What may take place during a hydrolysis reaction?

I a molecule of water is produced
II a sucrose molecule is split into fructose and glucose
III digestion of complex molecules into simpler ones using enzymes

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

9 The diagram shows a protease molecule catalysing the breakdown of a protein molecule.



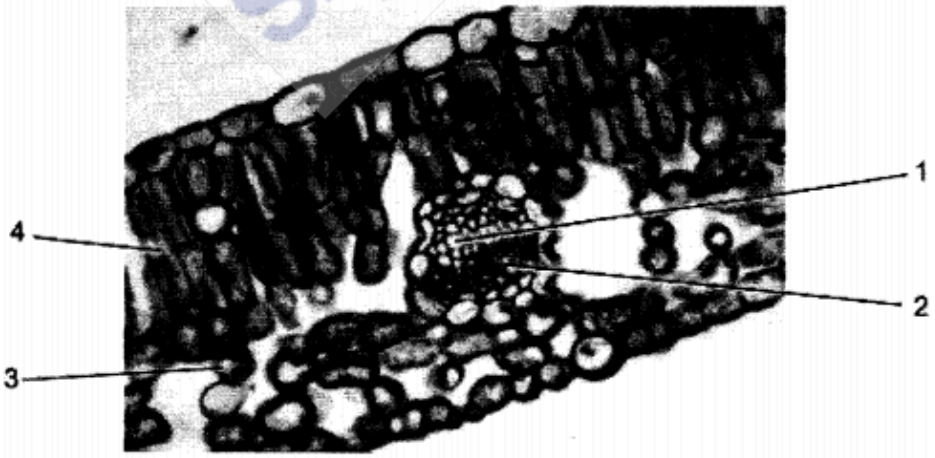
What are the parts labelled P, Q, R and S?

	enzyme	product	substrate	active site
A	P	Q	R	S
B	R	S	P	Q
C	S	P	Q	R
D	S	R	Q	P

10 What is **not** an example of assimilation?

A synthesis of glycogen from glucose
B synthesis of fats from fatty acids and glycerol
C synthesis of glucose from starch
D synthesis of proteins from amino acids

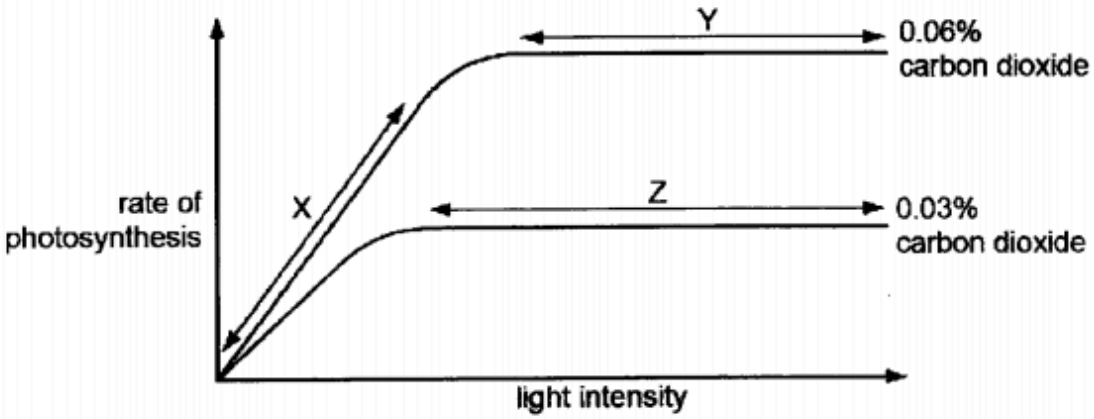
11 The diagram shows a transverse section of a dicotyledonous leaf.



What are the correct labels for 1, 2, 3 and 4?

	1	2	3	4
A	phloem	xylem	palisade mesophyll	spongy mesophyll
B	phloem	xylem	spongy mesophyll	palisade mesophyll
C	xylem	phloem	palisade mesophyll	spongy mesophyll
D	xylem	phloem	spongy mesophyll	palisade mesophyll

12 The graph shows the rate of photosynthesis of a plant at increasing light intensities at two carbon dioxide (CO_2) concentrations. The temperature is kept constant.



What are the limiting factors at X, Y and Z?

	X	Y	Z
A	CO_2 concentration	light intensity	CO_2 concentration
B	CO_2 concentration	light intensity	light intensity
C	light intensity	CO_2 concentration	CO_2 concentration
D	light intensity	CO_2 concentration	light intensity

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

reaction	equation
X	$Hb + O_2 \leftrightarrow HbO_2$
Y	$CO_2 + H_2O \leftrightarrow H_2CO_3$

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

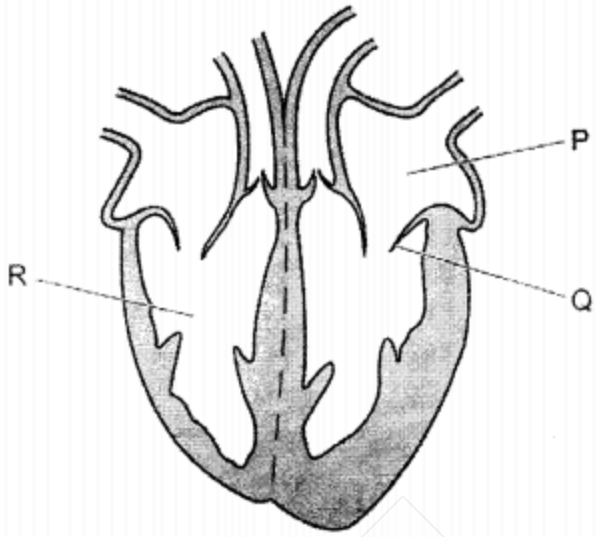
	reaction X		reaction Y	
	enzyme needed	location	enzyme needed	location
A	yes	alveoli	no	red blood cell
B	no	plasma	no	alveoli
C	no	red blood cell	yes	red blood cell
D	yes	red blood cell	yes	plasma

14 During the process of blood clotting, damage to blood vessels stimulates component L, and component M is converted to component N.

What are L, M and N?

	L	M	N
A	fibrin	platelets	fibrinogen
B	fibrinogen	platelets	fibrin
C	platelets	fibrin	fibrinogen
D	platelets	fibrinogen	fibrin

15 The diagram shows a section through the heart.

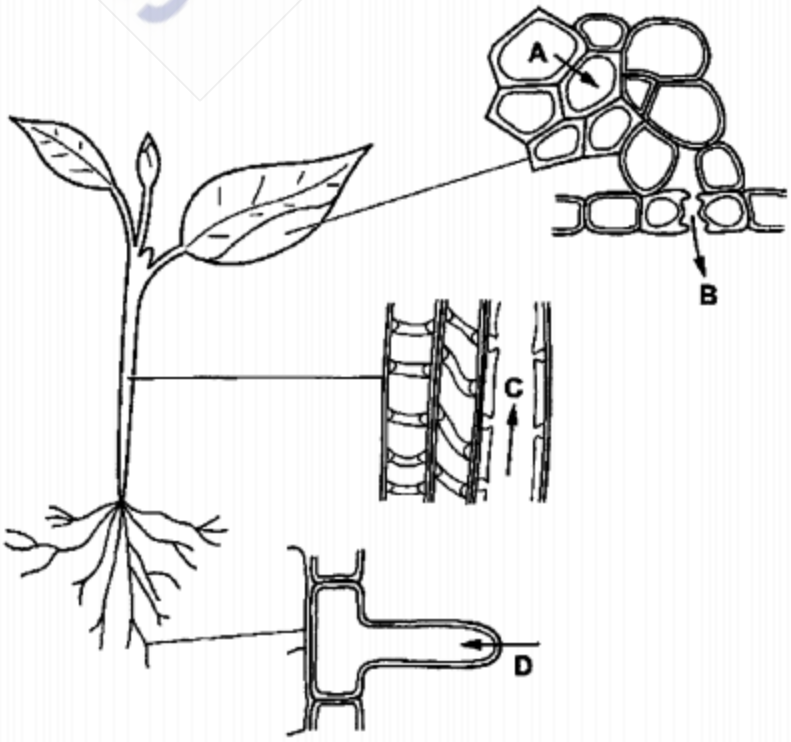


What is the function of the structure labelled Q?

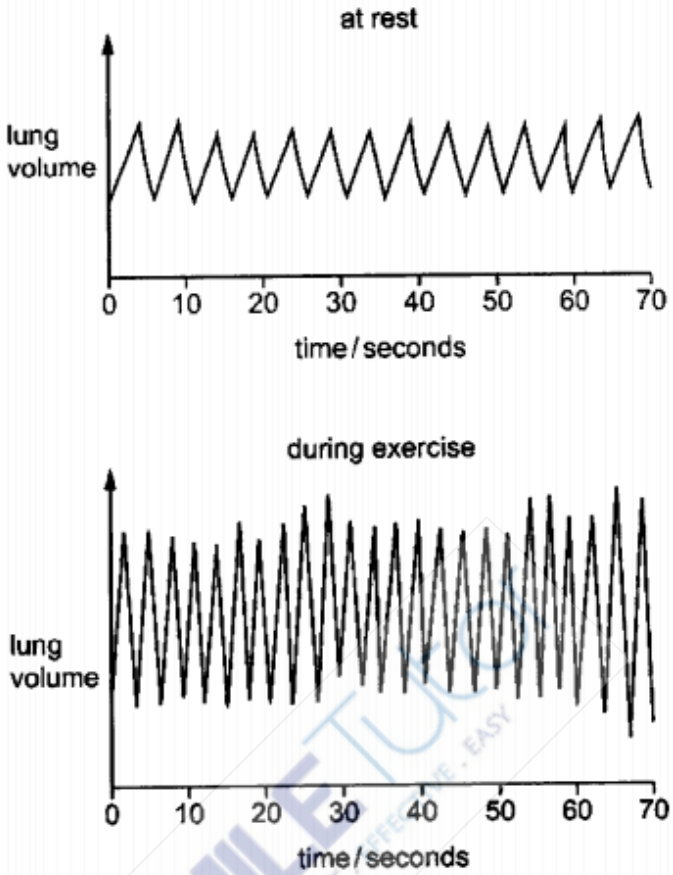
A It controls the amount of blood leaving the heart.
B It increases the pressure in part R.
C It prevents backflow of blood into part P.
D It prevents blood flowing into the vena cava.

16 The diagrams show stages in the passage of water through a plant.

Which arrow shows water moving from cell to cell?



17 The graphs show records of a person's breathing at rest and during exercise.

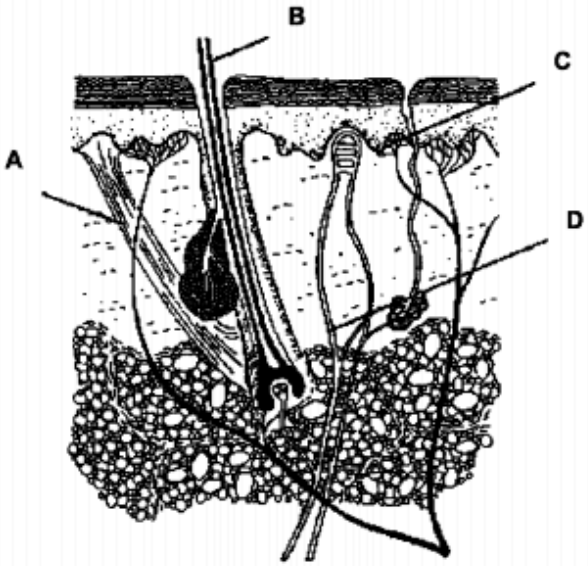


What is the increase in breathing rate when the person is at rest and then exercises?

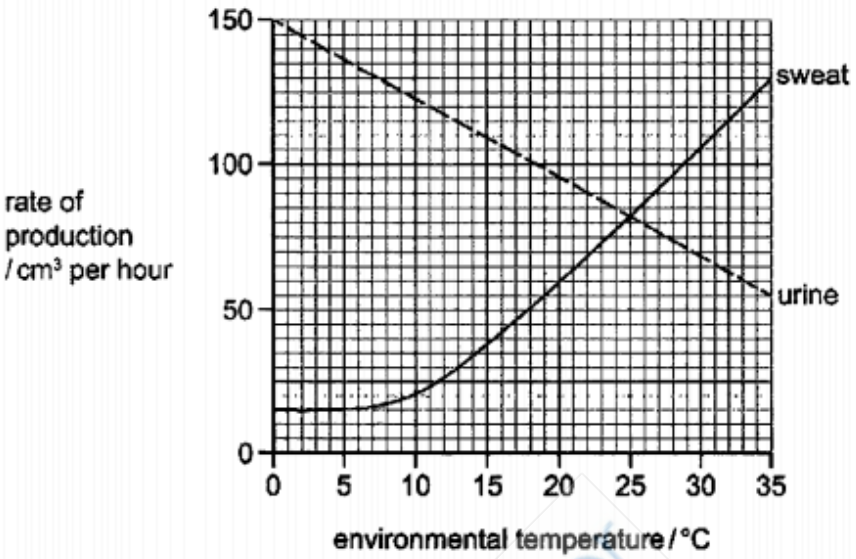
A 9 breaths per minute
B 12 breaths per minute
C 21 breaths per minute
D 60 breaths per minute

18 A person walks into a very cold room. Shortly afterwards, the hairs on their skin are raised.

Which labelled structure detects the change in temperature in this reflex?



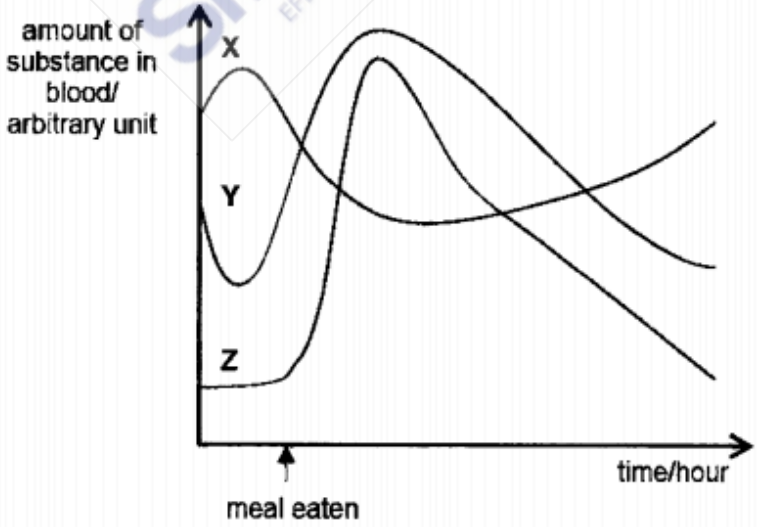
19 The graph shows the rates of sweat production and urine production at different environmental temperatures.



Which statement is correct?

A As the temperature increases, the rates of sweat and urine production increase.
B As the temperature increases, the rate of urine production increases.
C At 25 °C the rates of sweat and urine production are the same.
D Urine and sweat production are directly proportional to environmental temperature.

20 Blood glucose levels in the body are regulated by insulin and glucagon. The graph below shows the glucose and hormone levels of an individual before and after his meal.



Which of the following shows the accurate changes in glucose and hormone levels?

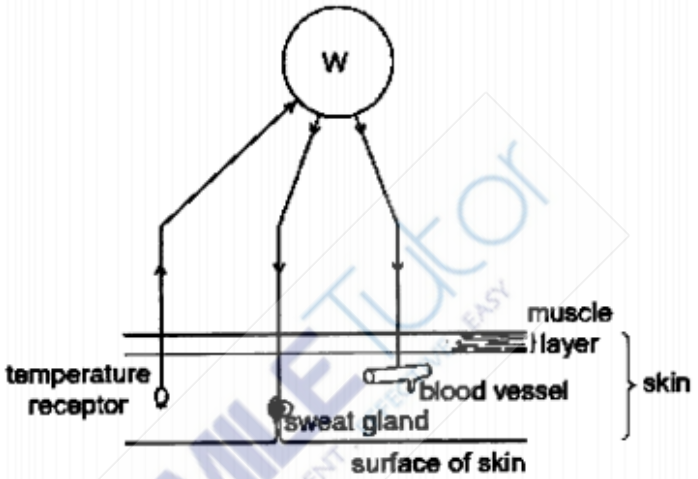
	line X	line Y	line Z
A	insulin	glucose	glucagon
B	glucose	glucagon	insulin
C	glucose	insulin	glucagon
D	glucagon	glucose	insulin

21 A man injures his hand in an accident. Shortly after, he can feel the objects touching his hand, but he cannot move his hand away from them.

What could have caused this?

A Receptors in his hand are damaged.
B Relay neurones in his hand no longer function.
C The nerve connection is cut only between the receptors in his hand and his central nervous system.
D The nerve connection is cut only between his central nervous system and the effectors in his arm.

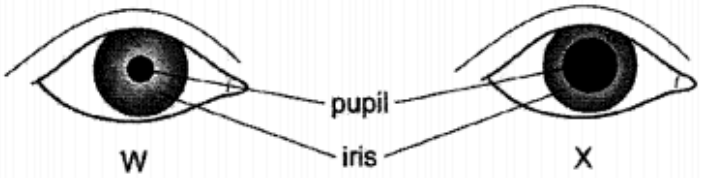
22 The diagram shows some nerve pathways involved in temperature control of the human body.



Which part of nerve pathway does W represent?

A hypothalamus
B ovary
C pituitary gland
D spinal cord

23 The diagrams show the front view of the pupil and iris of the eye in different light intensities.

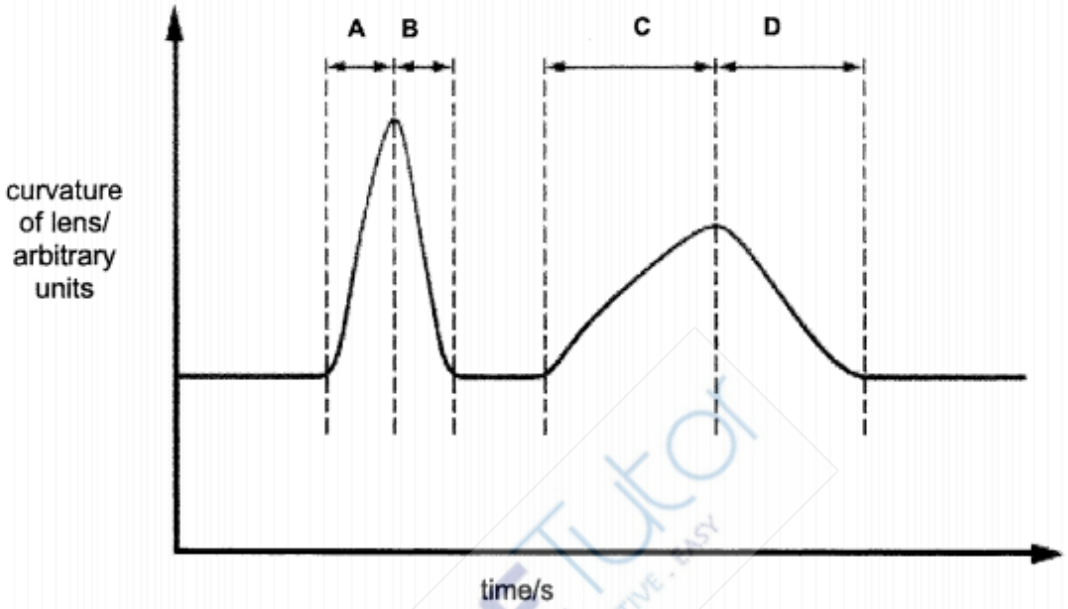


Which row correctly describes diagram X?

	light intensity	circular muscles of the iris	radial muscles of the iris
A	bright light	relaxed	contracted
B	bright light	contracted	relaxed
C	dim light	relaxed	contracted
D	dim light	contracted	relaxed

24 The diagram shows the curvature of the lens in a person's eye.
The shape of the lens changes as the person watches two motorbikes moving at different speeds.

Which period indicates that a motorbike was moving towards the person at a higher speed?



25 Hormones are chemicals involved in co-ordination in the body. Which combination in the table is correct?

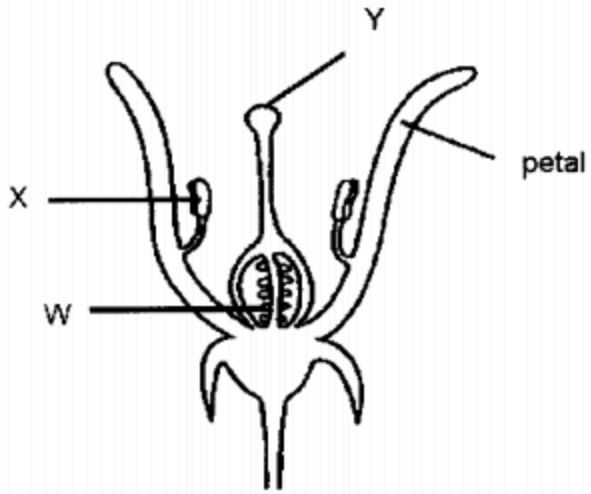
	hormones are carried by	hormones are destroyed by
A	blood plasma	kidney
B	blood plasma	liver
C	red blood cells	kidney
D	red blood cells	liver

26 Which of the following correctly describe(s) the action of adrenaline?

I removal of urea from the body
II raises the depth of breathing
III raises the rate of breathing
IV is controlled by secretions from the pituitary gland

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

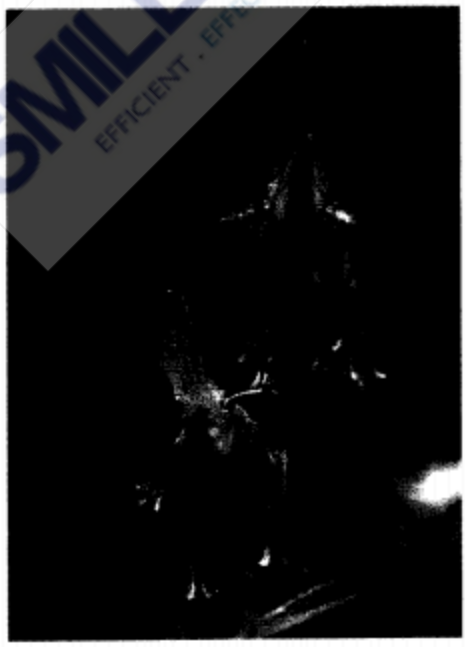
27 The diagram shows a section through a flower.



Which row about the labelled parts is correct?

	contains haploid nuclei	produces pollen	receives pollen
A	X only	W	Y
B	W only	X	Y
C	X and W	X	Y
D	X and Y	Y	W

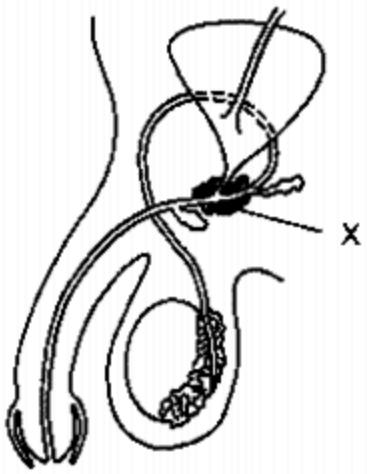
28 The photograph shows two wind-pollinated flowers.



Which row shows the features of these flowers?

	large petals	anthers positioned inside the flower	feathery stigmas
A	yes	yes	no
B	yes	no	no
C	no	no	yes
D	no	yes	yes

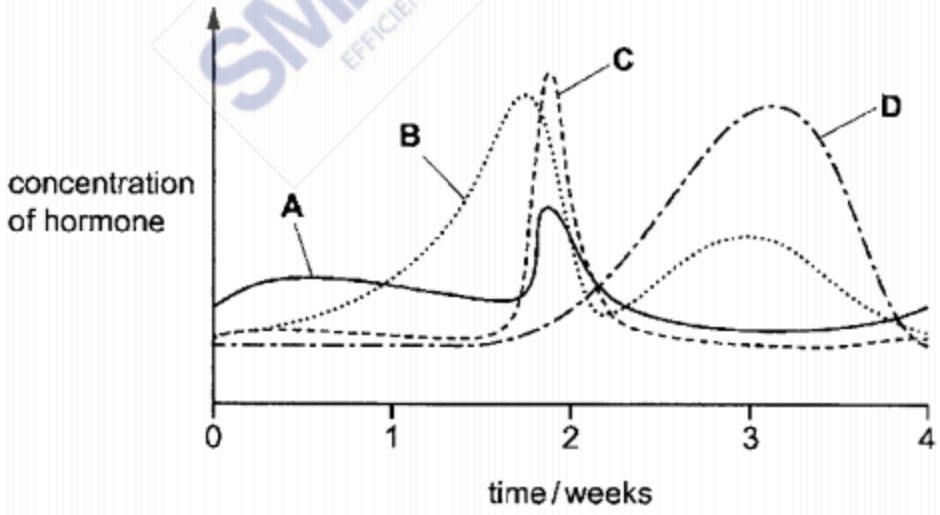
29 The diagram shows a section through the male reproductive system.



What will be the effect if gland X is removed?

A fewer sperms are formed
B fewer sperms can be stored
C less testosterone produced
D sperms are less active

30 The graph shows the four hormones that control the menstrual cycle.
Which curve on the graph represents the hormone oestrogen?



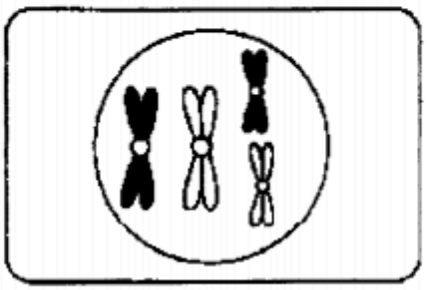
31 The table gives statements about HIV.

Which row correctly marks the statements as true or false?

	all HIV-positive people develop AIDS	an unborn baby is at risk if their mother is HIV positive
A	X	√
B	√	X
C	X	X
D	√	√

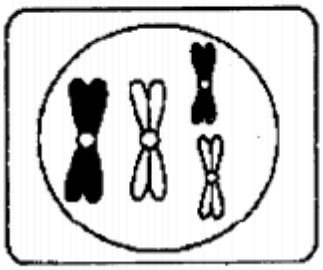
key:
√ = true
X = false

32 The diagram shows a cell during prophase of meiosis.

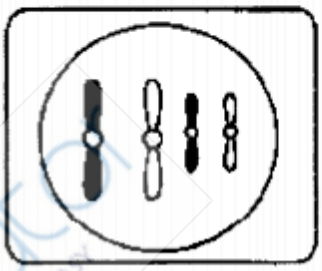


At the end of meiosis, which of the following will one of the daughter cells look like?

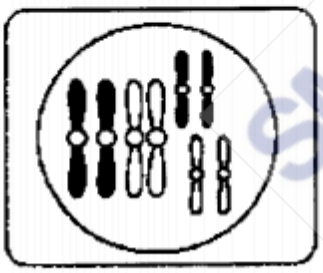
A



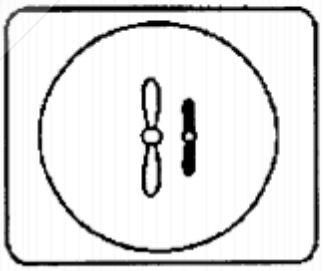
B



C



D

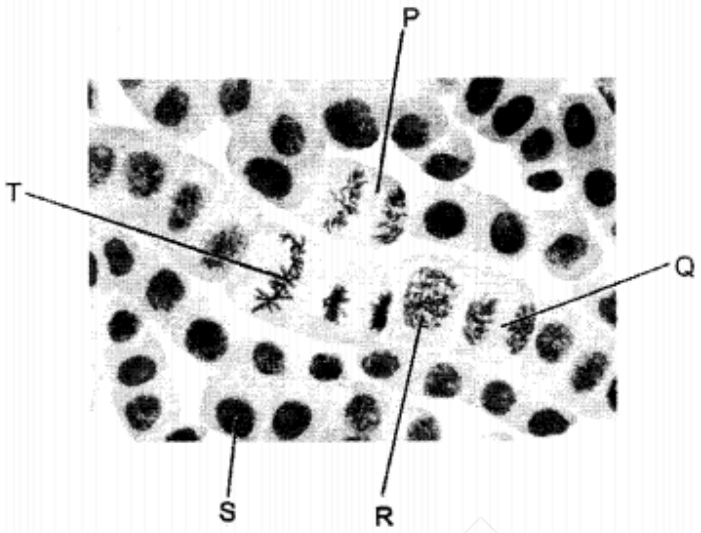


33 A toxin (poison) causes the malfunction of centrioles in an animal cell undergoing meiosis.

Which of the following processes will be directly affected by the presence of the toxin?

A chiasma formation between homologous chromosomes
B furrowing of cell membrane between daughter cells
C migration of chromosomes to opposite poles of cell
D replication of centromeres

34 The photomicrograph shows cells in different stages of mitosis.

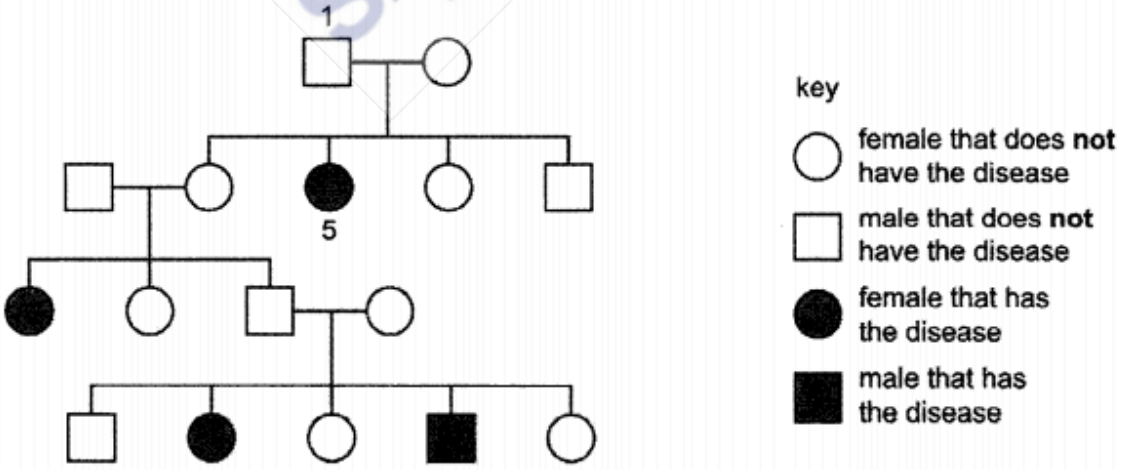


1 Cell T shows metaphase.
2 DNA replication occurs in cell R.
3 The amount of DNA in cell P is the same as in cell T.
4 The correct order for the stages is S → R → T → P → Q.

Which statements are correct?

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

35 The pedigree diagram shows the inheritance of a genetic disease in a family.



Which row describes the correct genotypes for individual 1 and individual 5, for this genetic disease?

	individual 1	individual 5
A	heterozygous	homozygous dominant
B	heterozygous	homozygous recessive
C	homozygous dominant	heterozygous
D	homozygous recessive	heterozygous

36 Some stages in the production of human insulin are listed.

1 Genetically modified E. coli bacteria are grown in large fermenters.
2 The gene for human insulin is inserted into the DNA of a bacterium called E. coli.
3 The gene for human insulin is obtained from human pancreas cells.
4 Human insulin is extracted and purified.

What is the correct sequence of these stages?

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

37 What is **not** an advantage of genetic engineering?

A Genes from genetically modified crops can spread to wild plants.
B It can give predictable results.
C It can improve the taste and nutritional value of crops.
D It can reduce the need to use insecticides and fungicides.

38 A scientist studied wild birds that lived by a lake. He observed that one bird species had a beak that was adapted to extract small insects from the water.

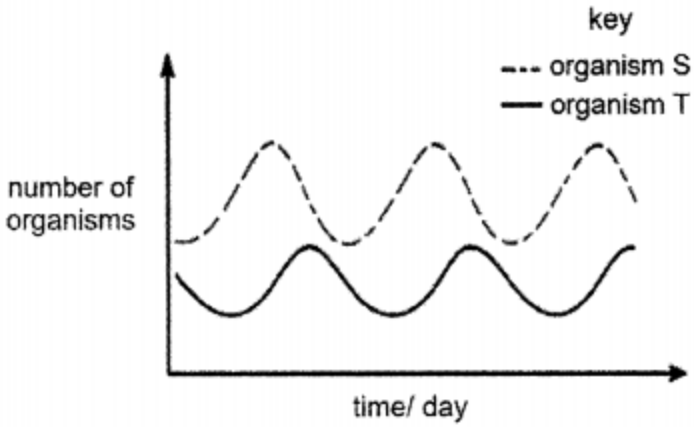
Which process would have occurred in the development of this specialised beak?

A fossilisation
B genetic engineering
C natural selection
D selective breeding

39 What is a food chain?

A a diagram showing an organism getting its energy by feeding on other organisms
B a diagram showing an organism's diet
C a diagram showing the flow of energy through a chain of organisms
D a diagram showing the names of trophic levels

40 The diagram shows a graph of the number of organisms over time.



What could organism S and T be?

	S	T
A	duck	plant
B	eagle	rabbit
C	lion	lamb
D	worm	chicken

Section A [50 marks]

Answer all the questions in the spaces provided.

1 Fig. 1.1 is a simplified diagram representing a transverse section of part of a young root. The diagram is not to scale.

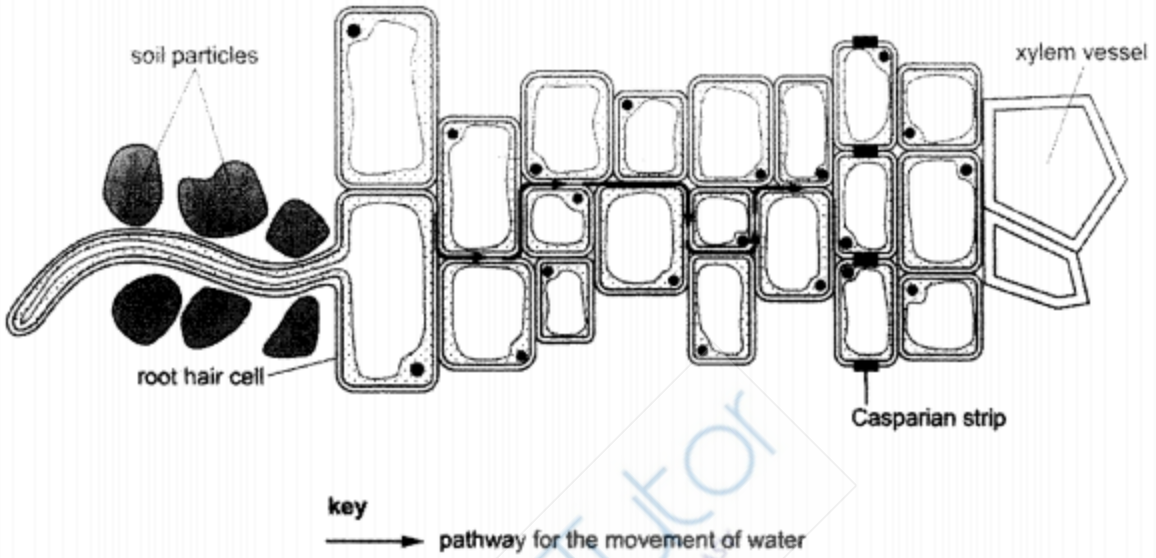


Fig. 1.1

(a) Table 1.2 shows three of the processes by which substances in solution can move across cell membranes in the young root. It also lists five statements that may apply to each of these three processes.

Complete Table 1.2 to show which of the statements apply to each of the three processes shown. Use a tick (√) to show that the statement applies or a cross (X) to show that the statement does not apply. Each box must contain a tick or a cross. The first row has been completed for you.

Table 1.2

statement	process		
	active transport	osmosis	diffusion
require energy	√	X	X
movement of oxygen into a root hair cell			
down a concentration gradient			
movement of mineral ions into the xylem			
movement of water as shown by arrows in Fig. 1.1			

[4]

(b) **(i)** On Fig. 1.1 **draw a label line** and label with the letter **C** to identify the cell membrane. [1]

(ii) Root hairs measure approximately 5μm in diameter and 500μm in length. Explain how this adapts root hairs for the absorption of water.

.....

.....

..... [1]

(iii) The Casparian strip is composed of impermeable corky substances like lignin and suberin, while ordinary cell walls are made of lignin alone. Suggest how the pathway for the movement of water shown by the arrows in Fig. 1.1 will continue toward the xylem vessels.

.....

.....

..... [1]

(c) Water enters the xylem vessels shown in Fig. 1.1. Explain how water moves up the xylem vessels to the leaves in a continuous column.

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..... [3]

[Total: 10]

2 Fig. 2.1 shows part of the thoracic and abdominal cavity in a human.

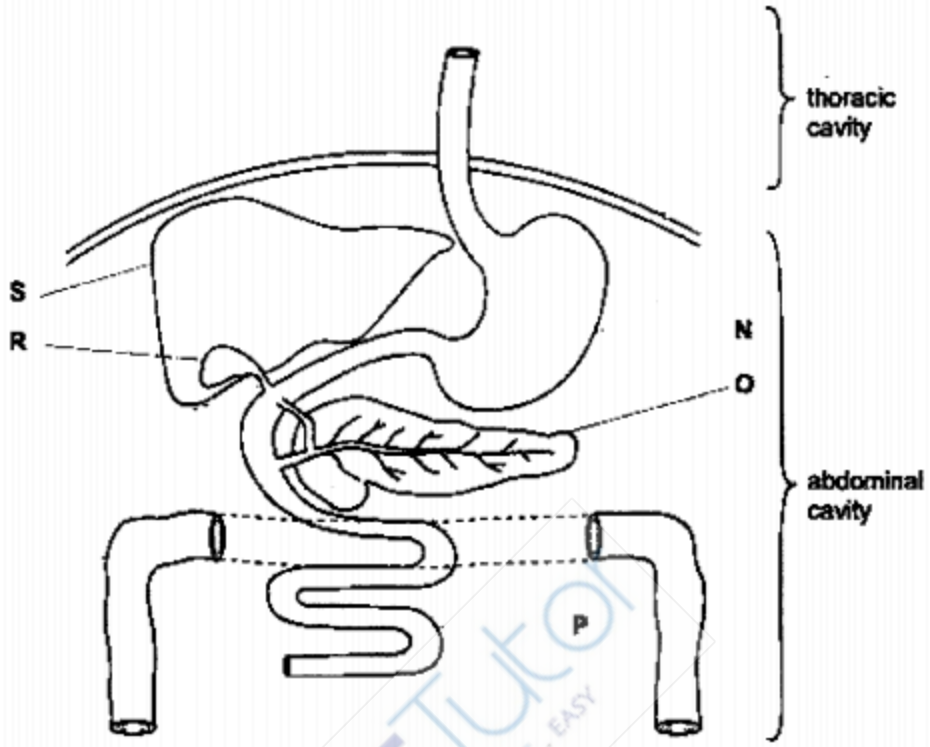

Fig. 2.1

(a) Organs **N**, **O** and **P** all secrete digestive enzymes.

(i) Define the term enzyme.

.....

.....

.....

..... [2]

(ii) Identify organs **N**, **O** and **P** and state the identity of one digestive enzyme secreted by each of these structures.

organ	identity	one digestive enzyme secreted by organ
N		
O		
P		

[3]

(b) Fig. 2.2 shows what happens to fat globules in organ **P** in the presence of bile.

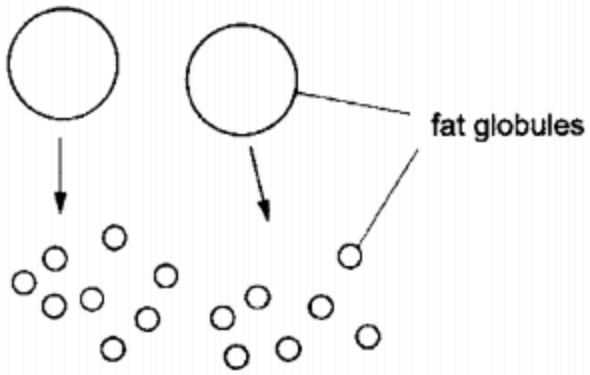

Fig. 2.2

(i) Name the process occurring in Fig 2.2.

..... [1]

(ii) Using Fig. 2.1, identify which letter represents the organ that produces bile.

..... [1]

(iii) Explain the advantage of the process shown in Fig. 2.2.

.....

.....

..... [1]

[Total: 8]

3 Fig. 3.1 shows two sections of lung tissue as seen with a microscope.

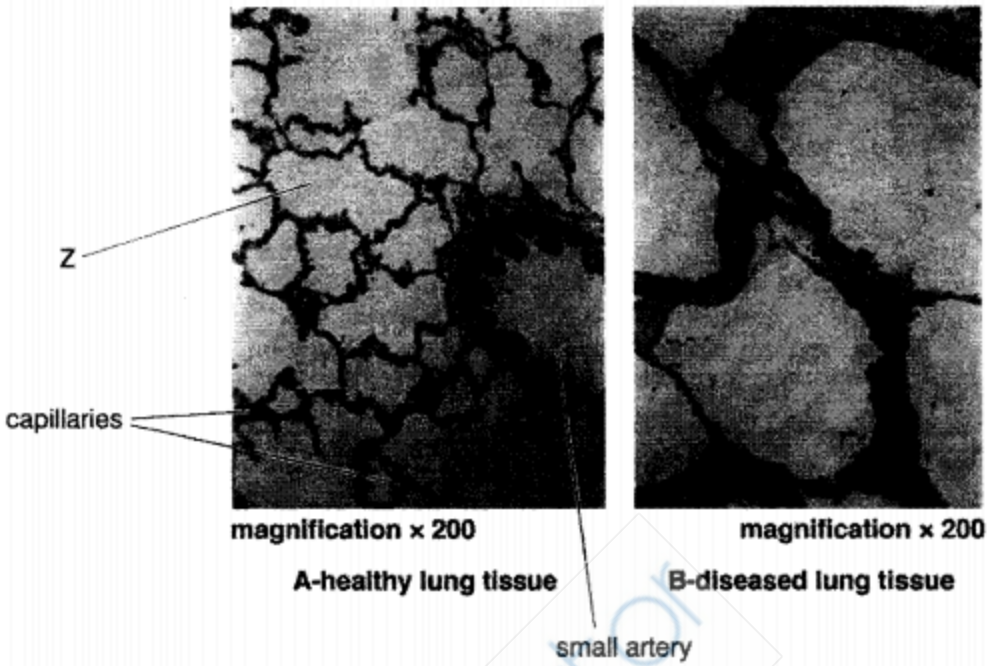

Fig. 3.1

(a) (i) Name the structure labelled **Z** in Fig. 3.1 **A**.

..... [1]

(ii) Explain, using features visible in Fig. 3.1 **A**, how the healthy lung tissue is adapted for gas exchange.

.....

.....

.....

.....

.....

.....

..... [3]

(b) (i) Describe one visible difference between the diseased and healthy lung tissue shown in Fig. 3.1.

.....

..... [1]

(ii) Suggest one possible cause for the diseased lung tissue shown in Fig. 3.1.

.....

.....

..... [1]

[Total: 6]

4 The kidney has the second highest mitochondrial content and oxygen consumption after the heart. Fig. 4.1 is an electron micrograph section of the proximal convoluted tubule. Microvilli form the brush border on the surface facing the lumen. Mitochondria are present closer to the plasma membrane of the cells.

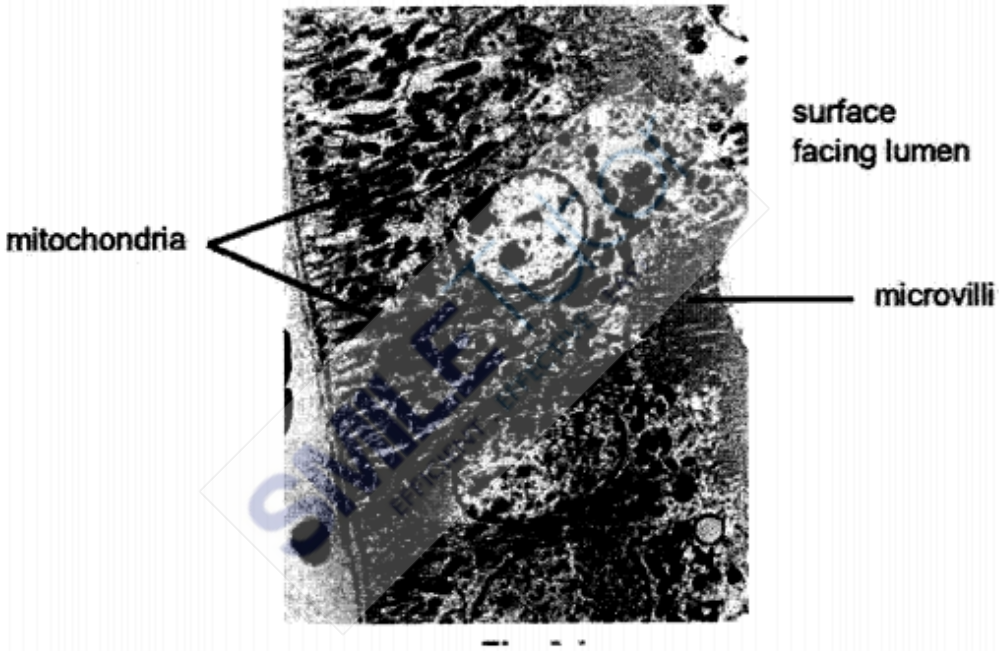

Fig. 4.1

(a) Suggest why proximal tubular cells have a large number of mitochondria.

.....

.....

.....

.....

.....

..... [2]

(b) Suggest the purpose of microvilli in the proximal tubular cells.

.....

.....

..... [2]

When a person suffers kidney failure, they are given dialysis as shown in Fig. 4.2.

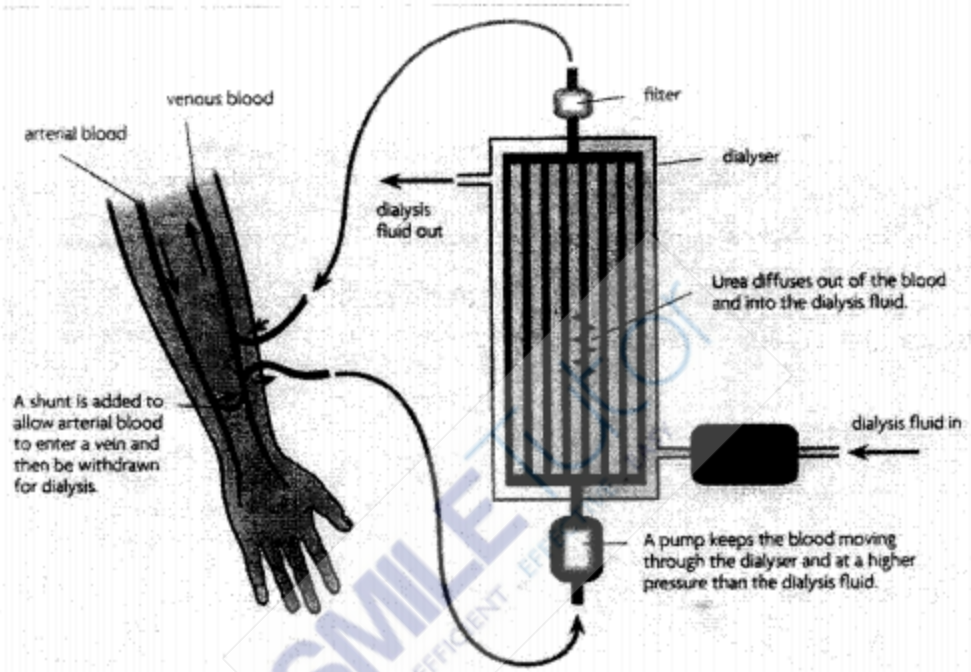

Fig. 4.2

(c) Compare and contrast the mechanism of kidney dialysis to the structure and function of the proximal tubular cells and its microvilli in the kidney.

.....

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.....

.....

.....

.....

..... [4]

[Total: 8]

5 Scallops, which are bivalve molluscs, are important commercially throughout the world. The marine bay scallop, *Agropecten irradians*, has three distinct shell colours, yellow, orange and black. The shell colour is controlled by a gene with three alleles, yellow, S^y, orange, S^o, and black, S^b.

Scallops are hermaphrodite and are able to fertilise themselves to produce offspring. Single mature adult specimens of yellow, orange and black scallops were collected and kept in separate tanks of seawater until they produced young. The young were then recorded for shell colour.

The results were as follows:

adult	offspring
yellow scallop	25 yellow and 8 black
orange scallop	31 orange and 9 black
black scallop	27 black

(a) Explain the results from the orange and black scallops. Your answers should include a genetic diagram for orange scallop to explain the situation.

(i) orange scallop

.....

.....

.....

.....

.....

.....

..... [4]

(ii) black scallop

.....

.....

.....

.....

..... [2]

(b) Orange scallops are more valued for human consumption. Describe how a marine biologist could produce a pure-breeding line of orange scallops for commercial exploitation using the offspring from the single orange scallop.

.....

.....

.....

.....

..... [2]

(c) (i) It is known that genetic variation within a population of species helps to increase their survival rate. Explain one way how meiosis can lead to genetic variation when scallops produce gametes for fertilisation.

.....

.....

..... [1]

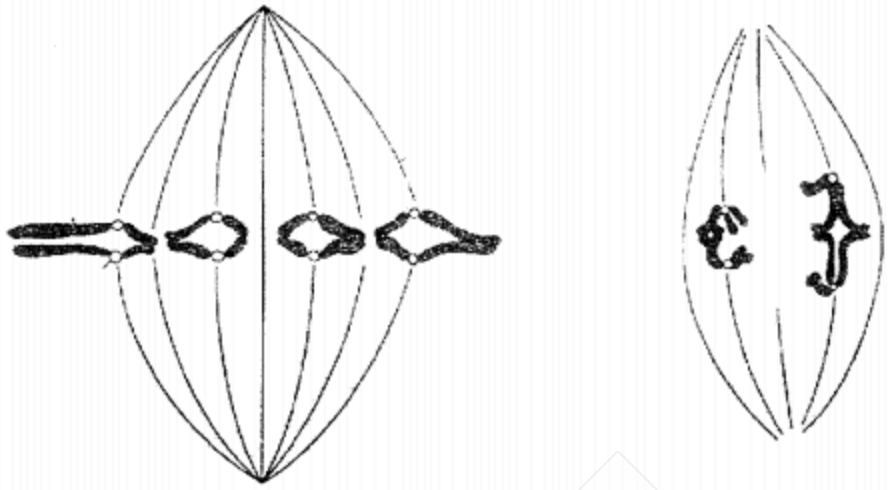
(ii) Not all scallops are hermaphrodites. Non-hermaphroditic scallops require another scallop to reproduce. Suggest why scallops that are non-hermaphroditic have a greater genetic variation compared to scallops that are hermaphroditic.

.....

.....

..... [1]
[Total:10]

6 **Fig. 6.1** shows the same stage in the two types of cell division in the cells of an organism.



Cell 1 **Cell 2**

Fig 6.1

(a) State the type of nuclear division and the stage of division in each cell.

Type of division

Cell 1: ..... Cell 2: .....

Stage:.....[2]

(b) Use your knowledge of cell division to describe two visible differences between the arrangements of chromosomes in cell 1 and cell 2.

.....

.....

.....

.....[2]

(c) Fig. 6.2 is a diagram showing the structure of part of a DNA molecule in the chromosome.

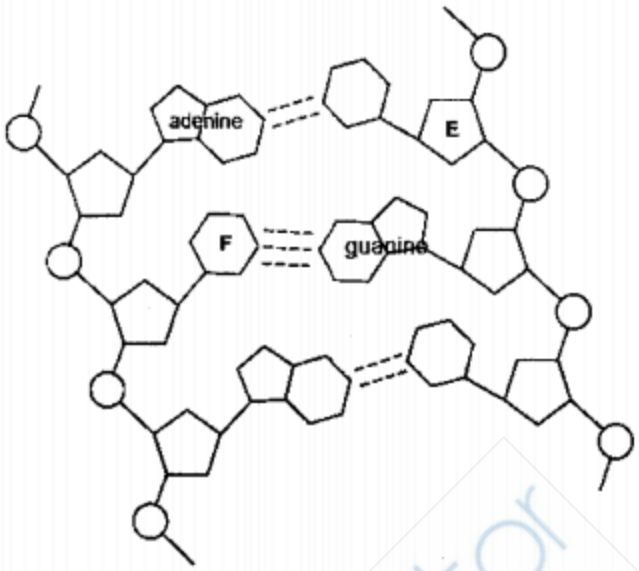


Fig. 6.2

(i) Identify structure **E** and structure **F** in Fig. 6.2.

E .....

F ..... [1]

(ii) On Fig. 6.2 **draw a circle** around one nucleotide. [1]

(iii) Suggest how DNA structure having weaker hydrogen bonds linking the two bases like adenine and thymine together and strong covalent bond linking two nucleotides together ensure genetic stability.

.....

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..... [2]

[Total:8]

Section B

Answer **three** questions

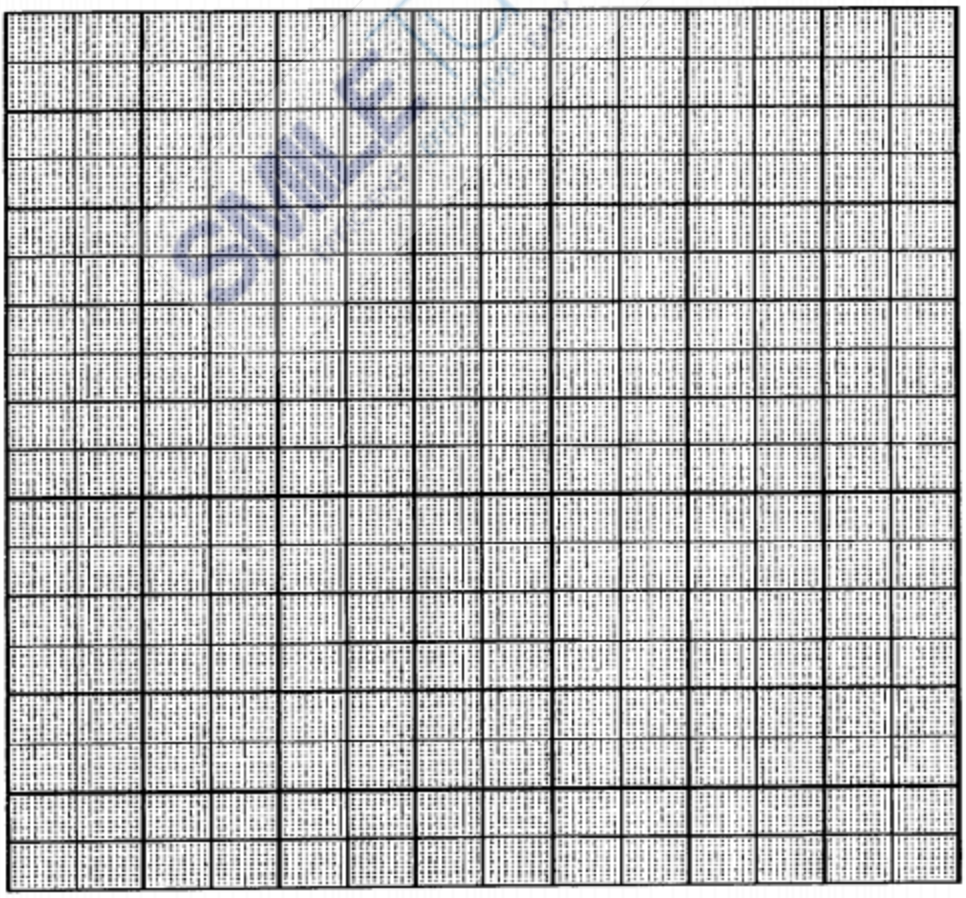
Question **9** is in the form of **Either/Or** question. Only one part should be answered.

7 Amy conducted an experiment to compare the rate of oxygen production of two different water plants, **A** and **B** at various light intensities. The conditions for both setup are similar. The results are shown in Table 7.1.

Light intensity / arbitrary units	Oxygen production / arbitrary units	
	Plant A	Plant B
0	0.0	0.0
10	0.9	2.1
20	2.2	4.0
30	4.5	4.5
40	6.5	4.9
50	7.0	5.0
60	7.0	5.0

Table 7.1

(a) Using the data in Table 7.1, plot a graph to show the relationship between the relative light intensity and the rate of oxygen production for water plant **A** and **B**.



[4]

(b) With reference to the data, compare and contrast the rate of oxygen production between water plant **A** and **B**.

.....

.....

.....

.....

.....

.....[3]

(c) Explain which of the potted plants should Amy choose as an indoor decorative water plant in an aquarium?

.....

.....

.....

.....[2]

(d) State a possible limiting factor of photosynthesis for water plant **B** at a light intensity of 50 arbitrary units.

..... [1]

[Total: 10]

8 Fig. 8.1 shows the external features of the human heart and some of its blood vessels 1-5.

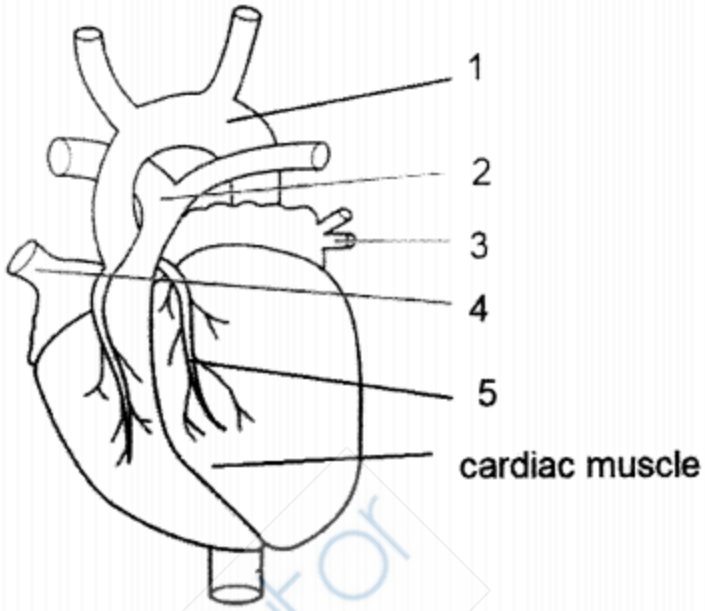


Fig. 8.1

(a) In the table below, name blood vessels 1-5, shown in Fig. 8.1 and explain how the structure of each blood vessel enables oxygenated blood to circulate into the cardiac muscle of the heart.

structure	name of blood vessel	explanation
1		
2		
3		
4		
5		

[5]

(b) Describe how the circulatory system helps to stop bacterial infection from a cut in the skin.

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..... [3]

(c) Smoking tobacco can cause the occlusion of the blood vessel 5. Suggest the effects of occluding the blood vessel 5.

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..... [2]

[Total: 10]

9 Either

Human activities affect the environment. Fig. 9.1 show the pyramid of numbers for one of the food chains in the sea.

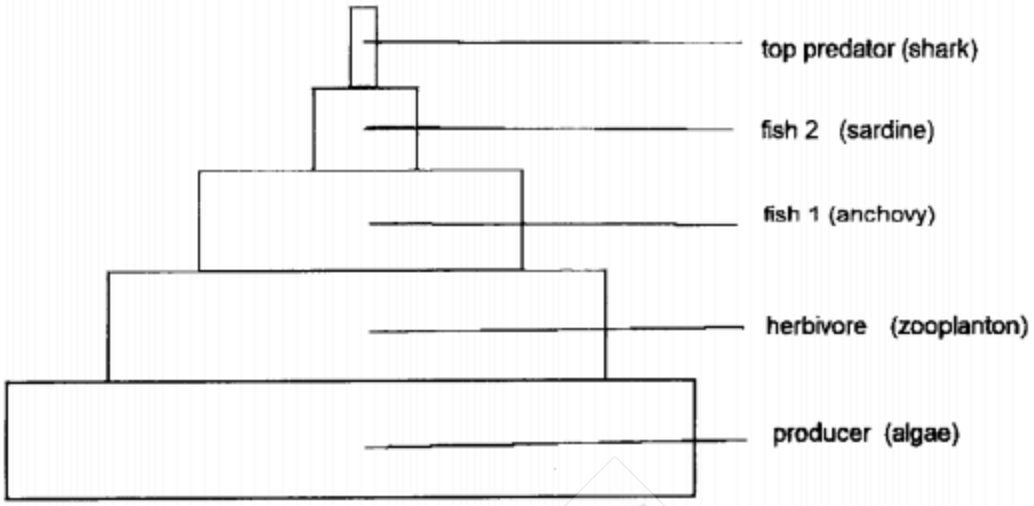

Fig. 9.1

(a) Explain why the pyramid of numbers has only 5 or less trophic levels.

.....

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..... [3]

(b) Sea fishing often remove the top predator fish like the sharks. Describe and explain the effect of removing the top predator fish through overfishing.

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..... [3]

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

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..... [4]

[Total: 10]

9 Or

Fig. 9.2 shows a large jar in which plants are growing. This jar provides an environment in which plants can live for many months without adding water or removing the tightly fitting cork to allow air to enter.

Fig. 9.2

(a) Explain the importance of placing the jar where it can receive a supply of sunlight. Briefly describe the non-cyclical nature of this energy flow.

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..... [3]

(b) Explain why no air needs to be added to the jar. In your answer, identify the major ecological processes involved and the carbon sink in the jar.

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..... [4]

(c) Describe how we can continue to cut down trees for timber production but also maintain the biodiversity of forests.

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.....

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.....

.....

..... [3]

[Total: 10]

ANSWER SHEET

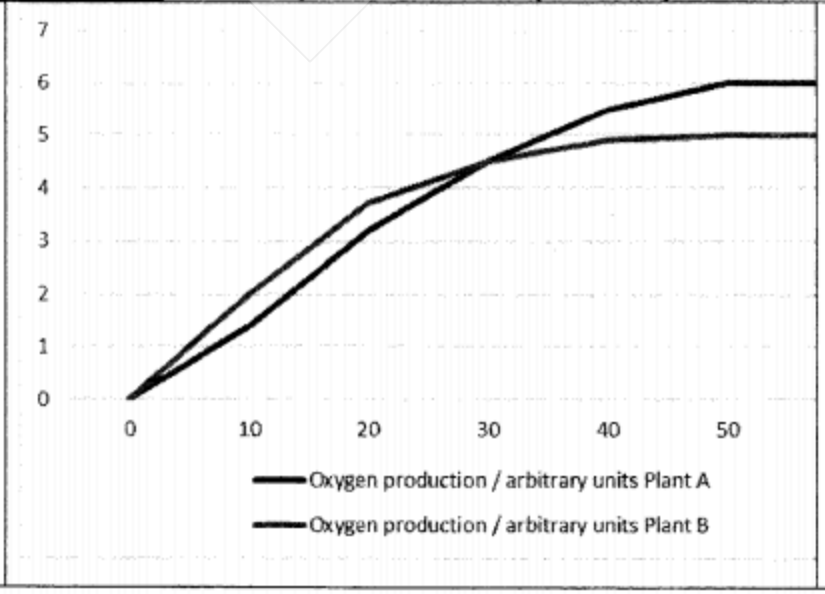
Paper 1: Multiple Choice Questions (40 marks)

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

Paper 2 Section A: Structured Questions (50 marks)

<table>
<tr><th>No</th><th>Answer Key</th><th>Mark</th></tr>
<tr><td>1(a)</td><td>
<table>
<tr><th></th><th>active transport</th><th>osmosis</th><th>diffusion</th></tr>
<tr><td>movement of oxygen into a root hair cell</td><td>X</td><td>X</td><td>√</td></tr>
<tr><td>down a concentration gradient</td><td>X</td><td>√</td><td>√</td></tr>
<tr><td>movement of mineral ions into the xylem</td><td>√</td><td>X</td><td>√</td></tr>
<tr><td>movement of water as shown by arrows in Fig. 1.1</td><td>X</td><td>X</td><td>X</td></tr>
</table>
</td><td>1
1
1
1</td></tr>
<tr><td>(b)</td><td>(i) ruled line and label on any of the cell
(ii) large surface area to volume ratio ; efficient absorption
(iii) osmosis from cell to cell due to water potential gradient</td><td>1
1
1</td></tr>
<tr><td>(c)</td><td>Transpiration pull;
Long hollow and narrow tube of xylem;
Adhesion and cohesion forces;</td><td>1
1
1</td></tr>
<tr><td></td><td>Total</td><td>10</td></tr>
<tr><td></td><td>Marker's comments:</td><td></td></tr>
<tr><td>2 (a) (i)</td><td>Enzymes are proteins; organic catalyst; speed up chemical reaction ;
without any change to itself</td><td>1
1</td></tr>
<tr><td>(ii)</td><td>
<table>
<tr><th>organ</th><th>identity</th><th>one digestive enzyme secreted by organ</th></tr>
<tr><td>N</td><td>stomach</td><td>protease/pepsin/renin</td></tr>
<tr><td>O</td><td>pancreas</td><td>protease/trypsin/ amylase/lipase</td></tr>
<tr><td>P</td><td>Small intestine</td><td>sucrase/maltase/lactase/erepsin / protease/lipase</td></tr>
</table>
</td><td>1
1
1</td></tr>
</table>

(b)	(i) emulsification (ii) S (iii) digestion of fats will be faster due to smaller fat globules	1 1 1
	Total	8
	Marker's comments:	
3 (a)	(i) Alveoli/air sac	1
	(ii) one cell thick wall; rapid diffusion spherical shaped with large surface area to volume ratio; rapid diffusion dense blood capillaries; high concentration gradient thin layer of moisture; dissolved gases	1 1 1 1 Any three
(b)	(i) alveolar walls breakdown (ii) prolong coughing leading to emphysema/caused by irritants in cigarette smoking. Any logical answer	1 1
	Total	6
	Marker's comments:	
4 (a)	Aerobic respiration takes place to release energy for active transport during selective reabsorption	1 1
(b)	Provide a large surface area to volume ratio; rapid diffusion/reabsorption of **essential** nutrients like glucose and amino acids	1 1
(c)	Proximal tubular cells are replaced by thin dialysis membrane surrounded by dialysis fluid with same glucose and minerals concentration; no active transport but diffusion occurs Microvilli are mimicked with long narrow tubing to provide large surface area to volume ratio	1 1 1 1
	Total	8
	Marker's comments:	
5 (a) (i)	Hybrid Cross Parental Phenotype: yellow X yellow Parental Genotype: $S^y S^b$ $S^y S^b$ Gametes: S^y S^b S^y S^b Offspring Genotype: $S^y S^y$ $S^y S^b$ $S^y S^b$ $S^b S^b$ Offspring Phenotype: Yellow Yellow Yellow Black Ratio: Ratio of 3 yellow : 1 black Parent genotype can only be $S^y S^y$ or $S^y S^b$. Any other cross combination with one homozygous dominant yellow, $S^y S^y$ will always produce only yellow offspring	1 1 1 1
(ii)	Black is homozygous recessive; $S^b S^b$ bred true	1 1

(b)	Multiple generations of yellow X yellow to obtain only yellow offspring ie breed true or Test Cross of orange with black will produce all orange offspring	1 1 or 1 1
(c) (i)	Meiosis produces haploid daughter cells as gametes containing one chromosome from each homologous pair due to independent assortment/crossover	1
(ii)	Fertilisation ensures the fusion of the haploid gametes from two parents to form diploid zygote	1
	Total	10
	.	
6 (a)	<table><tr><th>Cell 1</th><th>Cell 2</th><th>Stage</th></tr><tr><td>**mitosis**</td><td>**meiosis**</td><td>**metaphase**</td></tr></table>	1 (both cell 1 and 2) 1 (stage)
(b)	Cell 1 – random segregation of sister chromatids Cell 2 – random segregation of homologous chromosomes	1 1
(c) (i)	E- deoxyribose sugar F- cytosine	1
(ii)	Include deoxyribose sugar to base and phosphate group	1
(iii)	Replication of duplicate DNA can take place easily during interphase. Minimise any errors in the base sequence which remain the same throughout replication/transcription.	1 1
	Total	8
	Marker's comments:	
Paper 2 Section B: Free Response Questions (30 marks)		
7 (a)		1

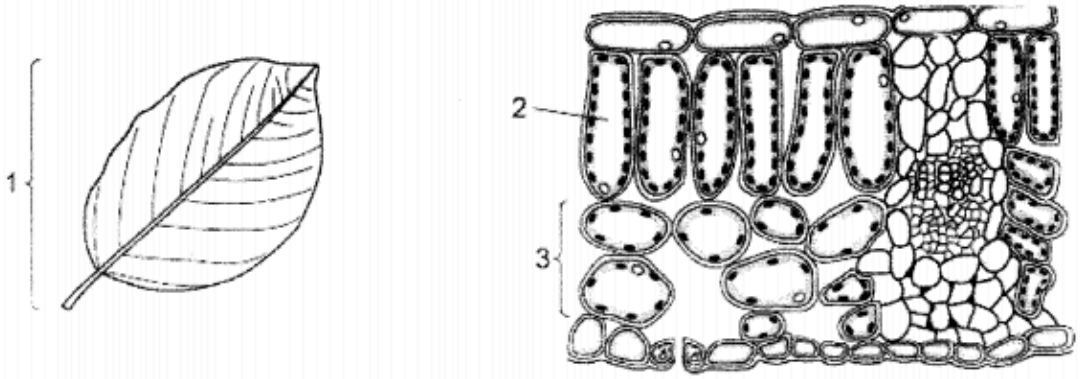
	scale ; correct plot points ; best fit curve ; correct axes and labels	1 1 1
(b)	Similarities: (b) At light intensity of 30, both plants shows the same i.e 4.5 au [1] (d) Rate of oxygen production remained constant (Reject: stopped) at 6.0 au for plant A and 5.0 au for plant B at light intensity of 50 au. Differences: (a) From light intensity of 0 to 20 au, plant B shows a higher rate of oxygen production. The oxygen production of plant Y increases to 3.7au while that of plant A only increase to 3.2 au with a difference of 0.5 au (manipulated data) [1] Accepted range: 0 TO 30 au Rejected range: 0 to 10 au (this is because the trend continues till 20au) (c) Above light intensity of 30, plant A shows a higher rate of oxygen production from 4.5 au to 6.0 au with a difference of 1.5 au as compared to plant B which has a rate of oxygen production from 4.5 au to 5.0 au with a difference of 0.5 au [1] (e) The maximum oxygen production of plant X was 6.0 while that of plant Y is 5.0 at light intensity of 50. [1]	1 1 1 [Any 3 points 1 from each category]
(c)	B; [1] B has a higher rate of oxygen production at lower light intensity indicating that it can photosynthesize better at lower light intensity while indoors. [1] *The relationship needs to be clearly made.	1 1
(d)	Carbon dioxide concentration in the water / temperature of the surrounding /size of leaves	1
	Total	10
	Marker's comments:	
8 (a)	Aorta – carry oxygenated blood at high pressure via arteries to the rest of the body including coronary arteries (blood vessel 5) Pulmonary artery - carry deoxygenated blood at high pressure	1 1

	to the lungs Pulmonary artery - carry oxygenated blood back from the lungs to the left atrium Vena cava- collect deoxygenated blood from the rest of the body to the right atrium coronary arteries (blood vessel 5) carry oxygenated blood to the cardiac muscle. 1,.2 and 5 have thick muscular elastic walls with small lumen 3 and 4 have thin muscular elastic wall with large lumen	1 1 1 1 1 1 Max 5
(b)	Bleeding of blood to flush the bacteria White blood cells are phagocytes and lymphocytes to fight against bacteria through phagocytosis and production of antibodies Clotting to prevent entry with formation of fibrin triggered by damaged platelets	1 1 1 1 1 Max 3
(c)	Less blood flow/narrow flow of oxygenated blood to cardiac muscle ; Blood clot; heart attack due to lack of oxygen for the cardiac muscle	1 1
	Total	10
	Marker's comments:	
9 E (a)	90% energy loss due to respiration, heat loss, excretion and defecation. 10 % retention through each tropic level Too little energy left for the 5th or 6th tropic level	1 1 1
(b)	The population of sardine will increase suddenly without the shark as predator; Equilibrium of the food pyramid will change with fluctuating population of anchovy, zooplanktons and algae. Loss of biodiversity due to collapse of the ecosystem with removal of keystone organism	1 1 1
(c)	Quota of catch for sustainability Conservations of fishing area Ban use of dredges and drift net/ cyanide fishing/mesh size Raising endangered species of fish in hatcheries for release into the sea	1 1 1 1
	Total	10
	Marker's comments:	
9 O (a)	Sunlight provides the energy for photosynthesis; inorganic → organic compounds in producer producers pass on the energy to consumers with 90% loss for each tropic level due to respiration, heat loss, excretion and defecation/10% retention of the nutrients/chemical energy	1 1 1
(b)	Carbon cycle; Photosynthesis by plants and algae reduces carbon dioxide concentration and Create carbon sink in organisms Living organisms released carbon dioxide during respiration	 1 1 1

	Dead organism decomposed to release carbon dioxide	1
(c)	Creation of laws to regulate the logging industry Reforestation: The planting of new trees or seedlings to replace trees that have been destroyed Designation of lands as forests reserves Research to improve quality of forests and making them more productive	1 1 1 1 Max 3
	Total	10
	Marker's comments:	

FU CHUN SECONDARY SCHOOL SA2 PAPER

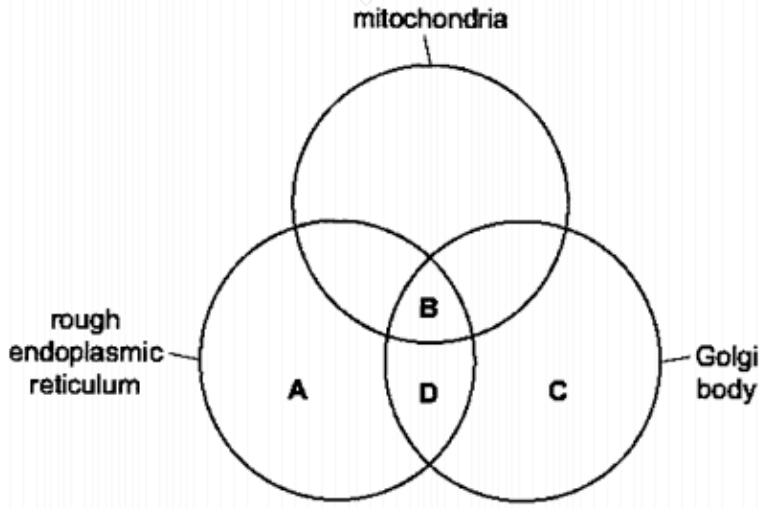
1 The diagrams show a leaf and its internal structure.



What are the levels of organisation of the labelled structures?

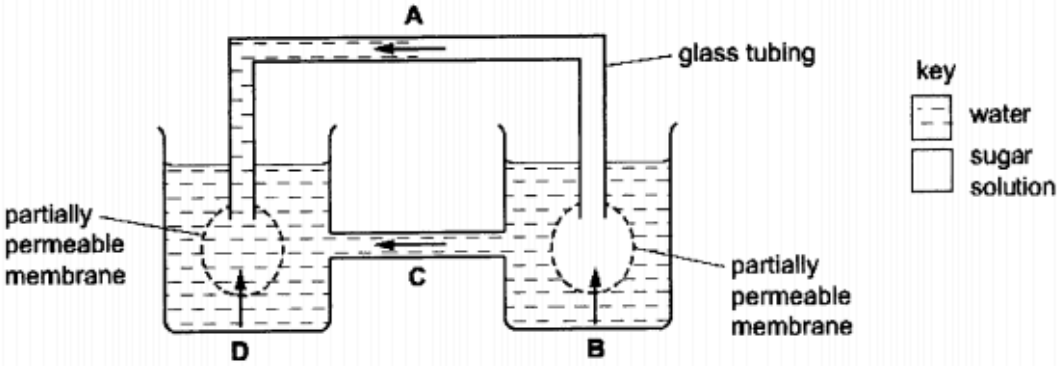
	cell	organ	tissue
A	1	2	3
B	1	3	2
C	2	1	3
D	2	3	1

2 Which cell structures are required for the formation of proteins in a cell that are to be secreted out?



3 The diagram shows an experiment investigating the process of osmosis.

Which arrow shows the direction of the net movement of water at the start of the experiment?



4 Different factors affect the rate of diffusion of molecules across a membrane.

Which row represents changes to factors that will result in the highest rate of diffusion?

	concentration gradient across a membrane	thickness of membrane	surface area of membrane	temperature
A	low	low	high	high
B	low	high	high	low
C	high	low	high	high
D	high	high	low	low

5 A student carried out four food tests on a sample. The results are shown in the table.

test	observation
Benedict's	yellow
biuret	purple
emulsion	cloudy
iodine	yellow

Which conclusions made by the student are correct?

1 Fat is present.

2 Sucrose was present.

3 Protein was present.

4 Starch was not present.

A 2 and 3 only

B 1, 2 and 4 only

C 1, 3 and 4 only

D 1, 2, 3 and 4

6 Which processes depend on the fact that water is a solvent?

	evaporation from the spongy mesophyll cells	glucose transported in blood plasma	loss of sweat from the skin surface
A	✓	✓	✓
B	✓	✓	×
C	✓	×	×
D	×	✓	×

key

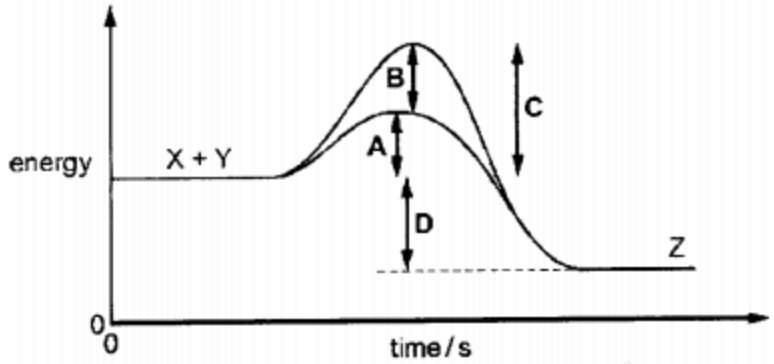
✓ : depends

× : does not depend

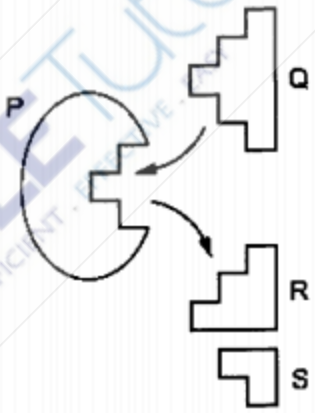
7 The graph shows the energy levels involved in an enzyme-catalysed reaction.

Substrate molecules X and Y combine to give product Z.

Which arrow shows the reduction in activation energy due to the enzyme?



8 The diagram shows an enzyme with its substrate and product molecules.



Which form an enzyme-substrate complex?

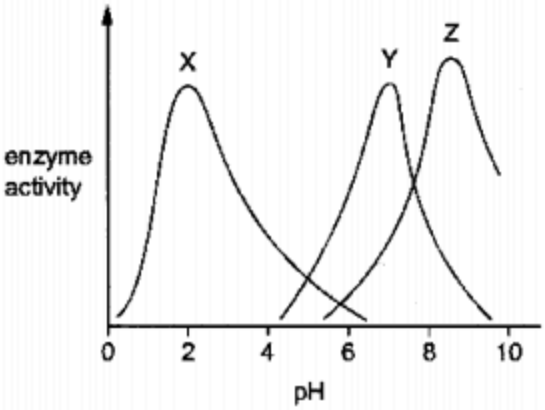
A P and Q

B Q and R

C R and S

D S and P

9 The graph shows the effect of pH on the activity of three different enzymes.



Which enzymes in the graph are likely to be protease enzymes?

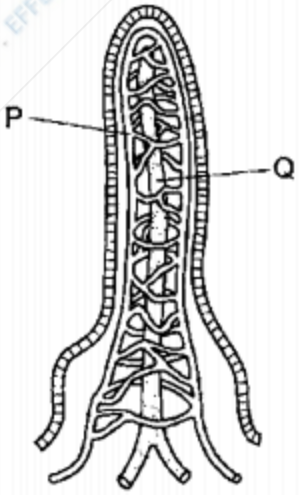
A X and Y

B X and Z only

C Y and Z only

D Z only

10 The diagram shows a villus.

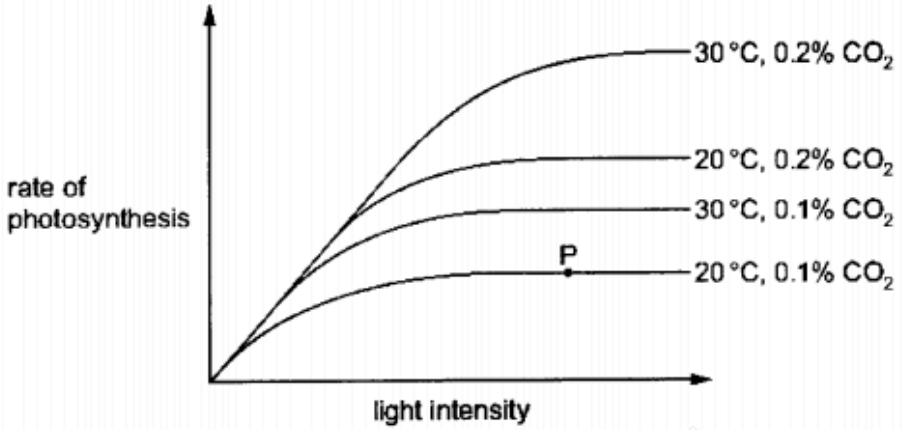


Which row identifies the products absorbed by P and Q?

	P	Q
A	amino acids	glucose
B	fatty acids	maltose
C	glucose	fatty acids
D	maltose	amino acids

11 The diagram shows how the rate of photosynthesis varies with light intensity.

The four curves show different conditions of temperature and carbon dioxide concentration.



What limits the rate of photosynthesis at point P?

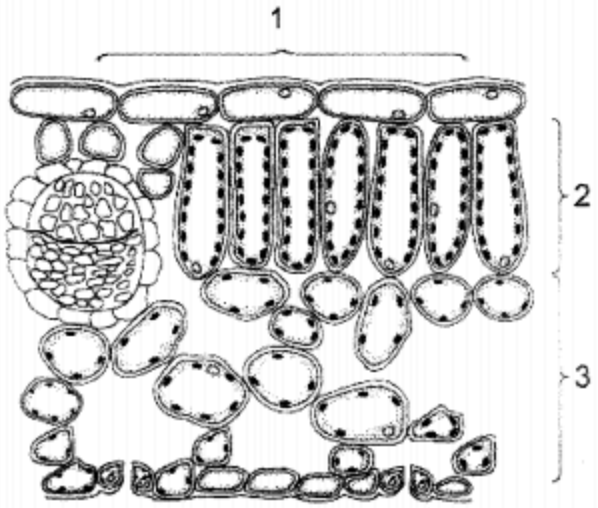
	light intensity	carbon dioxide concentration	temperature
A	✓	✓	×
B	✓	×	×
C	×	✓	✓
D	×	×	✓

key

✓ : limits rate of photosynthesis

× : does not limit rate of photosynthesis

12 The diagram shows part of a leaf as seen in cross section under the microscope.

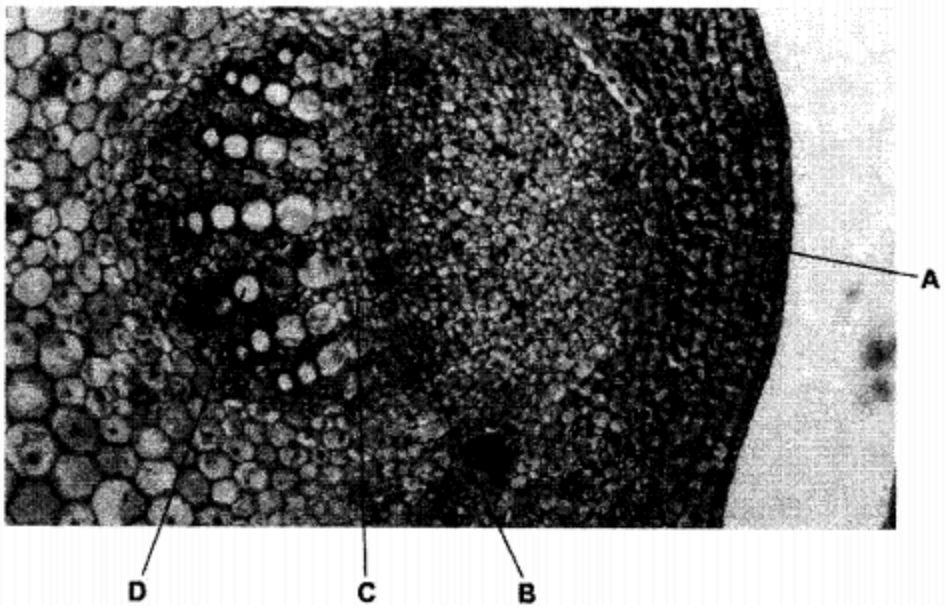


What are the names of regions 1, 2 and 3?

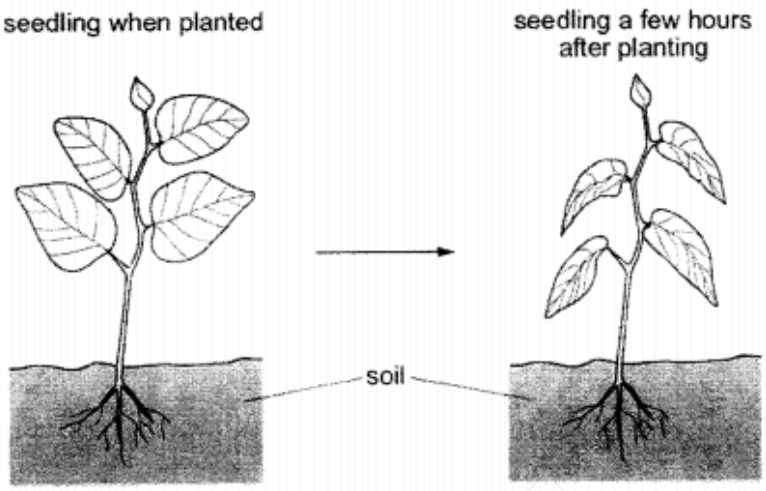
	region		
	1	2	3
A	palisade mesophyll	epidermis	spongy mesophyll
B	spongy mesophyll	palisade mesophyll	epidermis
C	epidermis	palisade mesophyll	spongy mesophyll
D	epidermis	spongy mesophyll	palisade mesophyll

13 The diagram shows a transverse section of a stem.

Which area is the phloem?



14 The diagram shows a newly planted seedling and the same seedling a few hours after being planted.



What is the correct explanation for the change in the appearance of the leaves?

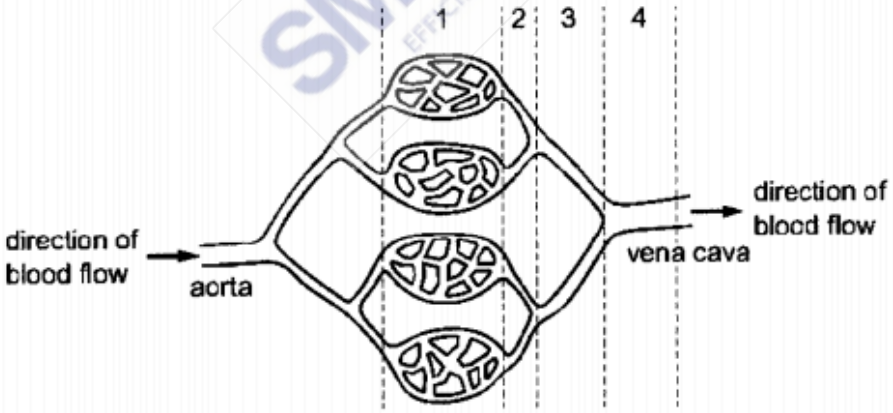
A Transpiration is faster than water uptake by root hairs so cells have become flaccid.

B Transpiration is faster than water uptake by root hairs so cells have become turgid.

C Transpiration is slower than water uptake by root hairs so cells have become flaccid.

D Transpiration is slower than water uptake by root hairs so cells have become turgid.

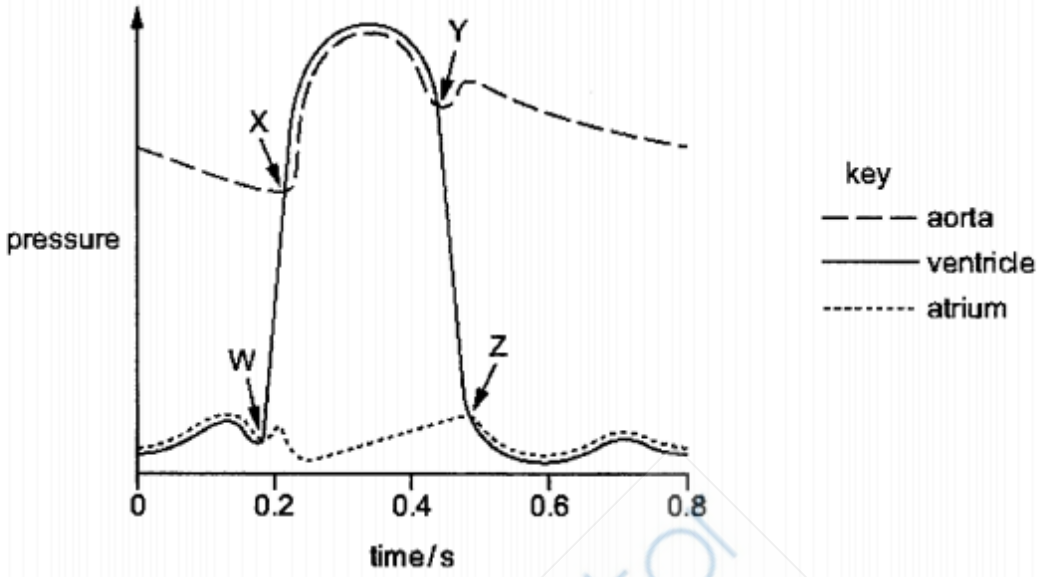
15 The diagram shows part of the circulatory system in a mammal.



Where is the blood pressure and the speed of flow the lowest?

	lowest blood pressure	lowest speed of flow
A	1	4
B	2	3
C	3	2
D	4	1

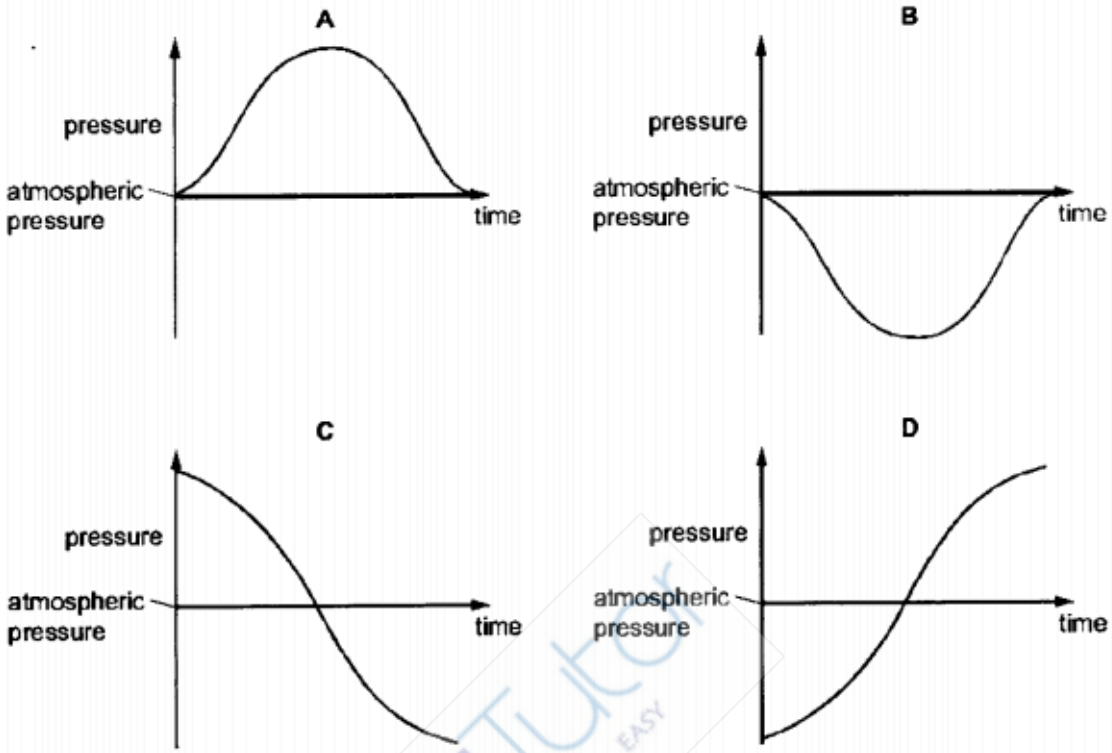
16 The graph shows pressure changes in different parts of the heart during a mammalian cardiac cycle. W, X, Y and Z indicate when a valve opens or closes.



Which row correctly identifies W, X, Y and Z?

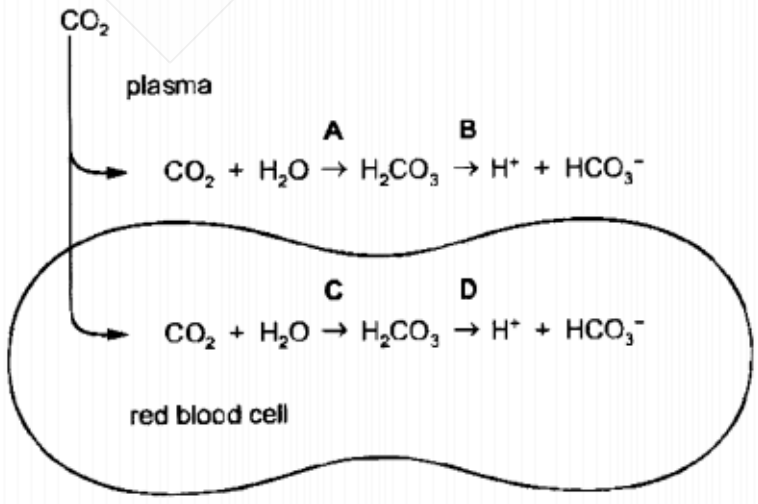
	W	X	Y	Z
A	atrioventricular valve opens	atrioventricular valve closes	semilunar valve opens	semilunar valve closes
B	atrioventricular valve closes	semilunar valve opens	semilunar valve closes	atrioventricular valve opens
C	semilunar valve opens	semilunar valve closes	atrioventricular valve opens	atrioventricular valve closes
D	semilunar valve closes	atrioventricular valve opens	atrioventricular valve closes	semilunar valve opens

17 Which graph shows how the pressure inside the lungs changes when taking one breath in?

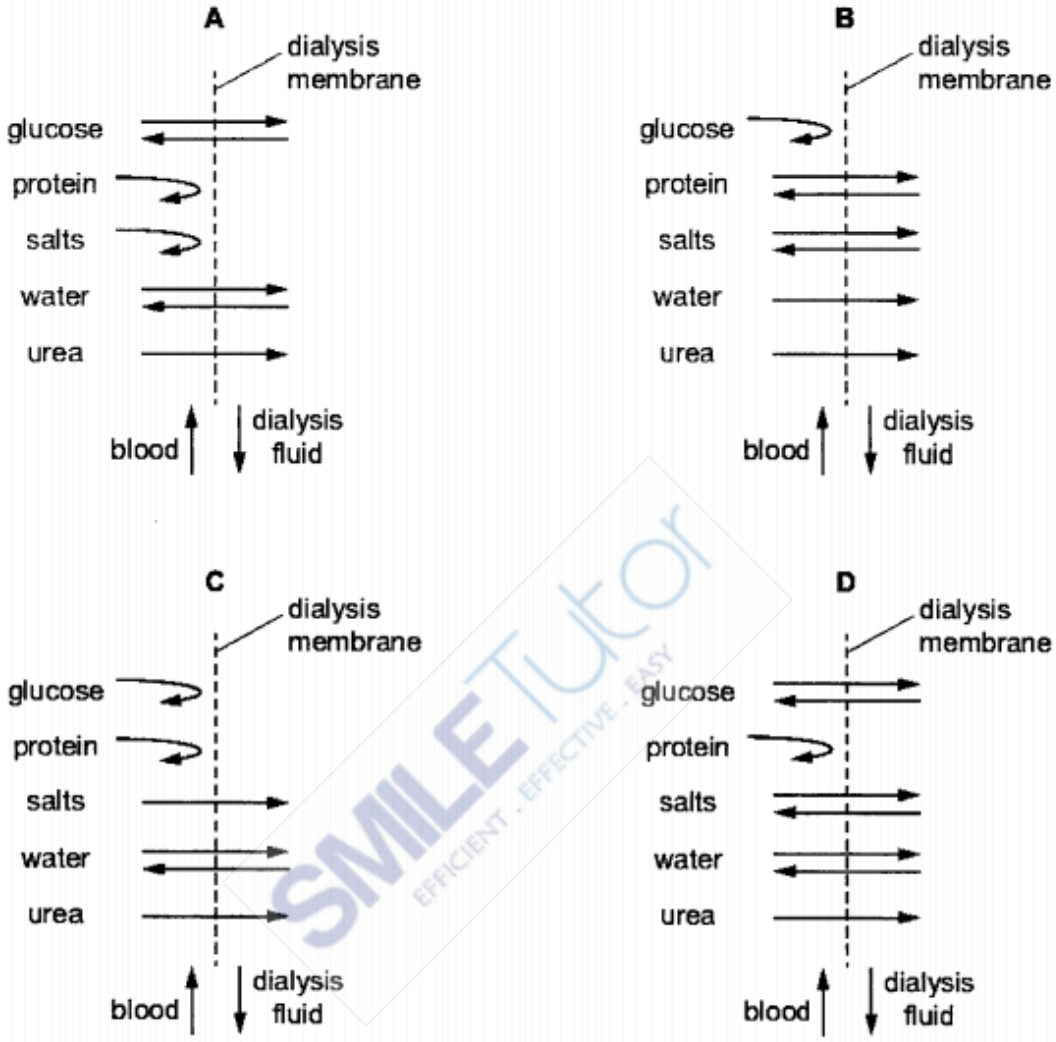


18 The diagram shows some of the reactions of carbon dioxide when it enters the blood from cells in a metabolically active tissue.

Which reaction is catalysed by the enzyme carbonic anhydrase?

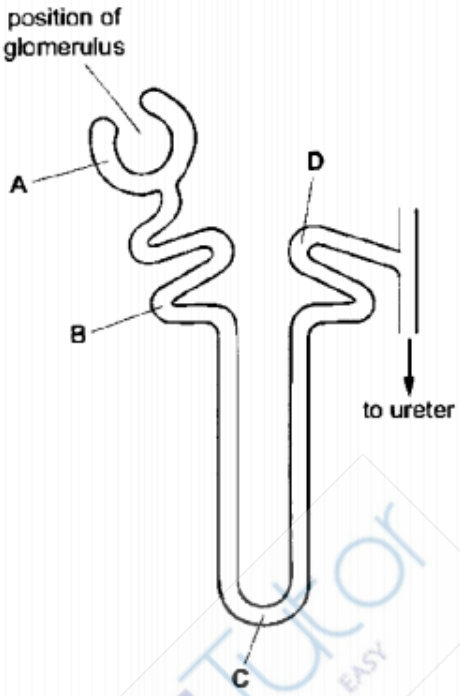


19 Which diagram shows the diffusion of substances between the blood and dialysis fluid during dialysis?



20 The diagram shows a kidney tubule.

In which part of the tubule is the glucose concentration highest?

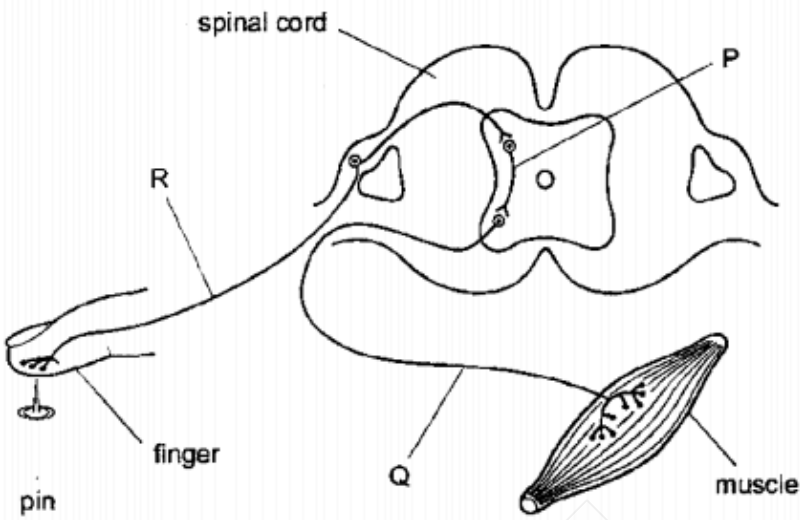


21 A student carried out an experiment to investigate the effect of temperature on the volume of urine produced.

Which row shows the experiment where the environmental temperature was increased from 20 °C to 40 °C but no other changes were made?

	urine produced / cm^3 per hour	
	before	**after**
A	60	60
B	80	40
C	120	145
D	100	130

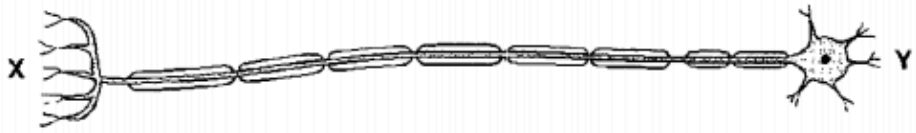
22 The diagram represents a simple reflex arc.



What is the sequence of nerve cells through which an impulse passes during a reflex action?

	first →		last
A	P	Q	R
B	Q	P	R
C	Q	R	P
D	R	P	Q

23 The diagram shows a neurone.



Which structures could be found at X and Y?

	X	Y
A	spinal chord	brain
B	brain	leg
C	hand	eye
D	gland	spinal chord

24 Which process is a response of the body that is part of a negative feedback process?

A release of insulin in response to low blood glucose concentration

B sweating in response to a decrease in blood temperature

C synthesis of glycogen in response to increase in blood glucose concentration

D vasoconstriction of arterioles in response to an increase in blood temperature

25 What are characteristics of hormones?

	affect target organs	carried by the blood	produced by glands
A	✓	✓	✓
B	✓	✓	×
C	✓	×	✓
D	×	✓	✓

key
✓ : yes
× : no

26 What are the symptoms of diabetes?

	concentration of glucose	
	in blood	in urine
A	+	+
B	+	-
C	-	+
D	+	-

key
+ : increased
- : decreased

27 Which row describes accommodation when viewing a near object?

	ciliary muscles	suspensory ligaments	lens shape
A	contracted	slackened	more spherical
B	contracted	tight	more spherical
C	relaxed	slackened	less spherical
D	relaxed	tight	less spherical

28 Pollen grains are transferred from the anthers to the stigma. The pollen grains adhere to the sticky stigma. The statements describe what happens next.

1 The pollen grain grows a pollen tube.

2 The pollen tube enters the ovule.

3 The pollen tube grows down the style.

4 The male nucleus fuses with an egg cell nucleus.

In which order do these stages occur?

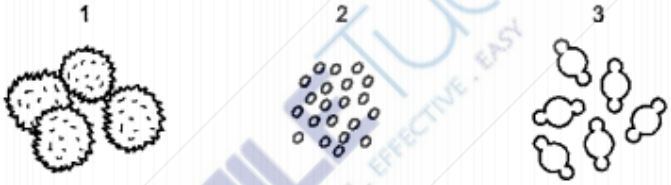
A 1 2 4 3

B 1 3 2 4

C 2 3 1 4

D 3 1 2 4

29 The diagrams show pollen grains from three different species of plant as they appear under the microscope. The diagrams are all to the same scale.



Which pollen grains are involved in insect-pollination?

A 1 only

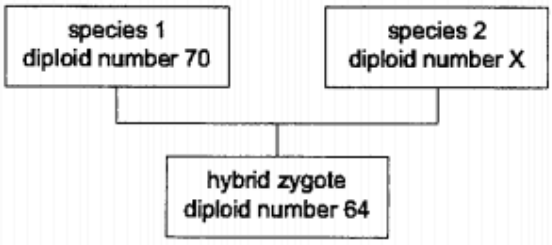
B 1 and 2 only

C 2 and 3 only

D 1, 2 and 3

30 Some plants of different species can be crossed with each other to form hybrids that have a diploid number different from either of the two parent species.

The diagram shows a cross between plants with different diploid numbers.



What is the diploid number of species 2?

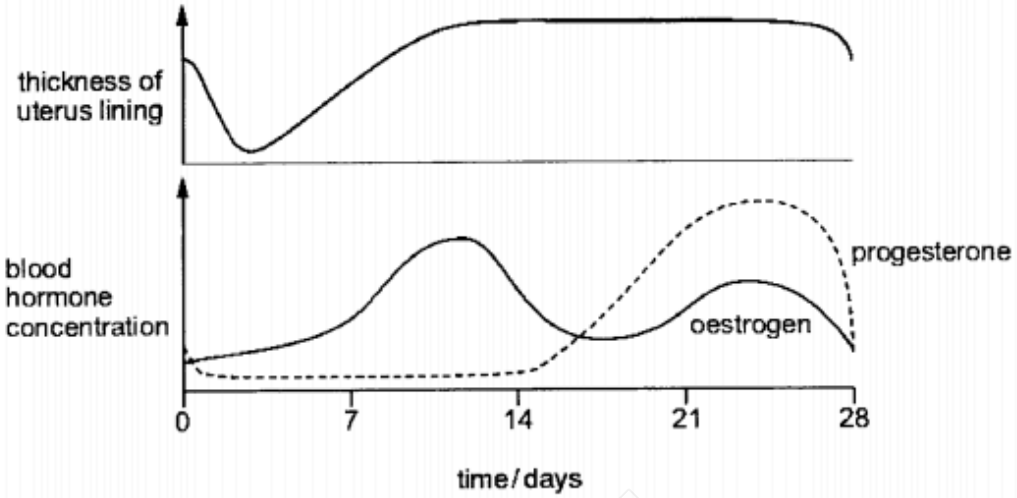
A 29

B 32

C 35

D 58

31 The graphs show changes that occur in a woman during the menstrual cycle.



Which statement is supported by evidence in the graphs?

A A large increase in progesterone concentration always results in thickening of the uterus lining.

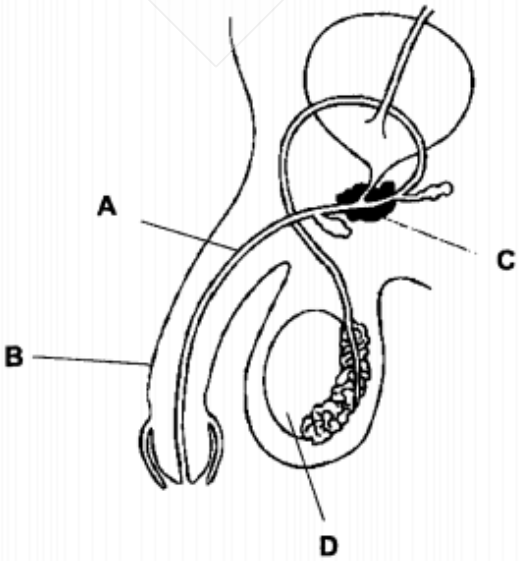
B At ovulation, the uterus lining is at its thickest.

C Each time the oestrogen concentration rises, the uterus lining becomes thicker.

D Within 5 days of ovulation, the uterus lining gets thinner.

32 The diagram shows the human male reproductive system.

Which structure produces male gametes?



33 The photomicrographs show cells in various stages of the cell cycle.

Which stage of mitosis is **not** shown?

A anaphase
B prophase
C metaphase
D telophase

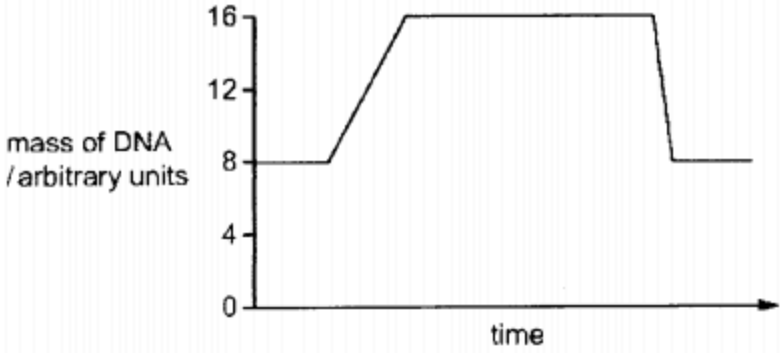
34 A DNA sample was tested to identify its bases.

35% of the bases in the DNA were guanine.

Which row shows the percentages of the other bases?

	adenine	cytosine	thymine
A	15	15	35
B	15	35	15
C	35	15	35
D	35	35	15

35 The diagram shows the mass of DNA in cells which are dividing.



Which row describes this type of cell division?

	type of cell division	type of reproduction using this cell division	this type of cell division gives rise to
A	meiosis	asexual	genetically identical offspring
B	meiosis	sexual	genetically dissimilar offspring
C	mitosis	asexual	genetically identical offspring
D	mitosis	sexual	genetically dissimilar offspring

36 A gene has 900 phosphate groups.

How many amino acids are found in the polypeptide that the gene codes for?

A 100
B 450
C 300
D 900

37 In a species of pea plant, height is controlled by one gene.

The allele for tall is dominant to the allele for short.

A test cross is done to identify the genotype of a tall pea plant.

The table shows the possible phenotypes of the offspring and a description of the genotypes of the tall parent pea plant.

	phenotypes of the offspring	description of the genotype of the tall parent pea plant
1	all tall	heterozygous
2	all tall	homozygous dominant
3	all short	homozygous dominant
4	tall and short	heterozygous

If a large number of offspring are produced, which rows are possible?

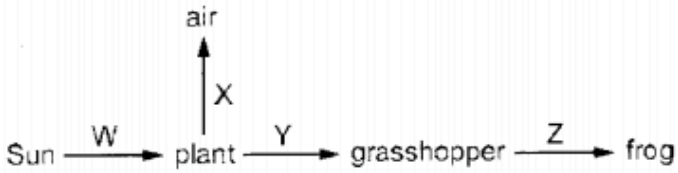
A 1 and 3
B 1 only
C 2 only
D 2 and 4

38 Which row correctly best describes human blood groups?

	affected by environment	has no intermediate phenotypes	shows continuous variation
A	✓	×	✓
B	✓	×	×
C	×	✓	×
D	✓	✓	×

key
✓ : yes
× : no

39 The diagram shows energy transfer through a food chain.
The labelled arrows represent the energy transfers.



Which energy transfers are shown by the labelled arrows?

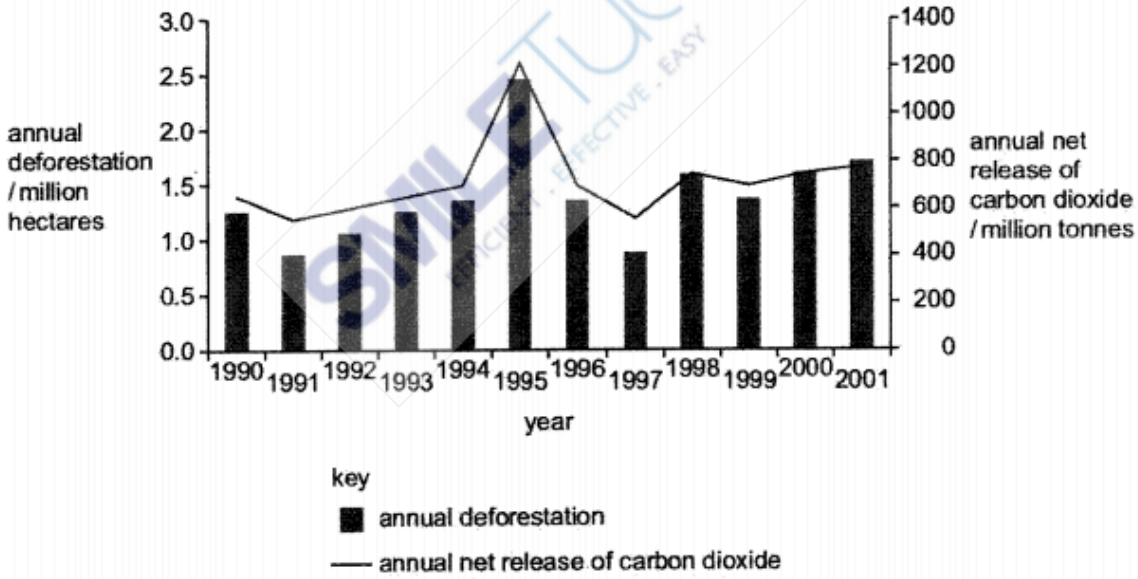
A X is heat energy transfer and Z is chemical energy transfer.

B X is chemical energy transfer and Y is heat energy transfer.

C Y is chemical energy transfer and Z is light energy transfer.

D Z is heat energy transfer and W is light energy transfer.

40 The graph shows the annual deforestation and annual net release of carbon dioxide from an area of tropical forest between 1990 and 2001.



Which statements are correct?

1 The highest rate of deforestation occurred in 1995.

2 There is a close relationship between annual deforestation and carbon dioxide release.

3 The annual net release of carbon dioxide increases every year.

A 1 and 2 only

B 1 and 3 only

C 2 and 3 only

D 1, 2 and 3

Section A

Answer **all** questions in the spaces provided.

1 Fig. 1.1 is a food web for a forested area in Central America.

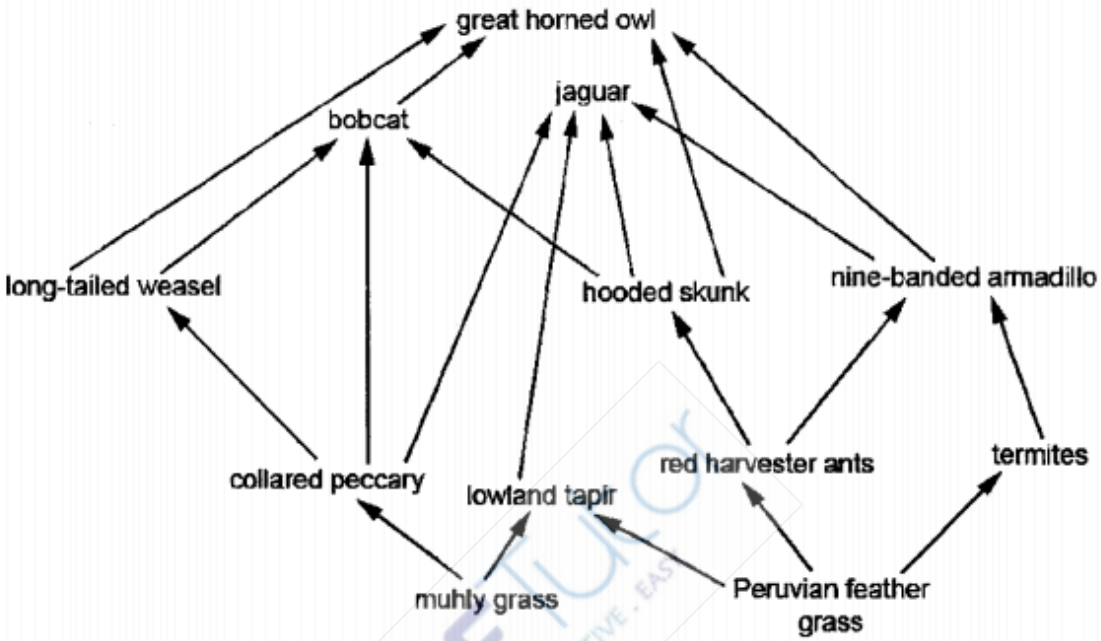


Fig. 1.1

(a) Complete Table 1.1 using information from Fig. 1.1.

Table 1.1

trophic level	description	example from Fig 1.1
producer		
	feeds on tertiary consumers	
secondary consumers		

(b) Fig. 1.2 shows the flow of energy through a food chain. The size of each box represents the energy available in each trophic level, numbered 1, 2, 3 and 4.

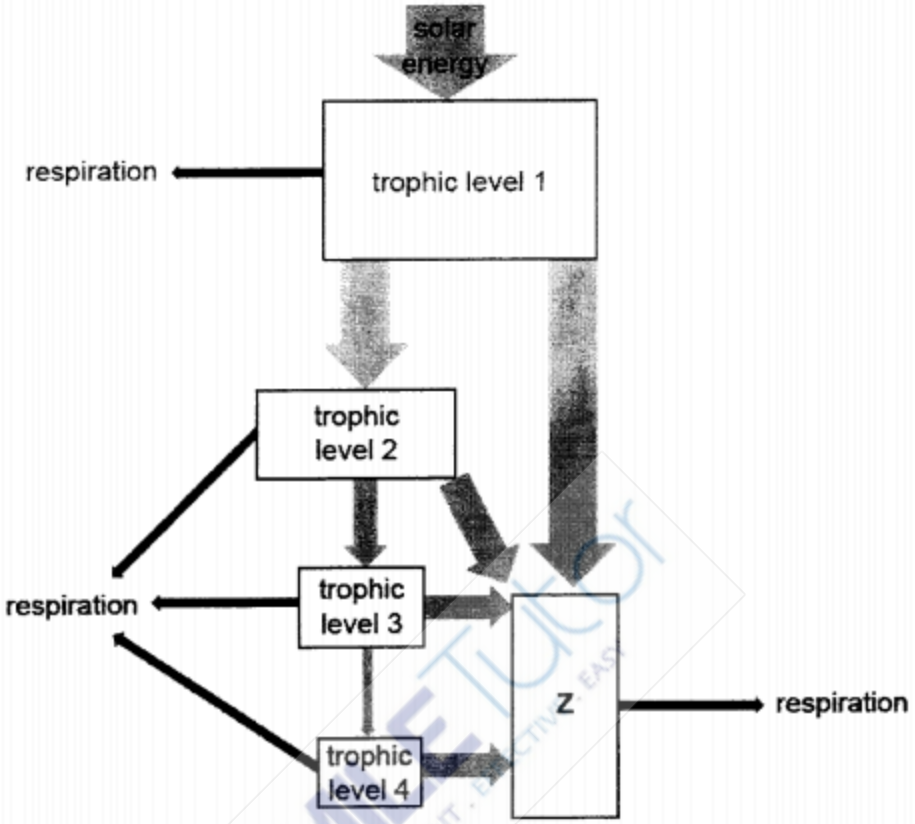


Fig. 1.2

(i) State the term given to the group of organisms represented by **Z** in Fig. 1.2.

..... [1]

(ii) Explain, with reference to Fig. 1.2, why food chains usually have fewer than five trophic levels.

.....

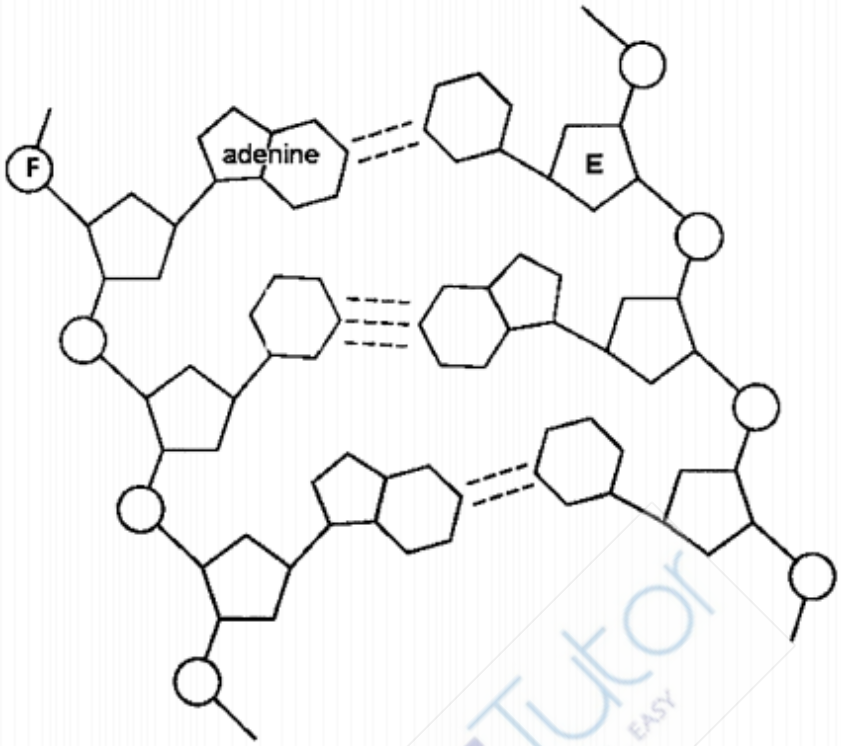
.....

.....

.....

..... [4]

2 Fig. 2.1 is a diagram showing the structure of part of a DNA molecule.



key

----- one hydrogen bond

Fig. 2.1

(a) **(i)** Identify structure **E** and structure **F** in Fig. 2.1.

E .....

F ..... [2]

(ii) On Fig. 2.1 draw a circle around **one** nucleotide. [1]

(b) Fig. 2.2 shows the DNA base sequence of a part of a gene on one strand.

complementary sequence				
DNA base sequence	**GGT**	**GCT**	**AAT**	**CTA**

Fig. 2.2

(i) Complete Fig. 2.2 by writing the DNA base sequence of the complementary strand. [2]

(ii) State the significance of the order of the bases.

.....

..... [2]

[Total: 7]

3 (a) Red blood cells are involved in the transport of oxygen and carbon dioxide in the blood.

Fig. 3.1 is a diagram representing the exchange of oxygen and carbon dioxide between a red blood cell in a capillary and a respiring cell. Some of the reactions that take place in the red blood cell are also shown. The diagram is **not** drawn to scale.

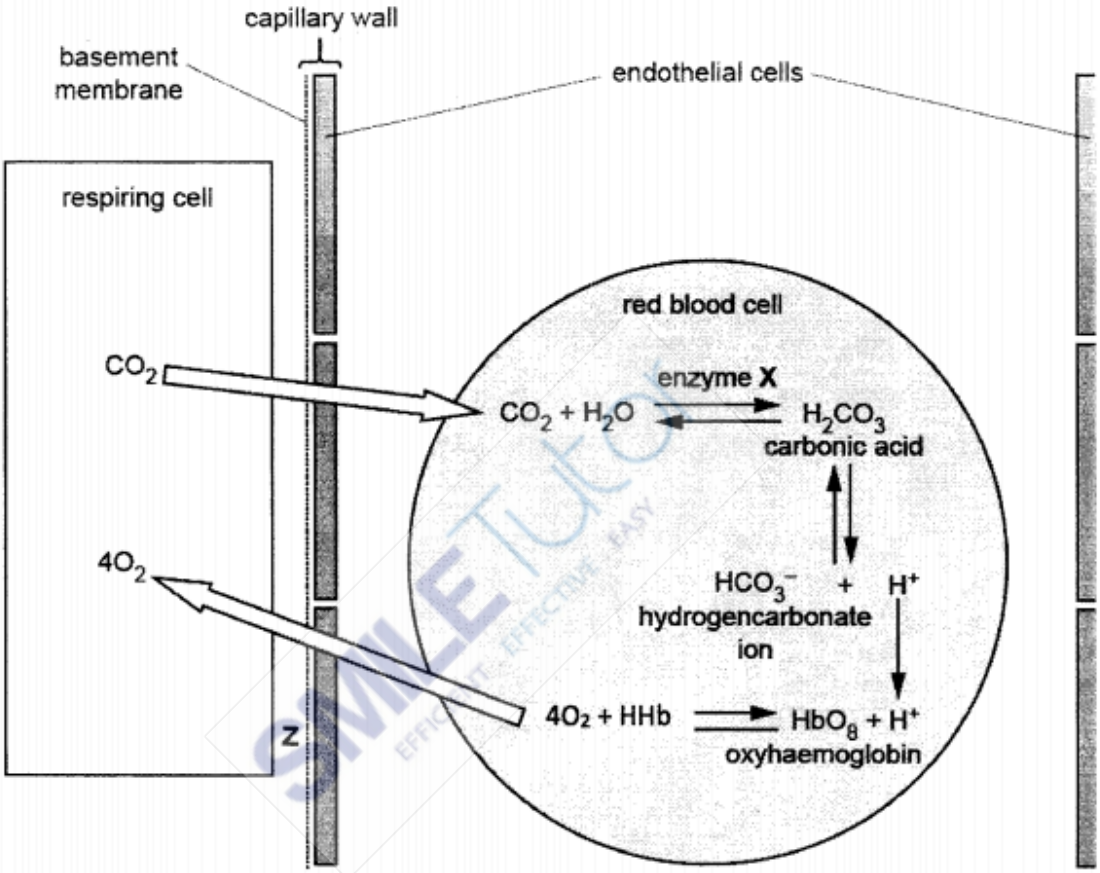


Fig. 3.1

(i) Identify the aqueous environment, labelled **Z** in Fig.3.1, that surrounds the respiring cell.

..... [1]

(ii) Identify enzyme **X**.

..... [1]

(iii) Describe enzyme **X**'s role when the red blood cell reaches the lungs.

.....

.....

..... [2]

(b) The gas exchange system has specialised cells to prevent harmful microscopic particles that are present in inhaled air from reaching the alveoli.

These particles are associated with many respiratory diseases.

Explain how specialised cells in the respiratory tract prevent harmful microscopic particles from reaching the alveoli.

.....

.....

.....

..... [4]

[Total: 8]

4 (a) Fig. 4.1 shows a bee with pollen on its legs.

Fig. 4.1

Bees are insects that pollinate some flowering plants.
They are attracted to the flowers by their colour, scent and nectar.

(i) Describe other ways in which flowers and pollen grains are adapted for insect pollination.

.....

.....

..... [3]

(ii) State where pollen is produced in a flower.

..... [1]

(iii) Explain why it is important that the pollen nuclei are haploid.

.....

..... [1]

(b) Describe the advantages of cross-pollination as compared to self pollination.

.....

.....

..... [2]

(c) Some farmers are concerned that genetically modified plants might cross-pollinate with wild varieties of plants.

Suggest how farmers could prevent cross-pollination between genetically modified plants and wild varieties of plants.

.....

.....

.....

..... [2]

[Total: 9]

5 **(a)** Protein digestion begins in the stomach of the human alimentary canal and is completed in the small intestine.

Describe in detail how the conditions of the alimentary canal allow for protein digestion by the enzymes.

.....

.....

.....

.....

.....

..... [4]

(b) Some people are unable to digest lactose (milk sugar) and have a condition known as lactose intolerance.

Fig. 5.1 shows what happens in the intestine of a person who is lactose intolerant if they eat food containing a lot of lactose.

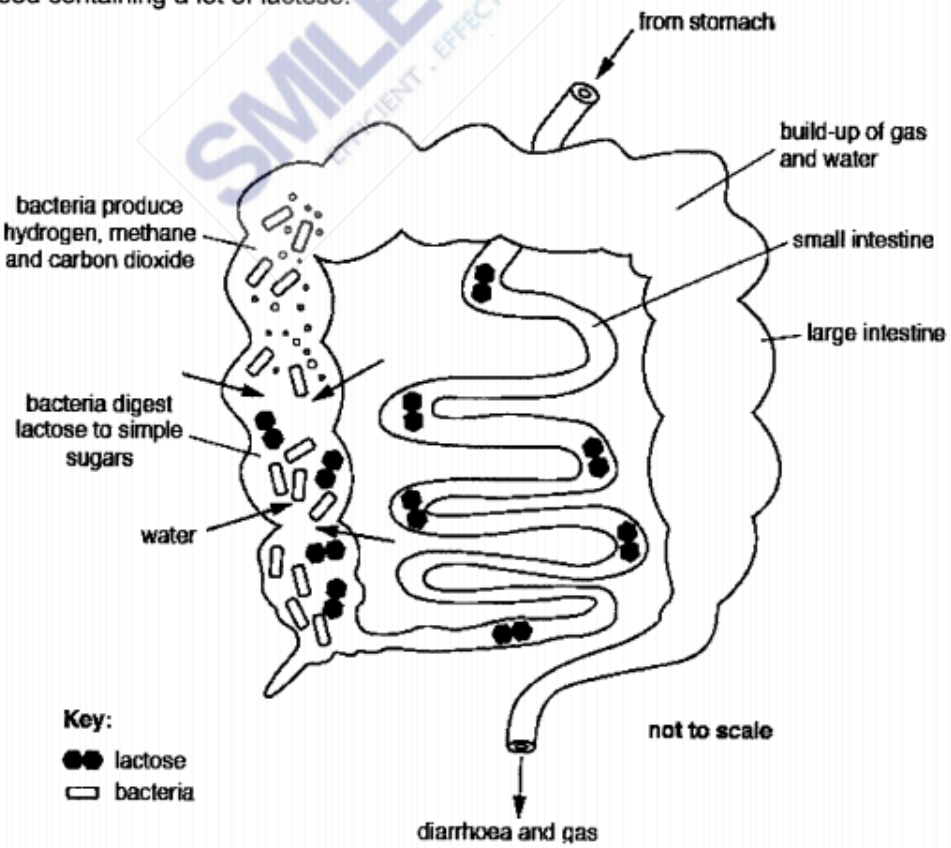


Fig. 5.1

(i) Explain why lactose is not absorbed by the small intestine.

.....

.....

.....

.....

..... [2]

(ii) Severe diarrhoea results in excessive loss of water.

Suggest the dangers to health of severe diarrhoea if it is not treated for a long time.

.....

.....

.....

.....

..... [3]

[Total: 9]

6 **(a)** Define transpiration.

.....

.....

..... [2]

A student investigated the effects of air movement on the rate of transpiration by using a potometer.

The potometer used by the student is shown in Fig. 6.1.

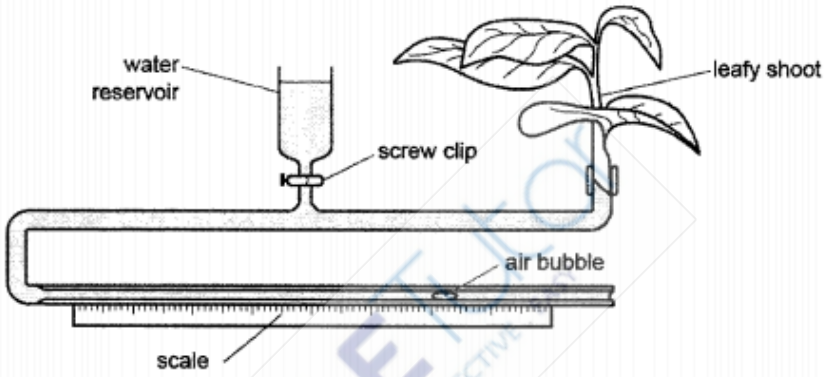


Fig. 6.1

The student recorded the distance the air bubble in the apparatus had moved after ten minutes with no air movement.

The rate of water uptake was used as a measure of the rate of transpiration.

The apparatus was then reset using the reservoir, and the experiment was repeated a further two times. All other variables were standardised during the three experiments.

Table 6.1 shows the results recorded by the student.

Table 6.1

experiment	distance moved by the bubble in 10 minutes / mm
1	12.5
2	12.0
3	11.5

(b) Use Table 6.1 to calculate the mean rate of movement of the bubble.

..... $mm\ min^{-1}$ [1]

(c) The student carried out another experiment using the same plant.

In this experiment a fan was used to blow air across the leaves of the plant.

All other variables were standardised.

The results showed that the bubble moved further in 10 minutes.

The student concluded that air movement increases the rate of transpiration.

Explain why air movement increases the rate of transpiration.

.....

.....

..... [2]

(d) Explain how water moves up through a xylem vessel in the stem of the plant in the potometer, shown in Fig. 6.1.

.....

.....

.....

.....

..... [4]

[Total: 9]

Section B

Answer any **two** questions in this section.

Write your answers in the spaces provided.

7 Hydroponics is a technique used to grow plants without soil.

Fig 7.1 shows plants being grown using hydroponics.

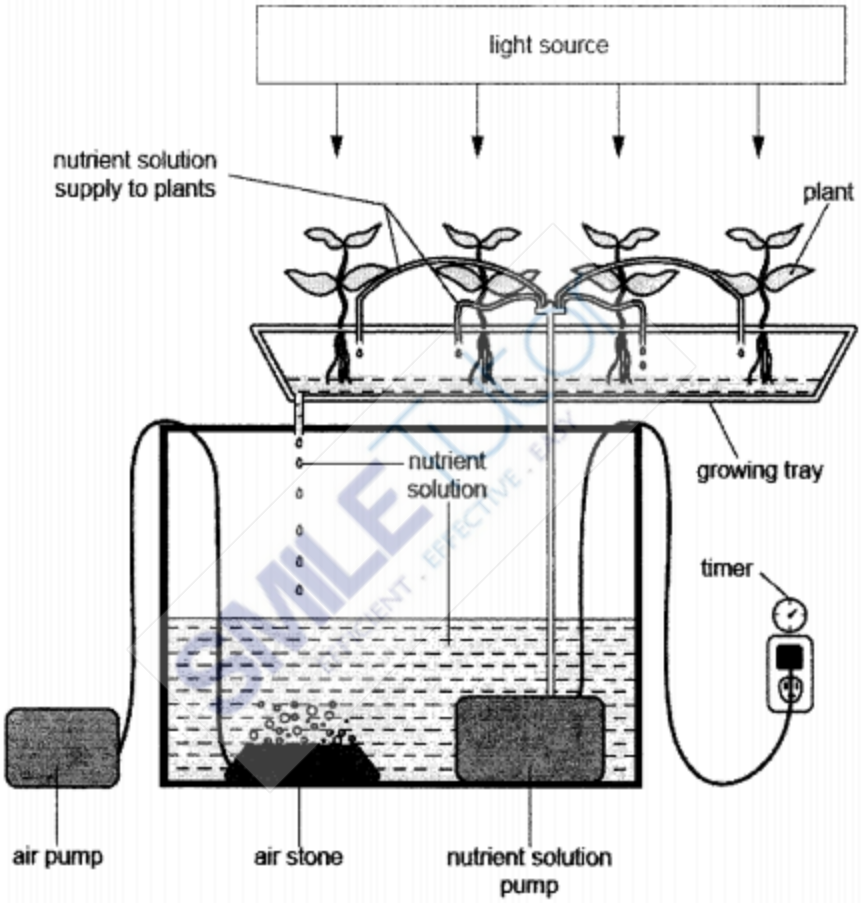


Fig. 7.1

(a) **(i)** The leaves of the plants are provided with a source of light for photosynthesis.

State, in symbols, the equation for photosynthesis.

(ii) Explain the advantage to the cells of the plant roots of pumping air through the nutrient solution using the air stone.

.....

.....

.....

.....

.....

..... [4]

(b) (i) Farmers grew groups of 20 tomato plants for the same length of time in nutrient solutions with a range of different concentrations of magnesium ions.

They determined the best concentration of magnesium ions for growth by measuring the following for each group of 20 tomato plants:

- the mean height of the tomato plant stems (cm)
- the mean mass of the tomato plant stems and leaves (g).

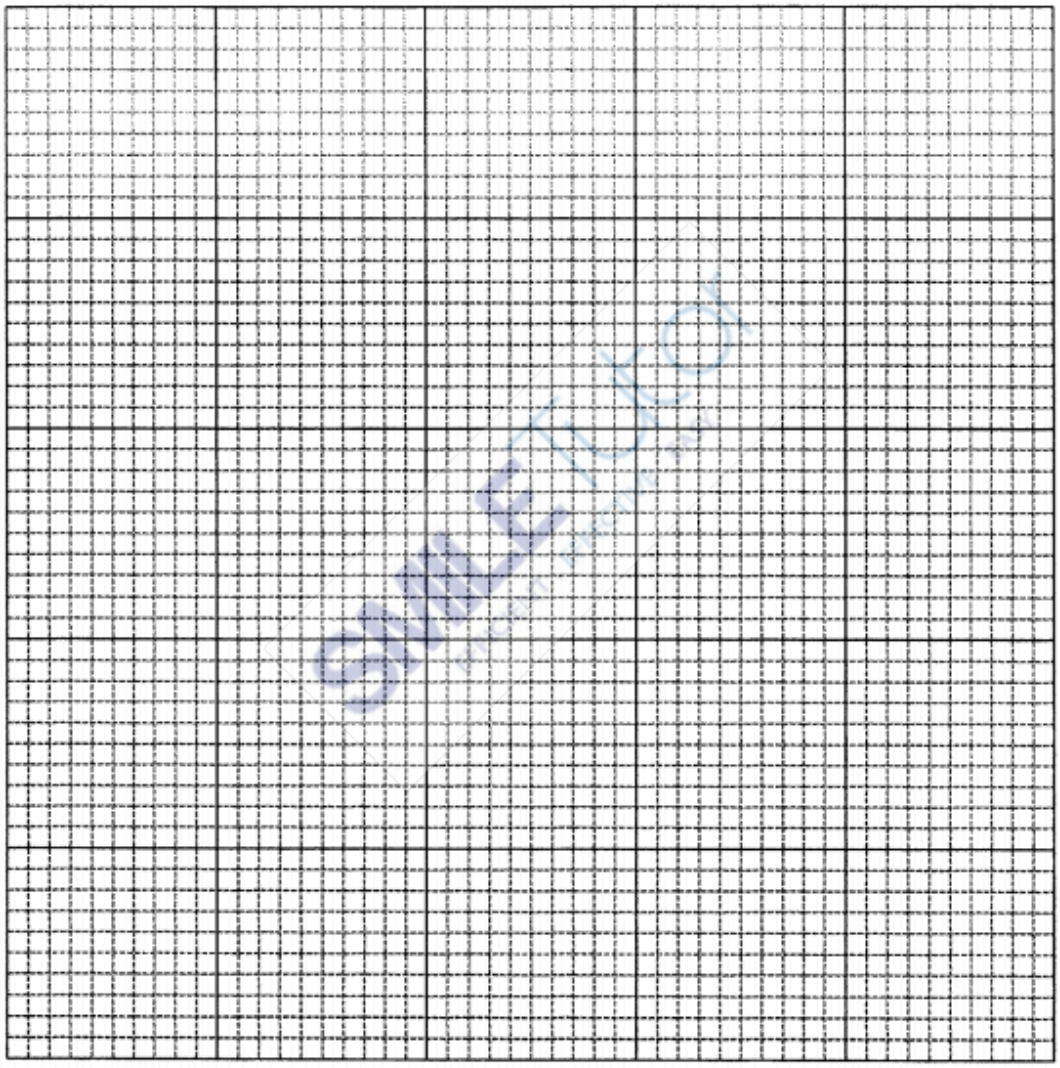
Table 7.1

concentration of magnesium ions /parts per million	mean height of tomato plant stems /cm	mean mass of tomato plant stems and leaves /g
0	20.0	6.3
50	30.3	11.7
125	32.6	12.3
250	23.4	10.4
500	20.4	8.0

Plot a bar chart of the results in Table 7.1 on the grid using both the left and right axes as labelled. Indicate the scale for each axis clearly.

mean height of tomato plant stems / cm

mean mass of tomato stems and leaves / g



[4]

(ii) State the range of magnesium ions that show the concentration of magnesium ions as a limiting factor on the growth of the tomato plants.

..... parts per million [1]

[Total: 10]

8 (a) There are four blood groups in the ABO system in humans: A, B, AB and O.

Parents with the phenotypes **blood group A** and **blood group B** are planning to have more children. They have two children, one with blood group A and one with blood group O.

Assuming both of them to be heterozygous, complete Fig. 8.1 to determine the probability that the next child will have blood group O.

		father's:	mother's:	
genotypes of parents		.....	.....	
gametes	.....	.....	.....	.....
genotype of offspring	.....	.....	.....	.....
phenotypes of offpspring	.....	.....	.....	.....

Fig. 8.1

probability that the next child will have blood group O ..... [5]

(b) Explain why the ABO blood group system is an example of co-dominance.

.....

.....

.....

..... [2]

(c) Fig. 8.2 shows the percentages of the global population with the four different blood groups in the ABO system.

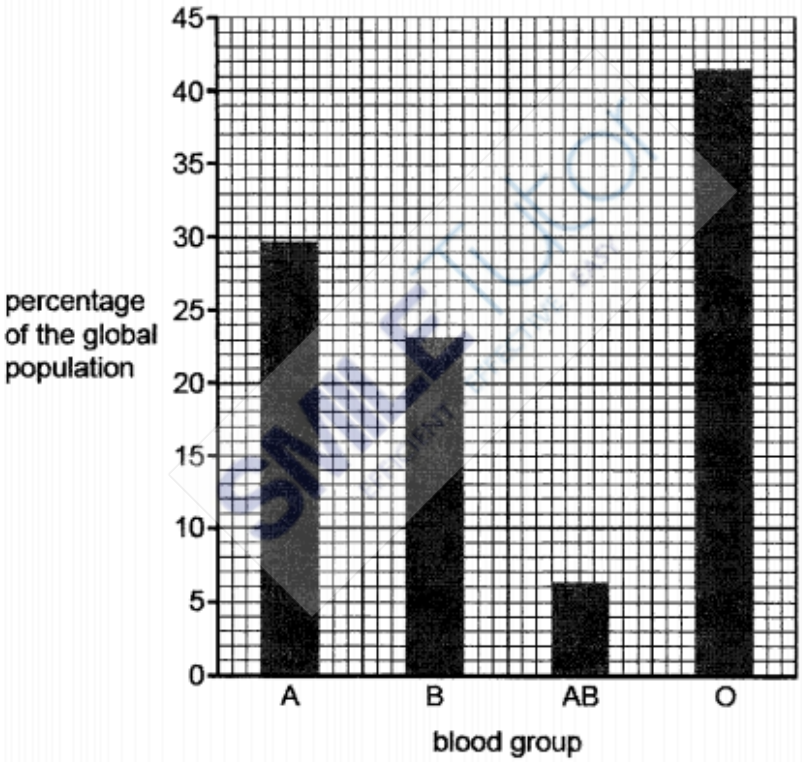


Fig. 8.2

(i) With reference to Fig. 8.2, explain why the ABO blood group system is an example of discontinuous variation.

.....

.....

..... [2]

(ii) Suggest why the high percentage of blood group O in the global population is an advantage for national blood banks.

.....

.....

..... [1]

[Total: 10]

9 Either

Fig. 9.1a shows the right eye of a person **before** moving into an area of bright light.

Fig. 9.1a

Fig. 9.1b

(a) **(i)** Complete Fig. 9.1b to show the appearance of the right eye of the person shortly **after** moving into an area of bright light.

..... [1]

(ii) With reference to **named** structures within the eye, describe the changes that take place when a person moves into an area of bright light.

.....

.....

.....

.....

.....

..... [4]

(b) Describe how the nervous system is involved in the maintenance of a constant body temperature.

.....

.....

.....

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.....

.....

..... [5]

9 Or

(a) State the role of platelets in the blood **and** describe the process they are involved in.

.....

.....

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.....

.....

..... [4]

(b) HIV invades specific lymphocytes that coordinate immune responses.

Fig. 9.2 shows the change in numbers of these lymphocytes following an HIV infection that has not been treated.

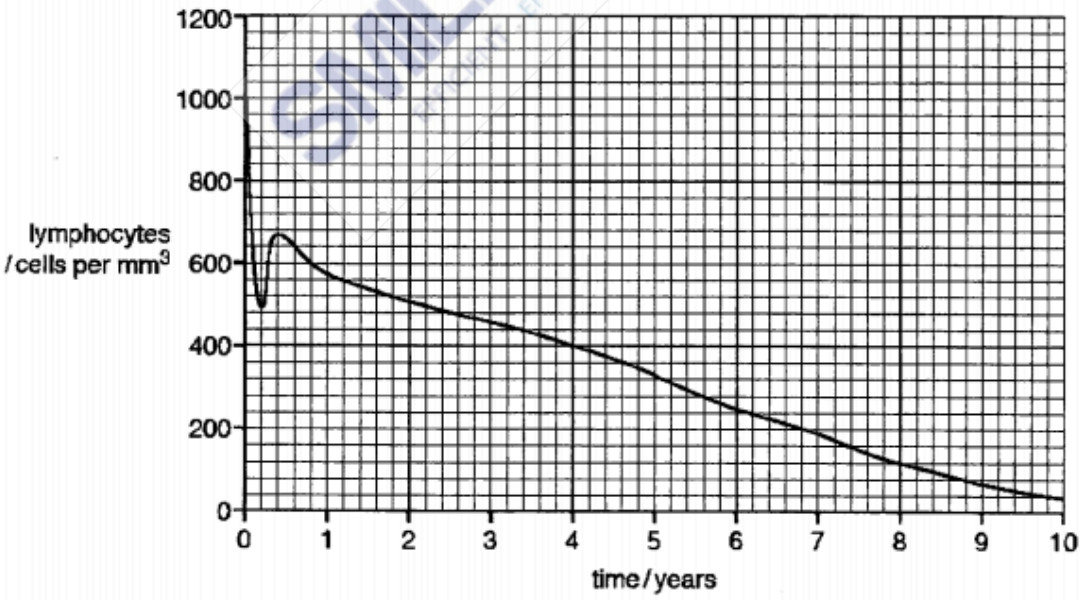


Fig 9.2

(i) Describe the changes in lymphocyte numbers following HIV infection.

.....

.....

.....

.....

.....

..... [3]

(ii) Describe the effects on the body of an untreated HIV infection as shown in Fig. 9.2.

.....

.....

.....

.....

.....

..... [3]

[Total: 10]

ANSWER SHEET

Prelim Answer Key

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

General notes

Symbols used in mark scheme and guidance notes.

/	separates alternatives for a marking point
;	separates points for the award of a mark
MP	mark point – used in guidance notes when referring to numbered marking points
OVP	other valid points
OWTTE	or words to that effect
ORA	or reverse argument / approach
ref./refs.	answer makes appropriate reference to
ecf	error carried forward
AW	alternative words of equivalent meaning
A	accept – as a correct response
R	reject – this is marked with a cross and any following correct statements do not gain any marks
I	ignore / irrelevant / inadequate – this response gains no mark, but any following correct answers can gain marks.
( )	the word / phrase in brackets is not required to gain marks but sets the context of the response for credit e.g. (waxy) cuticle. Waxy not needed but if it was described as a cellulose cuticle then no mark is awarded.
mitosis	underlined words – this word only

Section B

Qn no	part	Answer	Marks	guidance
1	(a)	trophic level | description | example from Fig. 3.1 producer | makes own food / photosynthesis / autotrophic | muhly grass / Peruvian feather grass ; quaternary / 4° / fourth / 4th, consumer | feeds on tertiary consumers | great horned owl ; secondary consumer | gets energy from / feeds on, primary consumers / herbivores | long-tailed weasel / bobcat / jaguar / nine-banded armadillo / hooded skunk ;	[3]	
	(b)(i)	(named) decomposers ;	[1]	
	(ii)	**1** *idea that* small percentage of energy from sun is 'fixed' by photosynthesis ; **2** most energy from sun not available / reference to wrong wavelength / AW ; **3** energy is lost, between / within, trophic levels / along food chain ; **4** ref. to 10% energy transfer / ORA ; **5** ref. to material that is, inedible / not digestible / egested / not absorbed / not consumed ; **6** energy lost, in respiration / heat / movement / (named) metabolic process ; **7** ref. to energy loss to (named) decomposers ; **8** ref. to (small) total percentage reaching fourth trophic level ; ***or*** not enough energy (in fourth trophic level) to support, 5th / another, level ; **9** would be very small population of predators in fifth trophic level / (population of) predators in fifth trophic level unlikely to survive ; **10** fifth trophic level may be parasites which are very small ;	[4]	
			Total: 8	

2	(a)	E - deoxyribose sugar, F – phosphate (group);	[2]	
	(b)	a ring drawn around 1 base, 1 deoxyribose and 1 phosphate on the same strand and passing through the H bonds ;	[1]	
	(c) (i)		[2]	2 triplets – 1m
	(ii)	amino acid sequence; ref to codon / coding; structure of protein affected;	[2]	
			[Total: 7]	

3	(a) (i)	tissue fluid;	[1]	
	(ii)	carbonic anhydrase;	[1]	
	(iii)	converts carbonic acid back into carbon dioxide and water; so (CO_2) can be, excreted / removed / exhaled ;	[3]	**A** catalyses reverse reaction so carbon dioxide can be, excreted / AW
	(b)	*any* ***four*** *from:* 1 ref to mucus, 2 mucus (is sticky and) traps particles of dust ; 3 cilia 4 cilia, waft / move, mucus / AW ; 5 *idea of* mucus with, particles / dust, is moved away from lung tissue ;	[4]	**A** mucous glands / goblet cells ; **A** on ciliated epithelial cells ; **A** ciliated epithelium **I** pathogens, microbes, bacteria, etc
			[Total: 8]	

4	(a) (i)	*any three from:* large / obvious / AW, petals / sepals ; anthers / stigmas, inside flower ; filaments are stronger / thicker / AW ; pollinators must touch anthers, to reach nectar / AW ; sticky stigma ; pollen, large ; pollen, sticky / spiky ; AVP ; honey guides / landing platforms / mimic insects	[3]	
	(ii)	anther ;	[1]	**A** stamen

	(iii)	*any one from:* so that diploid number restored (after fertilisation) / AW ; to enable sexual reproduction ; (so that the offspring) are genetically different / to allow variation ;	[1]	
	(b)	*any two from:* allows, more variation / genetic diversity ; plant more likely to survive (named) environmental change ; resistance to disease ; (ability to) evolve ; ref. to fitness	[2]	
	(c)	*any two from:* grow, GM / wild varieties, in glasshouses ; cover flowers ; remove stamens ; plant another species around the crop ; make a large, gap / wall, around the field ; use sterile GM plants ; grow female plants (only) ; AVP ;	[2]	MP1 **A** isolate plants
			Total: 7	

5	**(a)**	*ref. to conditions in alimentary canal:* low pH / pH 1–3 / (hydrochloric) acid, in stomach; high pH / alkaline / neutral / non-acidic / pH 7–9, in, small intestine / duodenum / ileum; ref. to denaturation; temperature is 37 °C; ref. to successful collisions;	[4]	**A** gastric juice **I** rennin **A** ± 1 °C
	(b)(i)	no enzyme to, digest / break down, lactose; lactose (molecule) is (too) large / complex; cannot pass through, (cell) membrane(s); no carrier protein for it ;	[2]	**A** no lactase / not enough enzyme **A** not broken down to small(er) molecules
	(ii)	1 dehydration / loss of water; 2 loss of, (named) salt(s) / ions / minerals / vitamins; 3 decrease in, volume of blood / blood pressure; 4 increase in blood concentration / decrease in water potential; 5 any effect on cells ; 6 AVP; e.g. less efficient reactions / slower metabolism / kidney failure / ref to effect on brain cells / coma / death	[3]	**I** fatigue / weakness / weight loss / headache / deficiency disease / dizziness / AW **A** loss / poor absorption, of nutrients / malnutrition **I** 'food' **A** volume of plasma e.g. cell shrinkage / loss of water from cells by osmosis mp6 **A** *idea that* less water as a solvent **R** no solvent
			Total: 9	

6	(a)	*in context of from a plant* loss of water vapour ; **I** evaporation unqualified from, the aerial parts / leaves ;	[2]	**A** stomata
	(b)	1.2 (mm min^{-1}) ;	[1]	
	(c)	*any **two** from:* humid air / water vapour, moves away from the leaves ; water vapour concentration gradient is steeper ; higher rate of evaporation into the air spaces in the leaf ;	[2]	
	(d)	Any four of : (water moves as an) unbroken column / AW ; transpiration pull / column of water, under tension / pulled up ; *ref. to* water potential ; - e.g. (evaporation results in) lower water potential at the top of the xylem vessel xylem vessel in vascular bundle of leaves; (water moves) down a water potential gradient / from a region of high water potential to a region of lower water potential, from xylem vessel in stem to xylem vessel in leaves;	[4]	**A** movement by, cohesion-tension ; cohesion / hydrogen bonds, between water molecules ; cohesive force *ref. to* adhesion of water molecules to, cellulose / lining / walls (of xylem vessels) ; **A** adhesive force *ref. to* hydrophilic / polar, property of cellulose (fibres) ; **A** hydrophilic / polar, parts of lignin
		Total: 10		

7	(a) (i)	**1** $6CO_2 + 6H_2O = C_6H_{12}O_6 + 6O_2$;	[1]	
	(ii)	**1** increased / more / greater / higher / high ; **any three from ...** **2** bubbles / surface area of air ; **3** oxygen ; **4** aerobic **+** respiration ; **5** energy ; **6** growth ; **7** absorption **AW** / active transport **+** ions / salts / minerals / magnesium ;	[4]	**1 Allow** only if linked to any of points **2** to **7** **5 Reject** energy produced
	(b)(i)	scale for both left and right Y axes appropriate; all bar charts of same width; accurate plot; X axes label with unit;	[4]	
	(ii)	0 to 125 (ppm);	[1]	
		Total: 10		

8	(a)	genotypes of parents I^AI^O + I^BI^O; gametes indication accordingly; genotype offpspring: I^AI^B, I^BI^O,,I^AI^O, I^OI^O; *phenotypes of the children:* **AB**, **B**, **A**, **O** ; *probability of next child with blood group O:* 0.25 / 25% / 1 in 4 ;	[5]	Penalise once for incorrect use of I^A symbol for blood group genotype
	(b)	both / two, alleles are expressed in, heterozygote / phenotype / AW ; ref. to, blood group **AB** / I^AI^B ;	[max: 2]	
	(c) (i)	*any two from:* phenotype is determined only by a gene ; no effect of environment on phenotype ; only, four / limited number of, phenotypes / (blood) groups / categories ; no intermediates between categories ;	[max :2]	**A** discrete groups
	(ii)	ref to O blood group as universal donor;	[1]	
			Total: 9	

9	E (a)(i)	shaded circle drawn in iris + smaller than in 9.1(a) ;	[1]	
	(ii)	iris + muscle ; circular + contract ; radial + relax ; pupil + constricts **AW** ;	[4]	
	(b)	Any five of hypothalamus ; reference to detecting blood temperature ; thermoreceptors + in skin ; detect temperature + of surroundings **AW** ; inerve mpulse + sensory neurone ; towards central nervous system / brain / spinal cord ; motor neurone + named effector ; shiver / vasoconstriction or vasodilation / sweat increase or decrease ; reference to negative feedback / **AW**;	[5]	**A** muscle or named effector / sweat gland
			Total: 10	

9	Or			
	(a)	(platelets) promote / involved in, clotting; fibrinogen changes to fibrin; soluble to insoluble; fibrin forms a mesh; traps blood cells; prevents loss of blood / stops bleeding; prevents entry of pathogens; AVP;	[4]	
	(b)(i)	decrease, steep / in short period of time / in two months / AW, to 500 cells per mm_3; increase to 650 – 670 cells per mm_3; gradual / AW, decrease until 10 years; to 40 cells per mm_3 at 10 years;	[3]	
	(ii)	no / reduced, (active) immune response; reduced production of antibodies; vulnerable to, infections / (opportunistic) disease / TB / cancers / pneumonia / AW; AIDS; weight loss / death / reduce life span;	[3]	
			Total: 10	

Sec 4E Biology Paper 3 - Section A

Qn	part	Answer	Marks	Guidance
1	(a) (i)	**MMO** 3 end times recorded ;	[1]	
	(ii)	**MMO** values entered for 9 discs + units not indicated next to them; data only entered as seconds (not minutes) ; correctly calculated means ; mean time for 3% < mean time for 1% ; readings for timing recorded to 2 dp;	[5]	
	(iii)	**ACE** time decreases / takes less time / speeds up the process **AW** ;	[1]	
	(iv)	**ACE** use more discs / repeat + mean / average ;	[1]	

<table>
<tr>
<td></td>
<td>(iv)</td>
<td>
ACE
<table>
<tr><th>source of error</th><th>explanation</th></tr>
<tr><td>difficult to cut discs;</td><td>poor cutting instrument AW;</td></tr>
<tr><td>discs not all same size / thickness / surface area;</td><td>different amount of enzyme in discs;</td></tr>
<tr><td>discs not all same mass;</td><td>different mass requires different amount of gas to float;</td></tr>
<tr><td>H_20_2 used by discs AW;</td><td>concentration of H_20_2 not the same for replicate discs;</td></tr>
<tr><td>temperature not controlled;</td><td>variation will affect rate of enzyme reaction;</td></tr>
<tr><td>discs taken from different parts of tuber / different tubers AW;</td><td>amount of enzyme in discs may vary;</td></tr>
</table>
</td>
<td>[4]</td>
<td>1 mark for suggestion and 1 mark for relevant explanation. source of error and explanation must be related</td>
</tr>
<tr>
<td></td>
<td>(e)</td>
<td>ACE

bottom of tube / stays the same / doesn't move / where it started AW ;
no H_2O_2 present or substrate present / catalase or enzyme doesn't react
with water + no bubbles / O_2 / gas produced ;

purpose : control;</td>
<td>[3]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(f)</td>
<td>1. independent variable - temperature + at least five temperatures uniformly spaced out;

2. dependent variable / measured variable – time taken for discs to reach surface ;

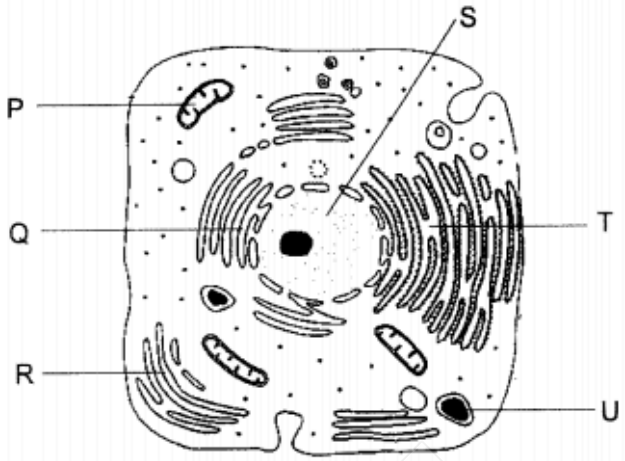
3. controlled variable / same -

same or specified volume / concentration of catalase or amount of discs used /
same or specified volume / concentration of hydrogen peroxide used ;</td>
<td>[max: 6]</td>
<td></td>
</tr>
</table>

		4. means of controlling temperature - water bath / thermostat / thermometer to monitor; **any two of the following:** determining the mean + amount of time for inferring on rate of catalase / lowest time corresponding to optimum temperature; plotting time vs temperature to obtain a trend curve; reliability: repeating the experiment at least three times		
			Total: 21	
2	(a)(i)	**MMO** 5 marks added to tally count ; tally count correctly completed (1 · 7 spines, 1 · 6 spines, 2 · 4 spines, 1 · 1 spine) ;	[2]	
	(ii)	**MMO** number of leaves 15 ; total number of spines 81 ; average number of spines per leaf 5.4 ;	[3]	
	(iii)	**PDO** both axes fully labelled with units ; linear scale with value at origin of mean number of spines axis + occupying more than half of grid ; three plots correct ± 1 mm ; three bars of equal width with ruled sides ;	[4]	
	(v)	continuous (variation); range of data / no intermediate **AW**;	[2]	
	(b)(i)	**MMO** guard cells at least 30 mm long + delimited ; sharp pencil + continuous lines drawn for guard cells and stoma + no shading anywhere ; stoma + 6 cells drawn + cell wall shown; nuclei shown in all cells drawn + correct position ;	[4]	
	(ii)	**PDO** 12 –15 ; measurement / 0.07 ; correct answer ;	[3]	**A** ecf
			Total: 19	

JURONGVILLE SECONDARY SCHOOL SA2 PAPER

Refer to the diagram of a typical animal cell to answer questions **1** and **2**.



1 Which of the following correctly matches the organelles where the molecules are formed?

	fats	mRNA	polypeptide	carbon dioxide
A	P	Q	U	R
B	Q	S	T	P
C	Q	T	R	P
D	T	S	Q	R

2 Which of the following correctly states the processes occurring in the organelles?

	Q	S	T
A	detoxification	translation	transcription
B	translation	replication	transcription
C	detoxification	transcription	translation
D	replication	transcription	translation

3 The diameters of three onion rings were measured before and after they were immersed in 50 cm^3 of sucrose solutions at different concentrations for 20 minutes. The results were recorded in the following table.

onion ring	initial diameter / cm	final diameter / cm
1	5.5	4.2
2	5.8	6.2
3	6.6	5.9
4	7.1	6.3

Which of the following correctly arranges the solutions that the onion rings were immersed in from the highest to the lowest water potential?

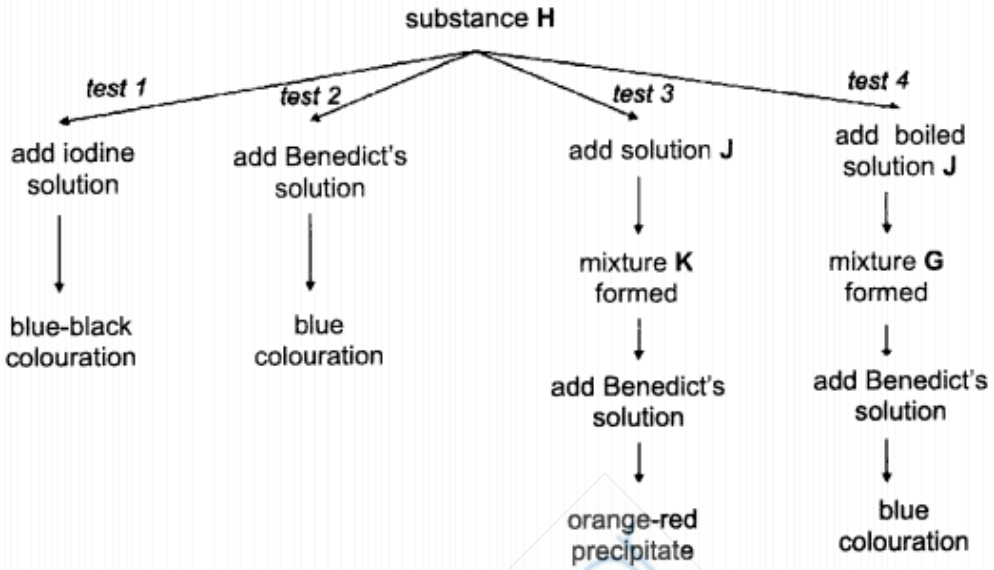
	highest →			lowest
A	1	3	4	2
B	1	4	3	2
C	2	3	4	1
D	2	1	4	3

4 Influenza virus has an enzyme called neuraminidase which breaks down glycoproteins in the membrane of the cell that the virus infects.

According to the lock and key model of enzyme action, which is the lock and which is the key?

	lock	key
A	cell membrane	virus
B	glycoproteins	neuraminidase
C	neuraminidase	glycoproteins
D	virus	cell membrane

5 The diagram shows a series of experiments carried out by a student on unknown food substance **H**.



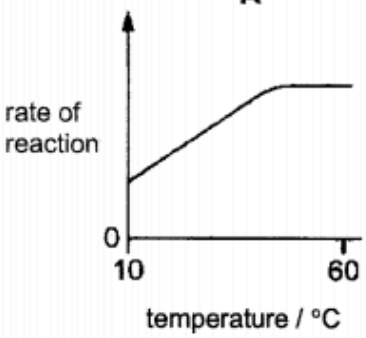
Which row correctly identifies substances **G**, **H**, **J** and **K**?

	G	H	J	K
A	reducing sugar	starch	saliva	starch
B	reducing sugar	reducing sugar	saliva	starch
C	starch	saliva	reducing sugar	reducing sugar
D	starch	starch	saliva	reducing sugar

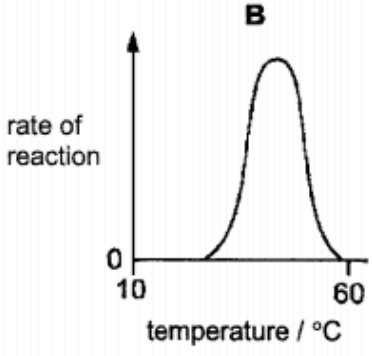
6 An enzyme needed for respiration was extracted from bacteria living in natural hot water springs where the water temperature is between 85 °C and 95 °C.

Which graph would represent the relationship between temperature and the rate of bacterial respiration?

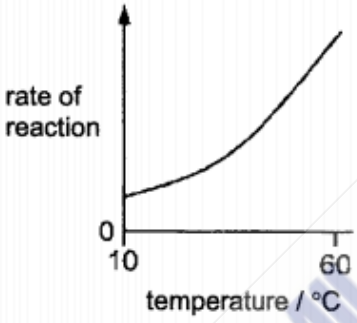
A



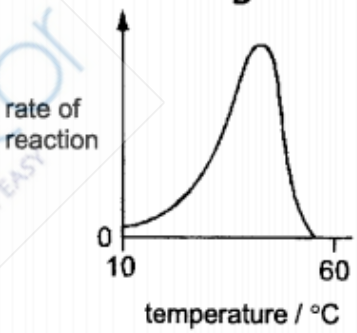
B



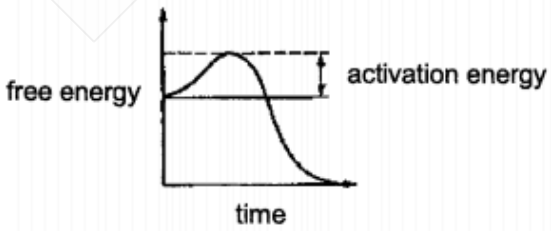
C



D

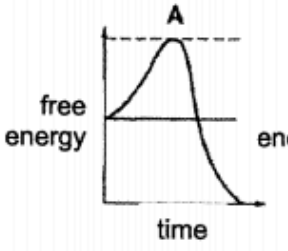


7 The graph shows energy changes during an enzyme-catalysed chemical reaction.

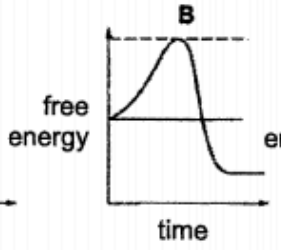


Which graph shows the energy changes for the same reaction when the enzyme is absent?

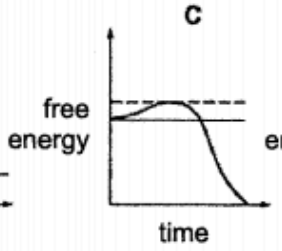
A



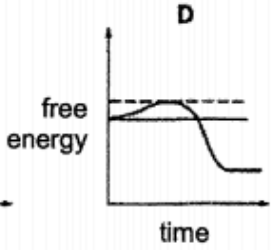
B



C



D



8 Cystic fibrosis affects the cells that produce mucus, sweat and digestive juices. In patients with cystic fibrosis, thick mucus blocks the pancreatic duct.

Which are the possible effects of this blockage?

I. egestion of oily stools
II. high blood pressure
III. malnourishment
IV. weight loss

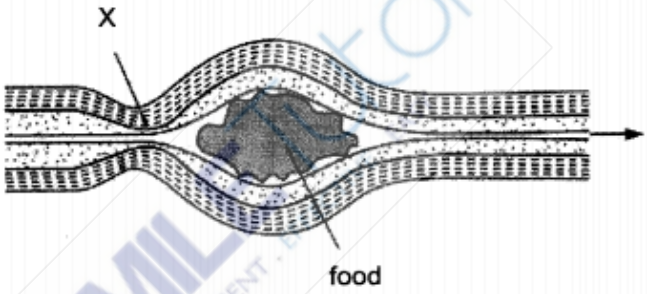
A I and III

B I, II and III

C I, III and IV

D II, III and IV

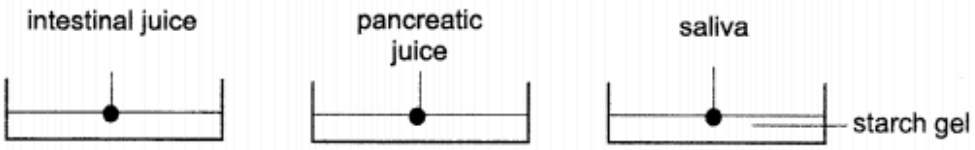
9 The diagram below shows a bolus of food moving along the alimentary canal.



Which of the following options best describes the action of the two sets of muscles at point X?

	circular muscles	longitudinal muscles
A	contract	contract
B	contract	relax
C	relax	contract
D	relax	relax

10 Drops of digestive juices from different regions of the alimentary canal were added to petri dishes coated with starch gel as shown below. After 1 hour, the starch gel was rinsed with distilled water and iodine solution was added to each spot.

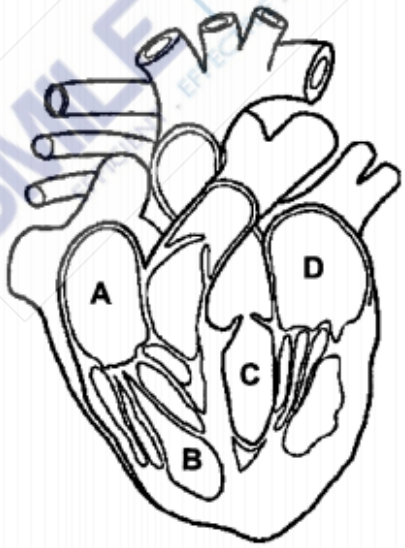


Which of the following would show the colour of the iodine solution at the spot?

	intestinal juice	pancreatic juice	saliva
A	blue-black	blue-black	brown
B	blue-black	brown	brown
C	brown	blue-black	blue-black
D	brown	brown	blue-black

11 The diagram shows the chambers of a human heart.

Which chamber will exert the highest pressure during contraction?



12 The table below shows the blood groups of four people and the type of blood they received in a transfusion.

person	recipient's blood group	donor's blood group
1	O	A
2	A	AB
3	B	O
4	AB	B

Which two people are at risk of agglutination?

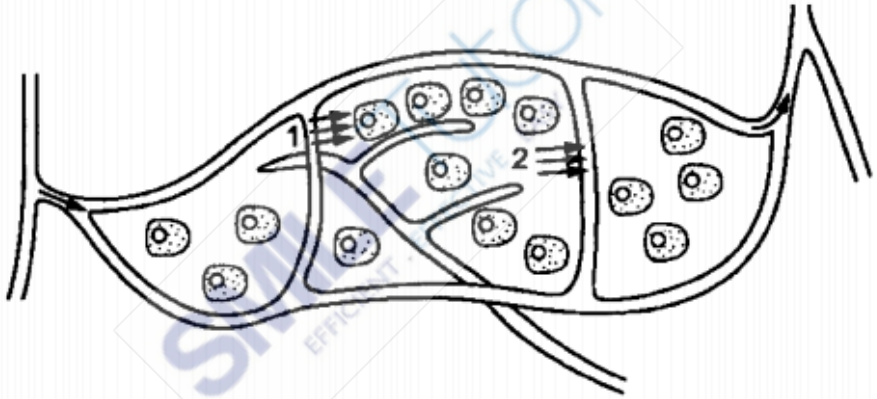
A 1 and 2

B 1 and 3

C 2 and 3

D 2 and 4

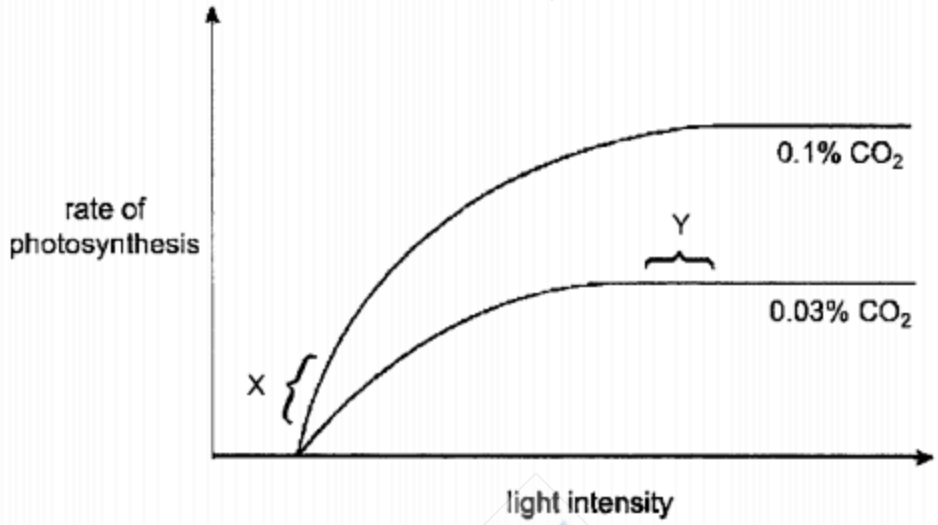
13 The diagram shows capillaries with the direction of movement of materials.



What is happening at position 1 and 2?

	1	2
A	carbon dioxide leaves the blood	urea enters the blood
B	oxygen diffuses	red blood cells return to the blood
C	red blood cells move out of the capillary	carbon dioxide diffuses
D	white blood cells enters the tissue fluid	waste products enter the capillary

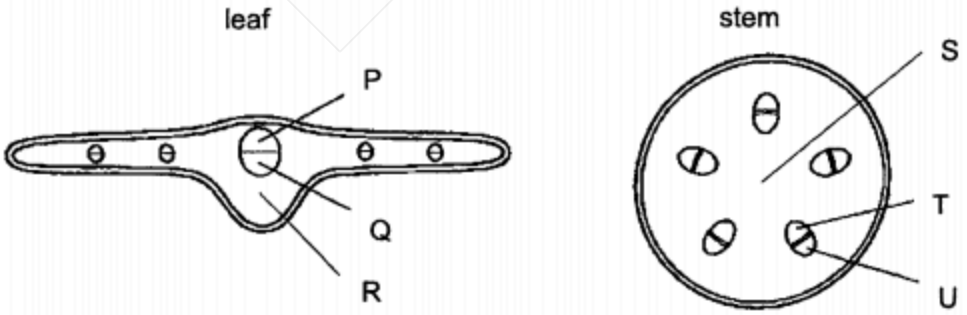
14 The diagram shows the graph of the rate of photosynthesis against light intensity.



What are the limiting factors of photosynthesis at regions X and Y?

	region X	region Y
A	CO_2 concentration	light intensity
B	CO_2 concentration	temperature
C	light intensity	CO_2 concentration
D	light intensity	temperature

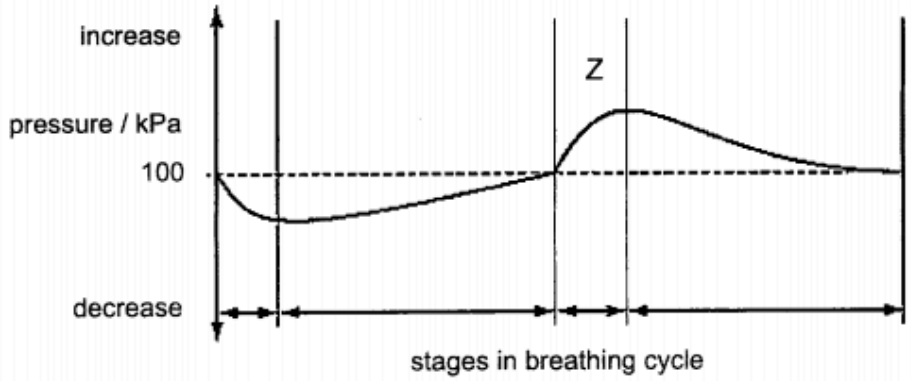
15 The diagrams show the sections through a leaf and a stem.



Where can amino acids be found?

	leaf	stem
A	P	U
B	Q	T
C	Q	U
D	R	S

16 The graph shows changes in the air pressure within the lungs during a breathing cycle.



What happens to the diaphragm and internal intercostal muscles at stage Z?

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

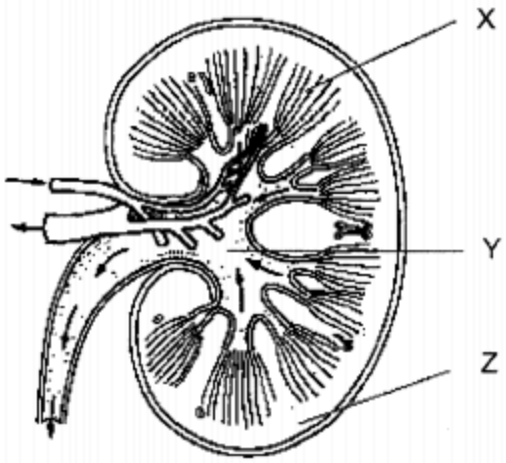
17 Which of the following states the correct end products of anaerobic respiration?

A lactic acid
B lactic acid + carbon dioxide + energy
C lactic acid + ethanol + energy
D lactic acid + energy

18 Which row shows the effect of chemicals in tobacco smoke on human health?

	chemical	causes	increased risk of
A	nicotine	makes blood clot easily	emphysema
B	nicotine	paralyses cilia lining	chronic bronchitis
C	tar	makes blood clot easily	chronic bronchitis
D	tar	paralyses cilia lining	emphysema

19 The diagram shows a cross-section of a human kidney.



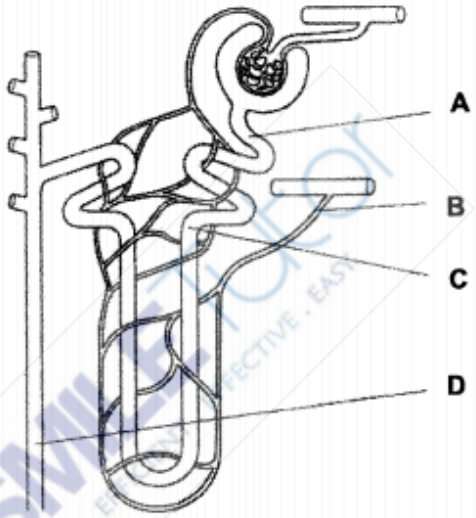
In which regions does the following processes occur?

	selective reabsorption	ultrafiltration
A	X	Y
B	X and Y	Z
C	X and Z	Z
D	Y	X and Z

20 Two samples of fluids were removed from different parts of a kidney tubule for analysis. The results, in arbitrary units, are shown in the table.

chemical	glomerular filtrate	second sample
urea	10	8
sodium ions	10	1
water	100	5
glucose	5	0

From which position was the second sample taken?



21 Drinks, such as coffee, contains caffeine. Caffeine affects the process of hydration because it is a diuretic. This means that it inhibits the production of the ADH hormone at the pituitary gland.

What is the effect of drinking coffee?

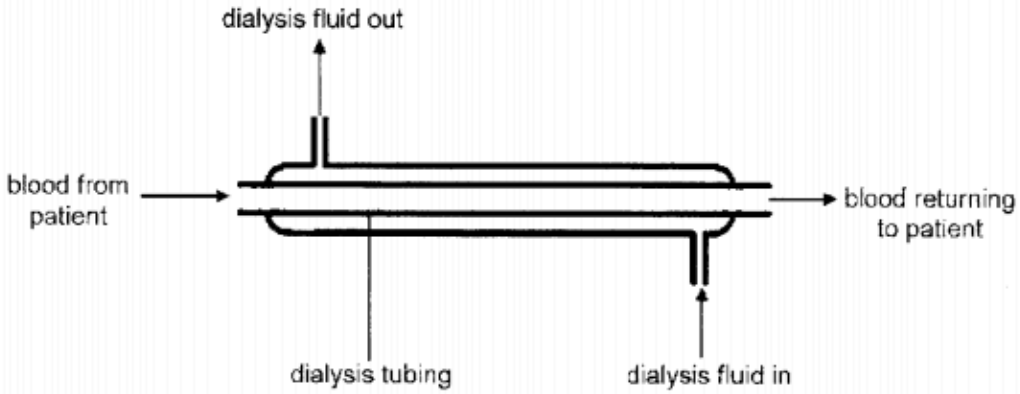
A Larger volume of diluted urine is produced.

B Larger volume of concentrated urine is produced.

C Smaller volume of diluted urine is produced.

D Smaller volume of concentrated urine is produced.

22 An engineer has been asked to improve the efficiency of the dialysis machine shown in the diagram.



The engineer made the following list of recommendations:

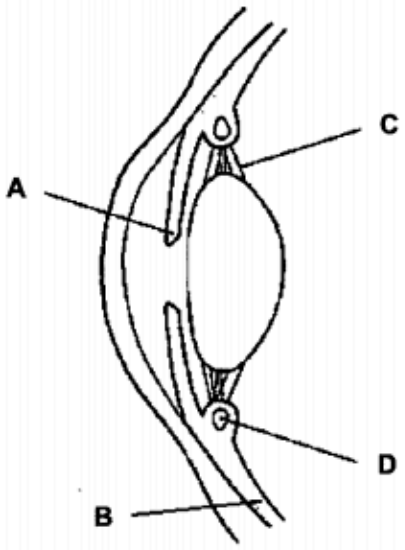
1 Increase the length of the dialysis tubing by coiling it.
2 Increase the rate at which dialysis fluid is replaced.
3 Increase the rate at which blood flows into the dialysis machine.
4 Increase the thickness of the dialysis tubing.

Which recommendations will improve the process of dialysis?

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

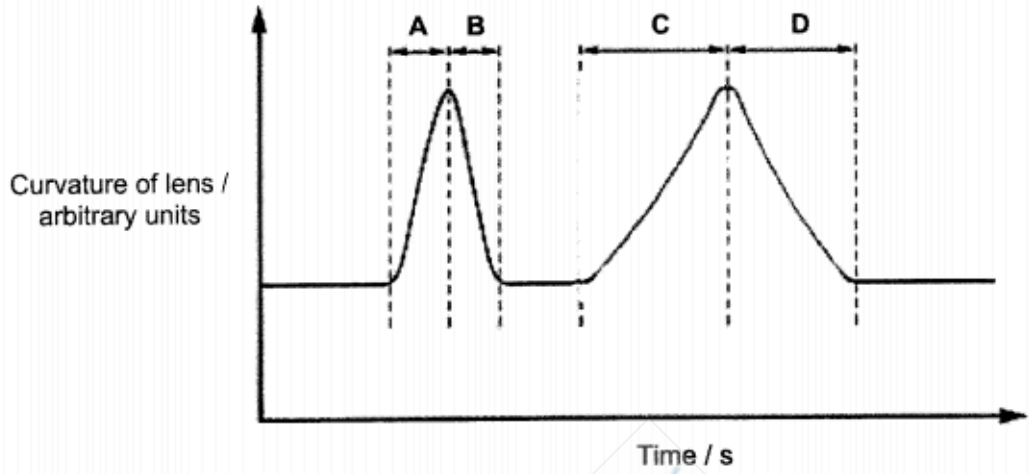
23 The diagram shows a section through a human eye.

Which structure contains the muscles to protect the eye from being blinded by a bright beam of light?

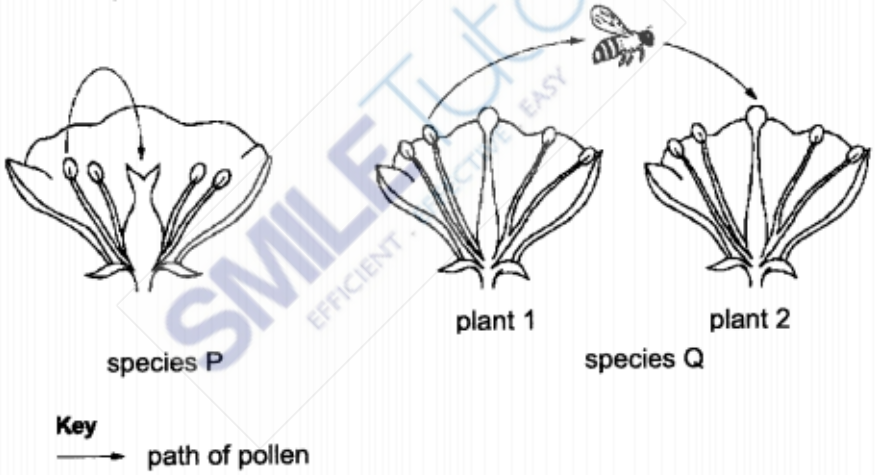


24 The graph shows how the curvature of the lens in a person's eye changes as the person watches two motorbikes go past at different speeds.

During which period was a motorbike moving away from the person at the higher speed?



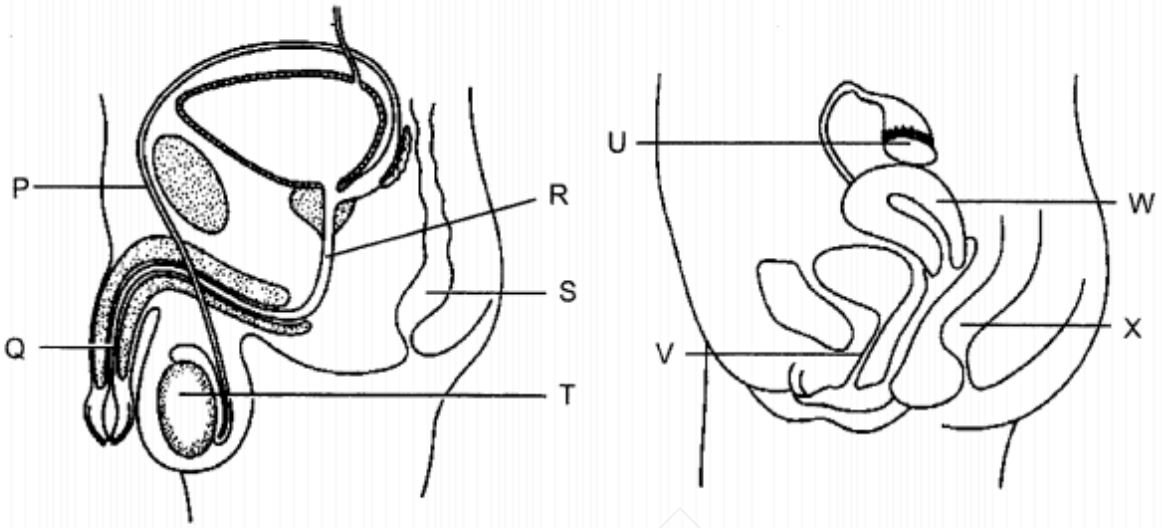
25 The diagram shows pollination in two different species of flowers.



Which of the following classify the mode of pollination and type of reproduction correctly?

	species P		species Q	
	mode of pollination	type of reproduction	mode of pollination	type of reproduction
A	cross	asexual	self	sexual
B	cross	sexual	self	asexual
C	self	sexual	cross	sexual
D	self	asexual	cross	asexual

26 The diagram shows male and female reproductive structures.



Which structures have similar functions?

A Q and U, S and X only

B R and V, T and W only

C S and X, T and U only

D T and W, R and X only

27 Which precautions should be taken to prevent the spread of HIV?

1 avoidance of any direct skin contact with another person
2 medical staff wearing gloves when treating patients
3 not sharing soap used by another person
4 prevent exchange of body fluids
5 treatment of blood products to destroy the virus

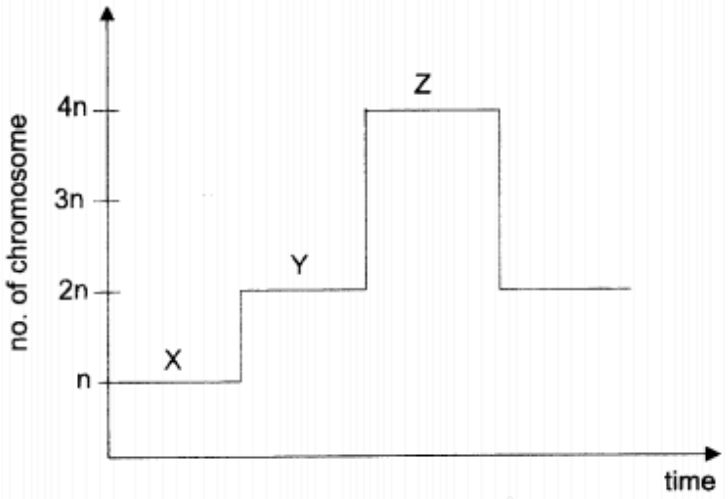
A 1, 2 and 3

B 1, 3 and 4

C 2, 3 and 5

D 2, 4 and 5

28 The diagram below shows changes in the amount of DNA per cell during various events in life.



Which of the following most likely represents X, Y and Z?

	X	Y	Z
A	anaphase I	metaphase I	interphase
B	fertilisation	interphase	telophase
C	gametes formation	fertilisation	interphase
D	telophase	gametes formation	fertilisation

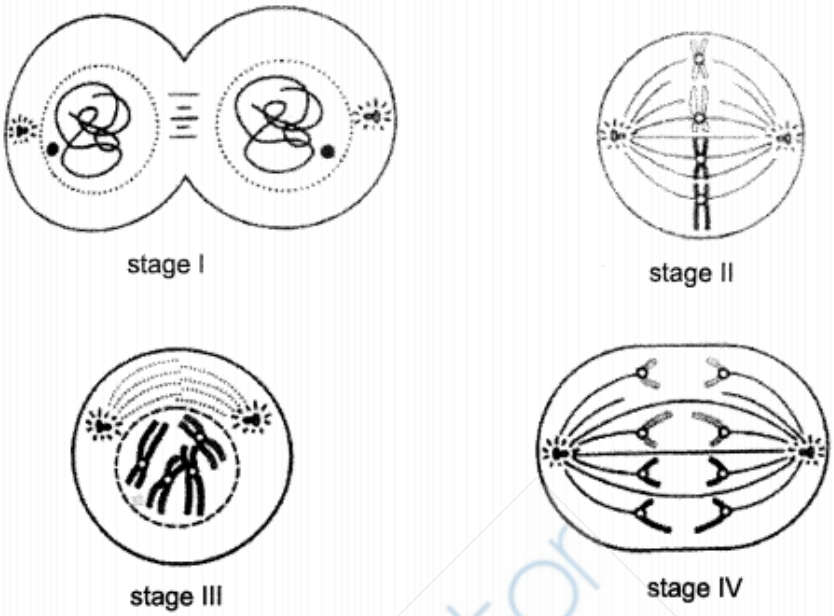
29 Cell division has the following functions.

I asexual reproduction
II growth
III production of enzymes
IV production of gametes
V repair of damaged tissue

Which functions are specific to mitosis?

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

30 The diagram shows some events of a cell cycle taking place in an animal cell. The events are not in the correct sequence.



Which of the following arranges the events in the correct sequence?

A I, II, IV, III
B II, IV, I, III
C III, II, IV, I
D III, IV, II, I

31 The diagram shows a pair of chromosomes from the same cell. A gene is found at the point labelled P.

In a heterozygous individual, what can be found at the position labelled Q?

A a different allele of a different gene
B a different allele of the same gene
C a different gene of the same allele
D the same gene of the same allele

32 Which statement regarding the structure of DNA is **not** true?

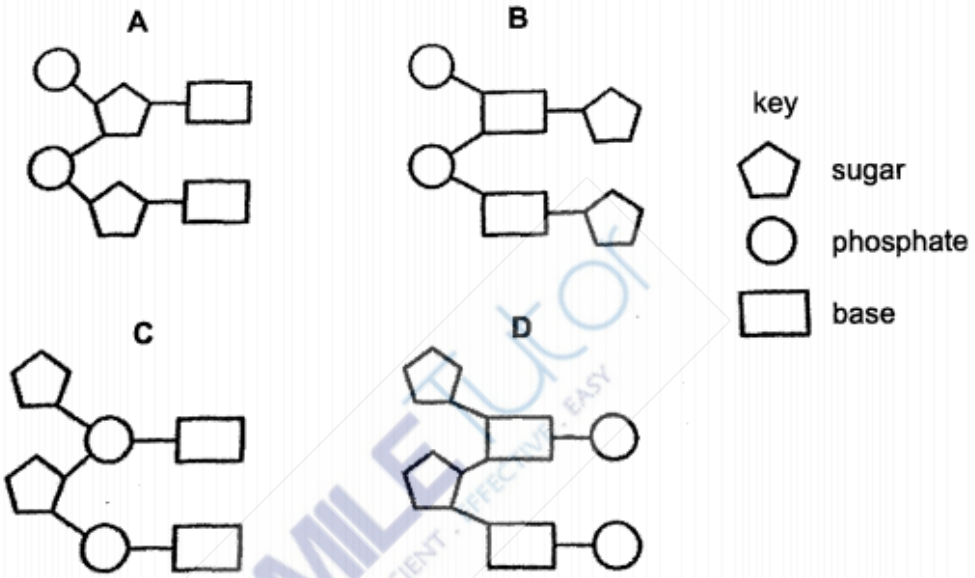
A A DNA molecule has a sugar-phosphate backbone and nitrogenous bases.

B A DNA molecule is made up of nucleotides joined together by peptide bonds.

C DNA consists of two straight anti-parallel strands of polynucleotide chains.

D DNA has 4 bases, which are joined by rule of complementary base pairing.

33 Which diagram shows the structure of two nucleotides in DNA?



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

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

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

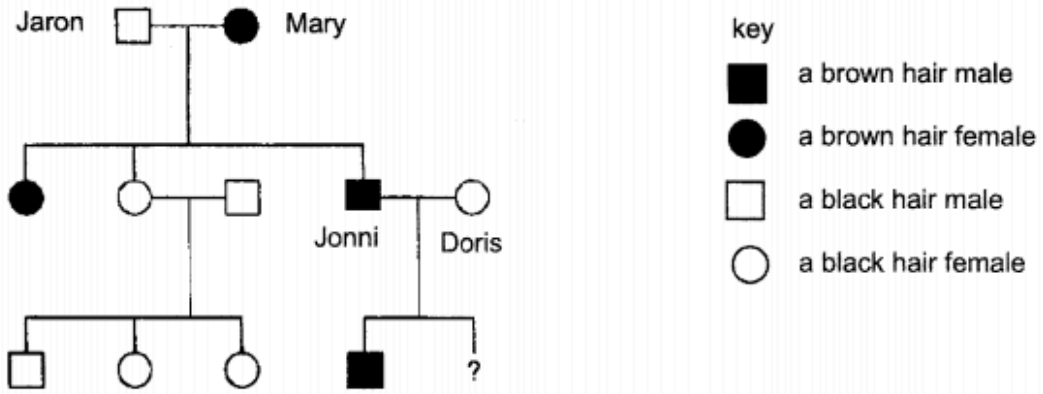
A Amino acids are used to produce different proteins in rats and turtles.

B The deoxyribonucleic acid (DNA) of the rat uses deoxyribose while the DNA of the turtle uses ribose.

C The rules of complementary base pairing are different in rats and turtles.

D The sequence of nucleotides are different and therefore code for different proteins.

Below is a family tree showing the inheritance of brown hair. The allele for brown hair is dominant to the allele for black hair. Use the information to answer questions **35** and **36**.



35 What is the probability of the second child of Jonni and Doris having black hair?

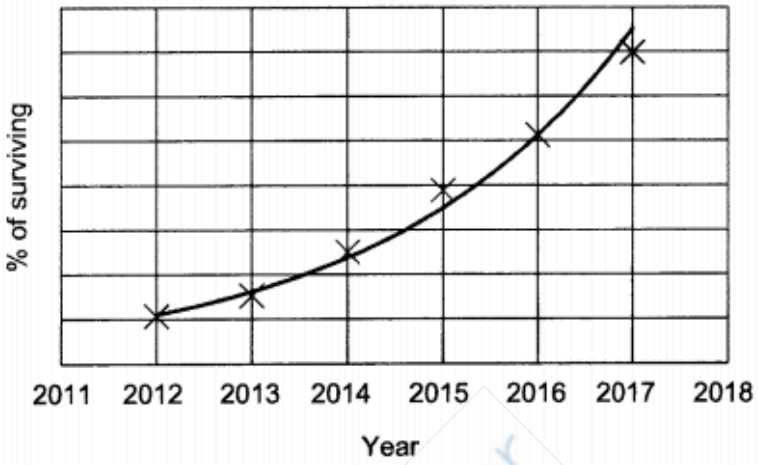
A 0.25
B 0.50
C 0.75
D 1.00

36 The first child of John and Doris is a male. What is the probability of the second child being a female?

A 0.25
B 0.50
C 0.75
D 1.00

37 A biologist studied the population of rabbits grazing in a grassland. He noticed that some rabbits have longer legs than others. He computed the chances of survival of rabbits with the longer legs over the years.

The graph below shows the results of his study.



Which of the following processes explains the results?

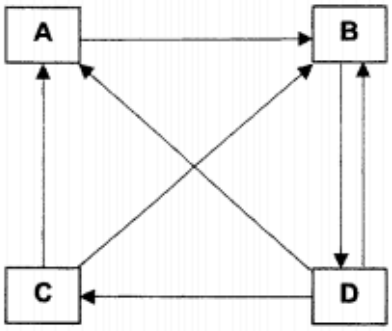
A artificial selection
B genetic engineering
C natural selection
D mutation

38 How does energy flow through the ecosystem?

	energy enters as	energy is transferred as	energy leaves as
A	chemical	heat	chemical
B	heat	chemical	chemical
C	light	chemical	heat
D	light	heat	chemical

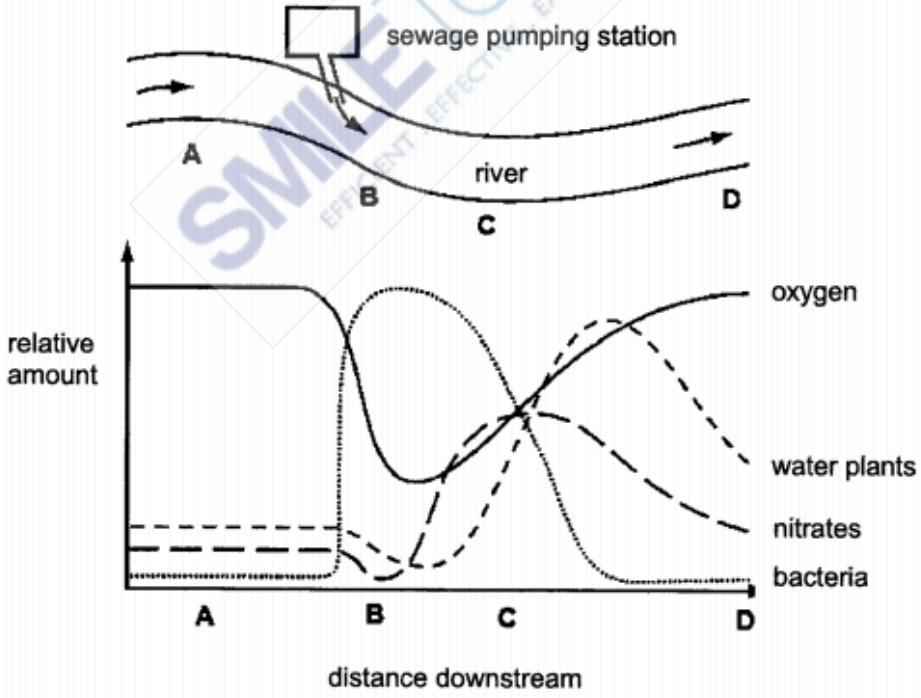
39 The diagram represents the cycling of carbon through the atmosphere, consumers, decomposers and producers in an ecosystem.

Which box represents organisms whose growth rate would be increased by a rise in levels of atmospheric carbon dioxide?



40 The diagram shows part of a river where untreated sewage is being pumped into. Some of the effects of adding sewage to the river are shown in the graph.

At which point in the river are decomposers most active?



Section A: Structured Questions [50 marks]
Answer **all** questions. Write your answers in the spaces provided.

1 Table 1.1 below shows the results obtained from urine samples taken from three different patients, P, Q, and R. Each patient is suspected to be suffering from a damaged organ, which led to different results in Table 2.1.

Table 1.1

patient	glucose	alcohol	haemoglobin
P	present	absent	absent
Q	absent	large amount present	absent
R	absent	absent	present

State a likely condition each of the patients, P, Q and R, is suffering from and provide an explanation for each identified condition.

(a) Patient P

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.....

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.....[2]

(b) Patient Q

.....

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.....[2]

(c) Patient R

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.....[2]

[Total: 6]

2 Large trees produce sun leaves on the outside of the canopy where it receives direct sun, and shade leaves inside the canopy where lower leaves are shaded by others. These two types of leaves have some adaptative differences.

(a) With reference to the difference in environmental conditions, suggest an explanation for the following adaptations:

(i) Shade leaves are wider with a larger surface area than sun leaves that are narrow and have a smaller surface area.

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.....[2]

(ii) Sun leaves are thicker than shade leaves

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.....[1]

(b) Suggest how the sun and shade leaves will differ in terms of stomata size and number.

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.....[2]

2 Fig. 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.

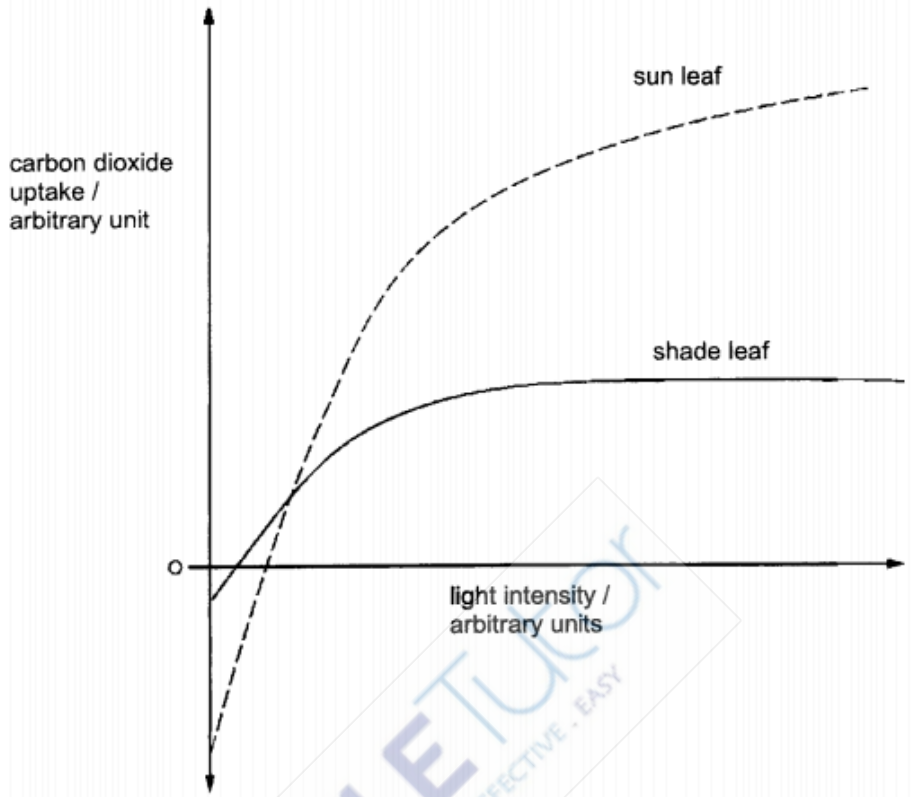

Fig. 2.1

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

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.....[2]

(d) Explain why the carbon dioxide uptake does not increase in the shade leaf as light intensity increases.

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.....[1]

2 **(e)** 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 in the plant.

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.....[2]

[Total: 10]

3 Fig. 3.1 shows transverse sections of two types of blood vessel.

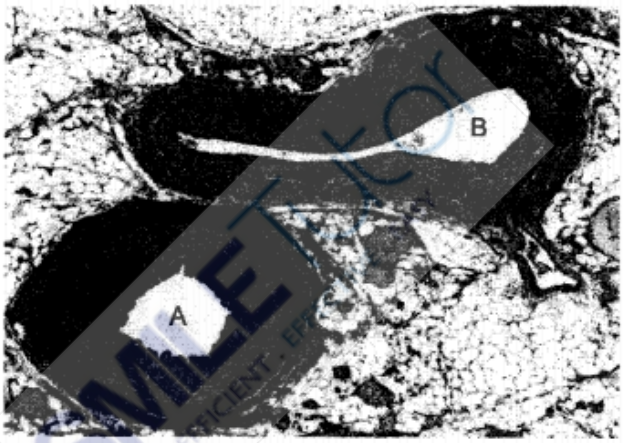

Fig. 3.1

(a) Name the type of blood vessel A and B:

A: .....

B: ..... [2]

(b) State another structural difference between A and B that is not shown in Fig. 3.1.

.....

.....[1]

3 Fig. 3.2 shows the changes in blood pressure and velocity of blood flow as the blood travels from the heart to the leg and returns to the heart.

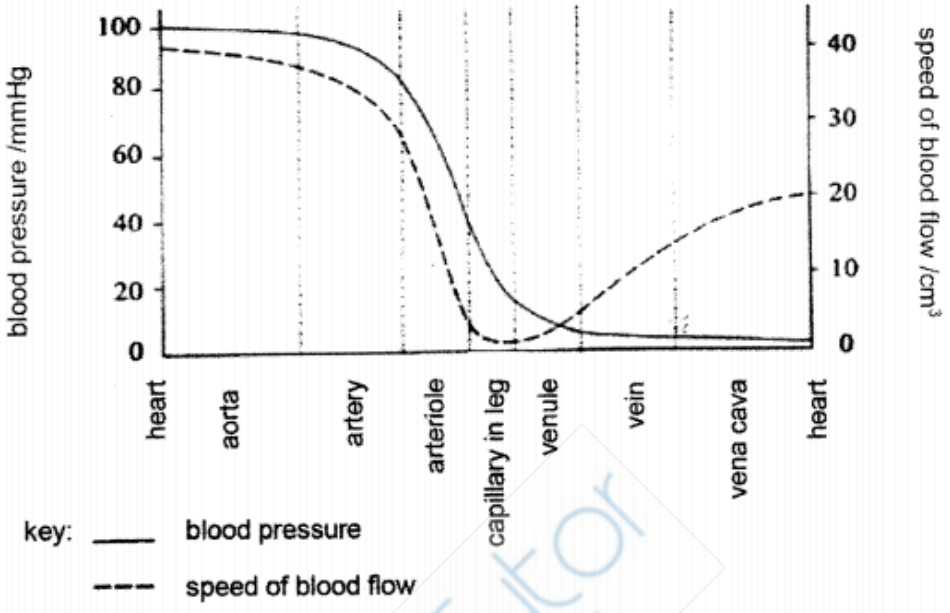

Fig. 3.2

(c) Compare the pressure in the artery with that in the vein. Suggest a reason for the difference.

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.....[2]

(d) Explain the importance of the low speed of blood flow in the capillary.

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.....[1]

(e) In the vein of the leg, the blood pressure is very low while the speed of the blood flow is quite high. Describe how such a high speed of blood flow in the correct direction is maintained in the vein.

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.....[2]

[Total: 8]

4 James was watching a soccer match at a stadium on a sunny afternoon. He felt the vibration of his phone and looked down to check it at the 3rd minute, before returning back to the game at the 7th minutes.

(a) (i) In the axis given in Fig. 4.1, sketch a graph, showing changes that are likely to occur to the thickness of her lens during these 10 minutes.

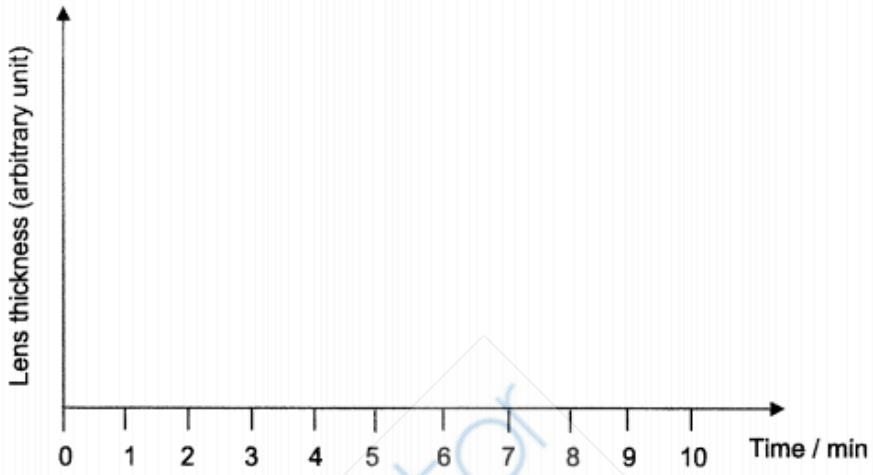

Fig. 4.1

[2]

(ii) Explain your graph in Fig. 4.1.

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.....[4]

4 (b) (i) In the axis given in Fig. 4.2, sketch a graph, showing changes that are likely to occur to the diameter of her pupil during these 10 minutes.

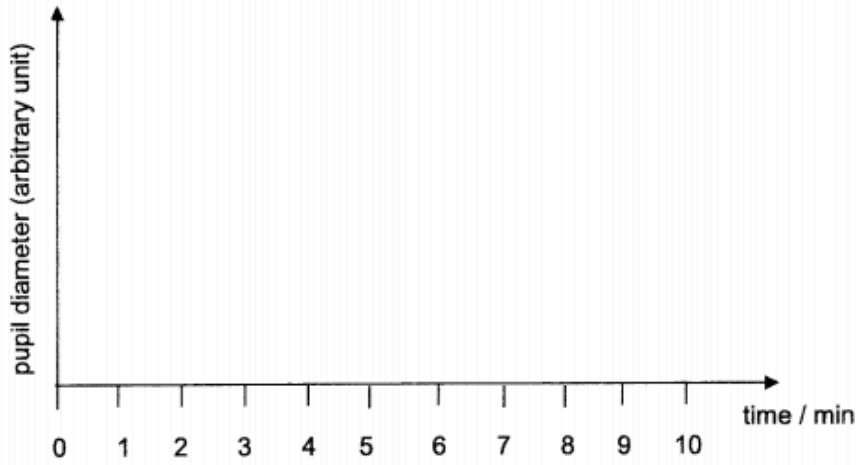

Fig. 4.2

[1]

(ii) Explain your graph in the lines provided below.

.....

.....[1]

[Total: 8]

5 The temperature of the human fetus whilst in the uterus is about 0.5 °C above that of the mother. At birth, the baby emerges into a relatively cool, dry atmosphere. The newborn baby loses heat rapidly and his body temperature can drop about 2 °C within several seconds after birth.

(a) Suggest two possible reasons why the body loses heat rapidly at birth.

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.....[2]

(b) Explain how the following help the baby to regulate its temperature:

(i) A layer of subcutaneous fat is developed by the fetus from about the fifth month of pregnancy onwards.

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.....[1]

5 (b) (ii) Blood vessels to the baby's skin constrict very quickly at birth.

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.....[2]

(c) It is important to monitor the baby's body temperature and oxygen level closely. It is observed that if skin temperatures drop just one degree from the ideal 36.5 °C, a baby's oxygen use can increase by 10 %.

Explain this observation.

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.....[1]

(d) A baby born prematurely is less able to regulate its body temperature and must be kept in an incubator as shown in Fig. 5.1.

Fig. 5.1

A constant temperature is maintained within the incubator using a sensor, thermostat (which is a temperature control centre) and an electric heater.

Use this example of the incubator to explain the meaning of negative feedback.

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.....[3]

6 Fig. 6.1 is a diagram of a human sperm cell.

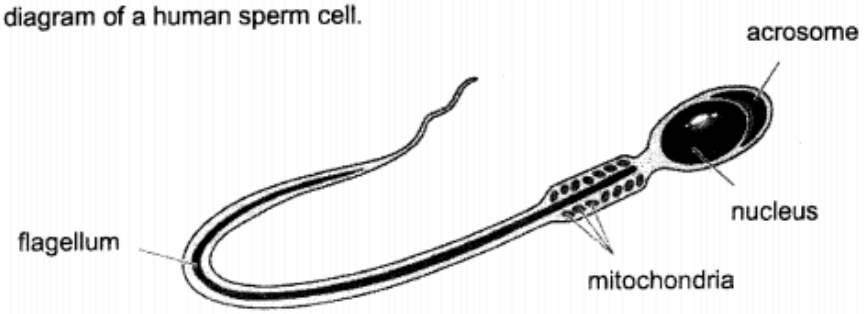

Fig. 6.1

(a) Describe and explain why the nuclei of sperm cells differ from those of other normal body cells in the male.

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.....[2]

(b) The nuclei of one sperm may also differ from that of another sperm of the same male. State how they might be different.

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.....[1]

(c) **(i)** Identify the organ where sperm is produced.

.....[1]

(ii) State one other function of the organ stated in **(c)(i)**.

.....[1]

6 Fig. 6.2 shows a human fetus developing in the uterus.

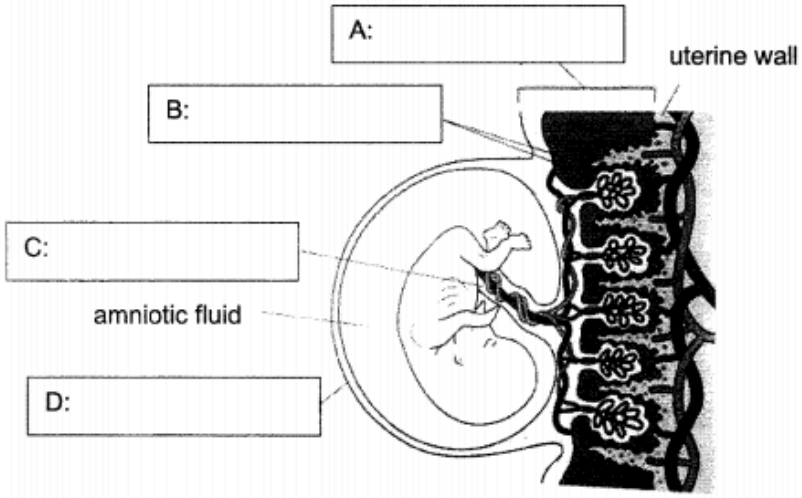

Fig. 6.2

(d) Label the structures A – D in Fig. 6.2. [2]

(e) Describe how structure A ensures healthy growth of the fetus.

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.....[2]

[Total: 9]

Section B (30 marks)
Answer **all three** questions.

7 Fig. 7.1 shows a pollen grain with a pollen tube growing from it.

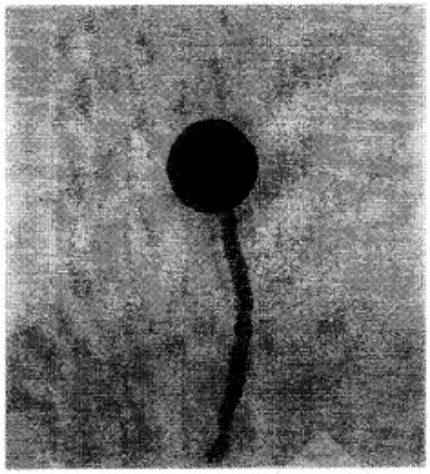

Fig 7.1

Pollen grains from the same type of plant were placed in sucrose solutions of different concentrations for a fixed amount of time. After this time, the pollen grains and tubes were examined using a microscope. The following observations were made for each concentration of sucrose:

- the number of pollen grains that had germinated to produce a pollen tube,
- the length of each pollen tube.

Table 7.1 shows the results of investigation.

Table 7.1

% sucrose concentration	% pollen grain germinated	mean pollen tube length / mm
1	6	0.005
2	13	0.008
4	25	0.015
8	56	0.040
10	31	0.030
20	25	0.018
40	13	0.006

(a) **(i)** A total of 12 pollen grains were placed in 20% sucrose solution.

Use the information in the table to calculate the number of pollen grains that germinated to produce a pollen tube in the 20% sucrose solution.

.....[1]

7 (a) (ii) Suggest why the mean pollen tube length was calculated for each sucrose concentration.

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.....[1]

(iii) Using the information in Table 7.1, suggest the optimum concentration of sucrose solution for the pollen tube germination and growth. Explain your answer.

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.....[2]

(iv) The germination of the pollen tube requires the movement of water from the surrounding into the pollen grains.

Suggest why placing a pollen grain in a solution with a higher sucrose solution than in your answer to **(a)(iii)** may result in a lower percentage of germination.

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.....[2]

(b) Describe the route taken by a growing pollen tube in a plant and explain its importance in plant reproduction.

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.....[4]

[Total: 10]

8 (a) In conditions of prolonged exposure to extreme cold temperatures (e.g. below 0 °C), frostbite occurs and the person may feel complete loss of sensation in the fingers and toes. Explain how this happens.

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.....[5]

(b) "The Braille system is a method that is widely used by the blind to read and write. Each Braille character is made up of dots which are raised on the surface of paper and a blind person can read by touching the raised dots."

Outline the nervous pathway which allows this to happen.

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.....[5]

[Total: 10]

EITHER

9 (a) Discuss the different processes that can lead to variation in organisms:

(i) Meiosis

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.....[2]

(ii) Fertilisation

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.....[2]

(iii) Mutation

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.....[2]

(b) Explain how natural selection can lead to evolution.

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[Total: 10]

OR

9 Fig. 9.1 below shows a number of organisms living together.

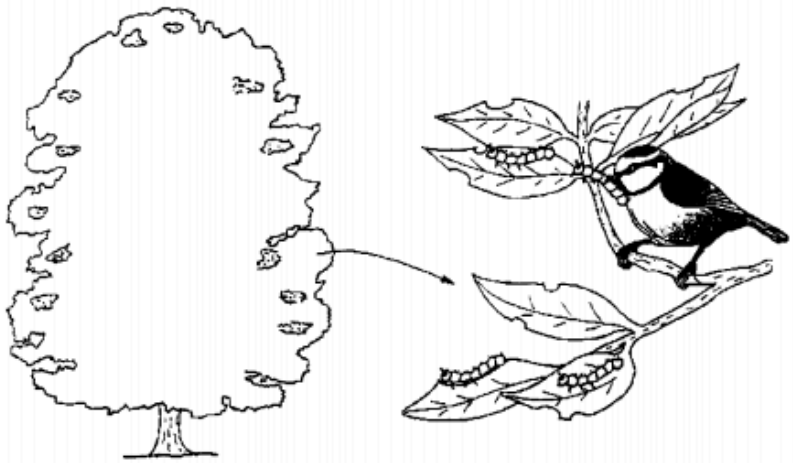

Fig. 9.1

(a) **(i)** The birds in the habitat become severely infected by fleas (parasites). Draw a detailed pyramid of numbers and pyramid of biomass below for this habitat.

Pyramid of numbers:

Pyramid of biomass:

[3]

(ii) Explain why the shape of the two pyramids differ.

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.....[2]

9 (b) For the past few weeks, a farm has attempted to increase its output of crops by spraying the crops with the pesticide DDT and fertilising the soil with high-nitrogen and phosphate chemical fertilisers.

Predict and explain what might happen to the organisms in a river located near to the farm during the next few months.

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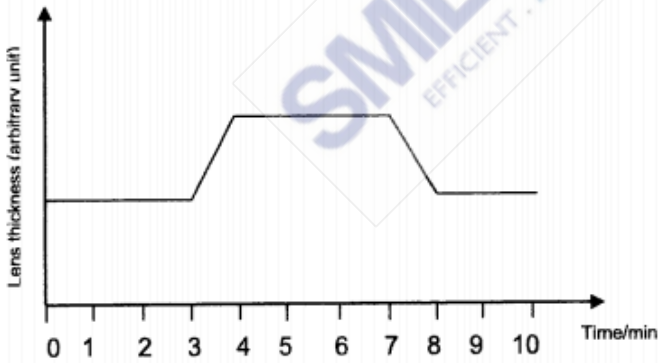
.....[5]

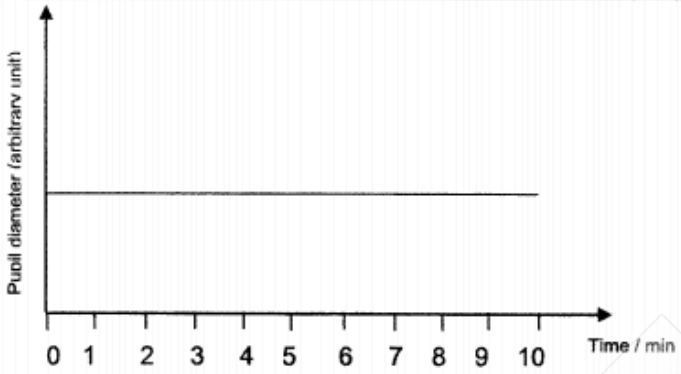
[Total: 10]

ANSWER SHEET

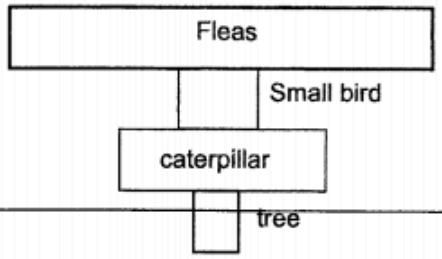
Qn	Marking Scheme	Remarks	Marks
1	B		
2	C		
3	B		
4	C		
5	D		
6	C		
7	A		
8	C		
9	B		
10	C		
11	C		
12	A		
13	D		
14	C		
15	C		
16	D		
17	D		
18	D		
19	C		
20	D		
21	A		
22	A		
23	A		
24	B		
25	C		
26	C		
27	D		
28	C		
29	B		
30	C		
31	B		
32	C		
33	A		
34	D		
35	B		
36	B		
37	C		
38	C		
39	D		
40	B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

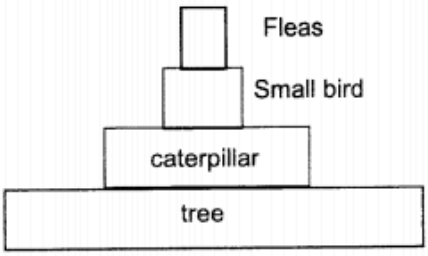
Qn	Marking Scheme	Remarks	Marks
1a	1. Patient is suffering from diabetes mellitus/ damaged islets of Langerhans/damaged pancreas 2. The inability to release insulin results in high blood glucose level in the body, which may not be absorbed during selective reabsorption in the proximal convoluted tubule of the nephron. Thus, glucose is present in urine		1 1
1b	1. Patient is suffering from liver failure; / Patient is intoxicated / liver cirrhosis; 2. The patient was unable to produce enzyme/alcohol dehydrogenase to break down alcohol.		1 1
1c	1. Ruptured glomerulus /basement membrane/ kidney failure; 2. As a result of the ruptured structure, red blood cells are able to pass through into the nephron tubules. As such, red blood cells found excreted through urine will show presence of blood.		1 1
2ai	Any 2 points: 1. Sun leaves are exposed to more heat and / or wind in their exposed locations, The smaller surface area of sun leaves protects against wilting; 2. Sheltered locations of shade leaves guard against water loss; Shade leaves expand in size to collect as much light energy as possible.	Accept any logical answer.	1 1
2ai i	Sun leaves develop longer palisade cells or an additional layer of palisade cells / thicker layer of cuticle to protect the sun from evaporation; [reject more cells.]	Accept any logical answer. Rej.: more cells.	1
2b	1. Stomata pores of sun leaves are smaller, but are greater in number. 2. Stomata pores of shade leaves are larger, but much fewer in number.	Ans must compare both number and size.	1 1
2c	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
2d	As the light intensity increases, light intensity no longer is a limiting factor for the shade leaf;		1
2e	Glucose is formed as a product of photosynthesis. AND Any 2 of the following:	Max [1] if glucose is not mentioned as end product.	 2

Qn	Marking Scheme	Remarks	Marks
	1. It can be converted to **cellulose**, a polysaccharide used for the production of cell walls of plant cells. 2. 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.		
			10m
3a	A: artery / arteriole B: vein / venule		1 1
3b	Semilunar valves are absent in A but present in B;		1
3c	Higher pressure in artery than in vein; Any 1 reason: • Thicker and more elastic muscle wall retain recoil effect whereas veins has thinner elastic muscular wall; OR • Constant contraction of (left) ventricular muscle maintains high pressure in the artery, unlike veins which are far distance to from the heart to have any high pressure;		1 1
3d	**Increase** time / provide **sufficient** time for exchange of substances (between blood in capillaries and tissue fluid);		1
3e	1. Muscle contraction of leg surrounding the vein ensures high speed of blood flow; 2. Presence of valves in the vein ensures the blood flow is moving in the same direction;		1 1
			8m
4ai	[1] for increasing thickness at 3 min [1] for decreasing thickness at 7 min  		**2**
4ai i	1. When he looks at the handphone in his hand at t=3min, the ciliary muscles of the eye will contract, relaxing the pull on the suspensory ligament; 2. Suspensory ligament slacken, relaxing the pull on the lens; 3. This would cause the lens to become thicker and more convex (decreasing the focal length) to allow it to focus on a near object 4. [overall [1] for describing the opposite events correctly] • At t=7min, as she looks back at the soccer game, the ciliary muscles will relax, pulling on the suspensory ligament; • Suspensory ligaments become taut, pulling on the edge of the lens.		1 1 1 1

Qn	Marking Scheme	Remarks	Marks
	• This would cause the lens to become thinner and less convex (increasing the focal length), allowing it to focus on a far object.		
4b i			1
4b ii	Light intensity remains the same throughout, hence there would be no alteration of the diameter of the iris.		1
			8m
5a	1. The room temperature is much cooler compared to mother's womb / uterus / body; 2. As amnionic fluid **evaporates** from the skin surface, **latent heat of vaporisation** is lost;	[1] for comparing temperature difference [1] mode in which heat is lost	1 1
5b i	Fat is an insulator against heat loss when it is expose to a colder environment		1
5b ii	1. To reduce blood flow to the skin capillaries 2. So as to minimize heat loss by radiation, convection and conduction (mention at least once mode of heat loss)	Reject, prevent excessive loss of heat	1 1
5c	New born baby uses the oxygen to increase metabolic reactions / respiration to generate energy and heat.		1
5d	1. When an increase in temperature is detected by a sensor; 2. The thermostat will off the heater; 3. Causing less heat to be released and thus counteract change / brings about opposite effect to the change to return temperature to norm;	(vice versa)	1 1 1
			9m
6a	1. (describe) The sperm is a haploid cell after going through meiosis, while somatic cells are diploid; 2. (explain) So that when the sperm fertilises the egg, the number of chromosomes in the zygote remains / restored to the same as the other cells and does not double		1 1

Qn	Marking Scheme	Remarks	Marks
6b	Some sperm contains X chromosomes while others contain Y chromosomes.		1
6ci	Testis / testes	Reject spelling error	1
6ci i	Secrete mal sex hormones, **testosterone**.		
6d	A: placenta B: (embryonic) villi / fetal capillaries C: umbilical cord D: amniotic sac	[1] for any 2 correct. Rej. Spelling error	2
6e	Any two: 1. It allows **oxygen and dissolved substances** (such as glucose, amino acids and mineral salts) to diffuse from the mother's blood into the fetal blood; 2. It allows **metablic waste or excretory proudcts** (such as urea and carbon dioxide) to diffuse from the fetus's blood into the mother's blood; 3. It allows **protective antibodies**, which protect fetus against diseases, to diffuse from the mother's blood into the fetal blood; 4. It produces **progesteronne** which maintains the uterine lining in a healthy state during pregnancy;	OWTTE Allow e.c.f	2
Section B			
7ai	Number of pollen grains that germinated = (25/100) x 12 OR 12/4 = 3 pollen grains		1
7ai i	Any one: some may not germinate / some may not produce a pollen tube ; accuracy / precision / reliability / validity / reduce error ;	Accept other logical answer.	1
7ai ii	8 % sucrose concentration; highest % of pollen grain germinated and **highest** mean pollen tube length;		1 1
7iv	1. Higher sucrose solution have lower water potential; 2. When the water potential of the solution is lower than the cytoplasm of pollen tube, less or no water molecules enters the pollen tube by osmosis. Hence stopping / hindering germination.	Reference to water "molecules"	1 1
7b	Route taken: 1. Germination of pollen tube occurs in the stigma, and it grow down the style towards the ovary; 2. Pollen tube enters the ovule through micropyle; Importance: 3. Pollen tube allows the movement of male gametes; 4. And releases the gametes into the ovules where nucleus of one male gametes fuses with the nucleus of the ovum to form the zygote during fertilization;		1 1 1 1
			10m

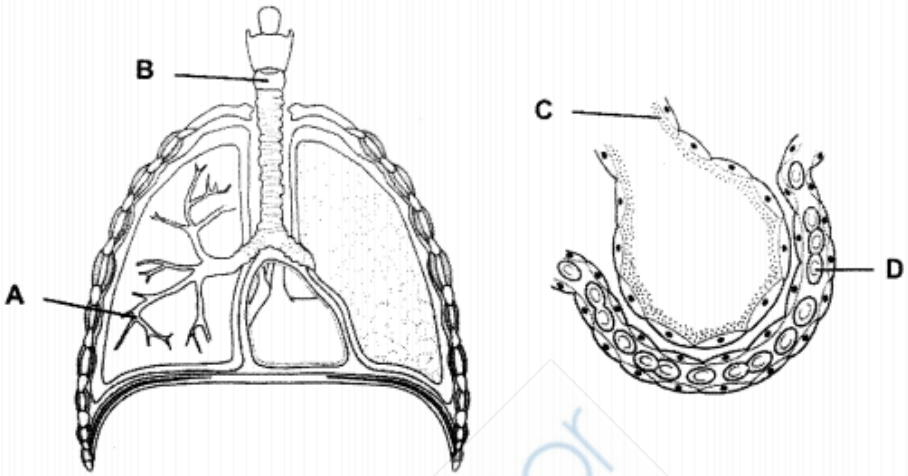
Qn	Marking Scheme	Remarks	Marks
8a	1. arterioles constricting, less blood flow to blood capillaries in skin; 2. reduce blood flow to the skin to prevent heat loss; 3. oxygen supply to skin reduced; 4. ice crystals in spaces around the cells; 5. cause cell death and destruction of cells in fingers and toes;		1 1 1 1 1
8b	1. When the blind person touches the raised marks on the surface of paper, the nerve endings of the touch receptors in the skin are stimulated; 2. Nerve impulses produced travel along the **sensory neurone to the spinal cord**; 3. and then through a synapse **to the relay neuron** in the spinal cord; 4. Electrical impulses travel through the relay neuron **to the brain**; 5. where the **brain will interpret the electrical impulses** as touching the raised marks.		1 1 1 1 1
			10m
9E ai	1. **Crossing over during prophase I**, which result in new combination of existing alleles along the chromosomes, and 2. **independent assortment during metaphase I**, where homologous chromosomes randomly align along the metaphase plate / equatorial plate; 3. (during meiosis) produce gametes that are **not genetically identical** to each other or to parent cells.	Any 2	1 1
9E aii	1. Fertilisation involves the **fusion of random gametes** 2. that carry **different alleles** for different genes from each parent / Each gamete is genetically dissimilar and haploid;		1 1
9E aii	1. Error can occurs during the **replication** of the gene or chromosome; 2. Mutation leads to random change in structure of gene or the number of chromosome;		1 1
9E b	1. In the presence of selection pressures such as **competition for food** or **predators**, **favourable traits** will confer a **selective advantage**. / nature selects varieties that are more competitive, more resistant to diseases and better adapted to changes in environment 2. Allowing those individuals to **survive and reproduce** 3. Causing most of the population to be of **individuals with the favorable trait** / individual with favorable trait becomes the predominant species in their environment. 4. Other individuals that are susceptible to diseases or environmental changes may gradually die off.		1 1 1 1
			10m
9O ai	**Pyramid of numbers**  	[1] for each correct shape of the pyramids [1] both pyramids with correct labels	3

Qn	Marking Scheme	Remarks	Marks
	Pyramid of biomass  	Deduct [1] for not using ruler and / or pencil	
9O aii	1. In the pyramid of numbers, many small caterpillars are able to feed on one large tree, and one bird can be infected by many fleas; 2. However, one tree and one bird will have a comparatively large biomass to support the caterpillar and fleas respectively;		1 1
9O b	1. Pesticides and fertiliser will enter the water bodies when it is washed down by rain or through underground water; 2. Pesticides like DDT may be ingested by the organisms and may not or may not be easily excreted out of organism. This will cause **bioaccumulation** of DDT in the organisms; 3. and up the food chain where its toxic effects will **amplify** and harm or kill the top consumer **(bioamplification)** ; 4. The high-nitrogen fertiliser released into the river will lead to the profuse growth of algae and water plants leading to **eutrophication**; 5. This will lead to lack of sunlight for submerged plants, causing them to die and multiplication of bacteria in the waters, and depletion in dissolved oxygen, resulting in death or other organisms like the fish; [1m for effects: esp of the immediate ones like death of submerged plants]		1 1 1 1 1

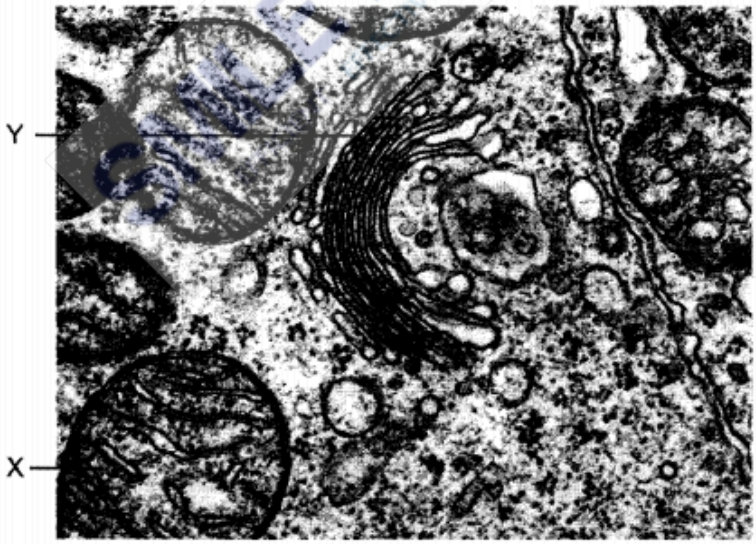
BUKIT BATOK SECONDARY SCHOOL SA2 PAPER

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

Which structure is a cell?



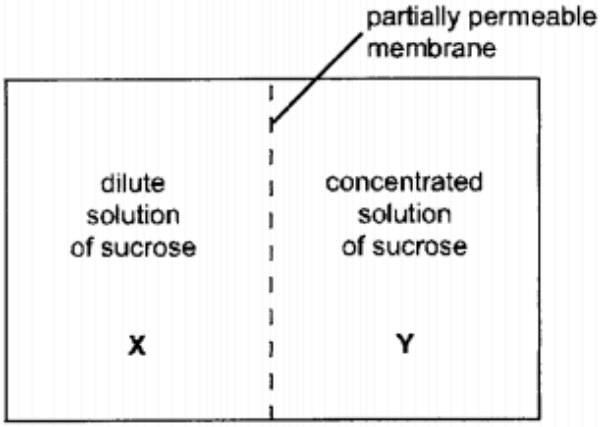
2 The diagram shows an electron micrograph of the internal structures of an animal cell.



What are organelles X and Y?

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

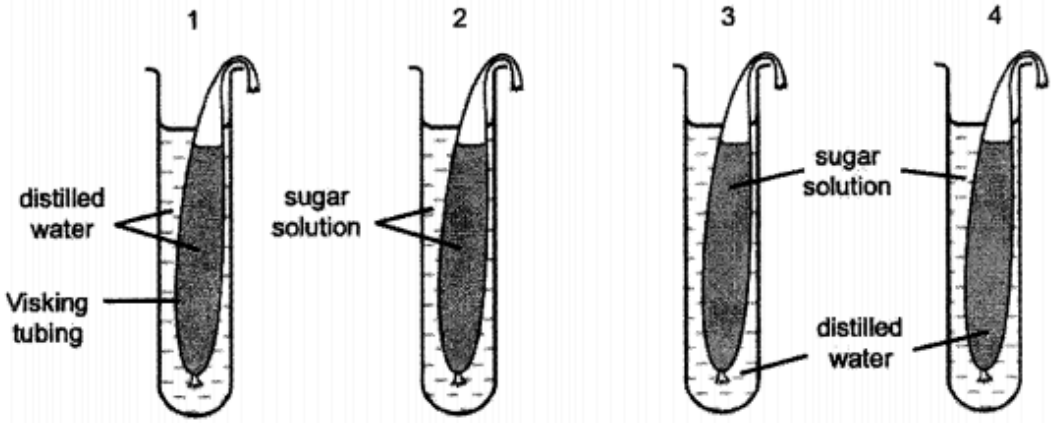
3 The diagram shows two solutions that are separated by a partially permeable membrane.



In which direction will the water and sucrose molecules move?

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

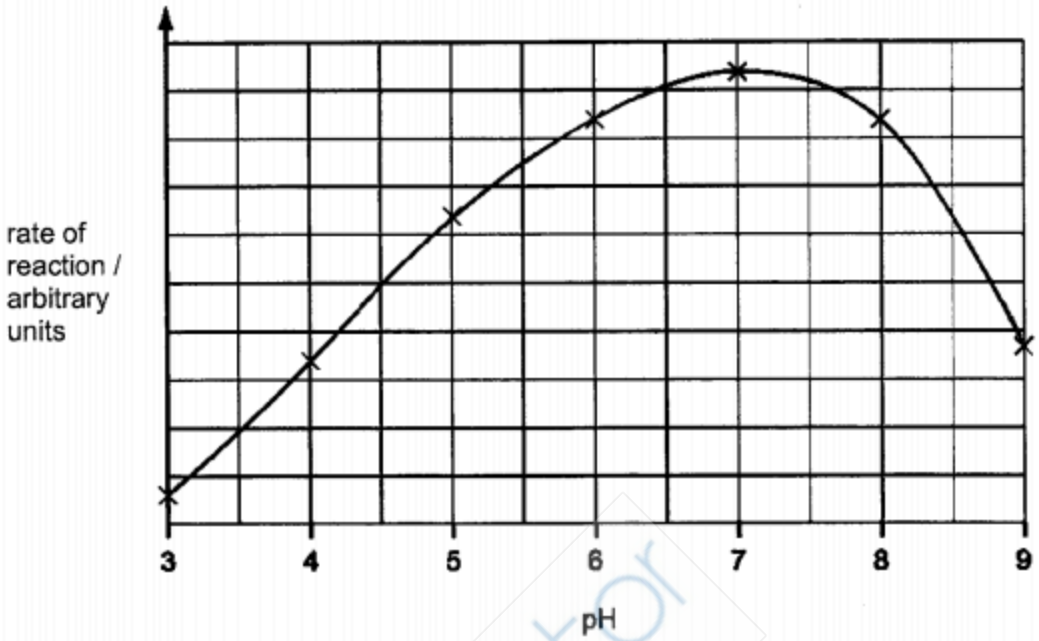
4 The diagram shows the apparatus used in an experiment on osmosis.



In which tubes will osmosis take place?

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

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



What does the graph show?

A The enzyme is denatured completely at pH 9.

B The enzyme works best at pH 6.

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

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

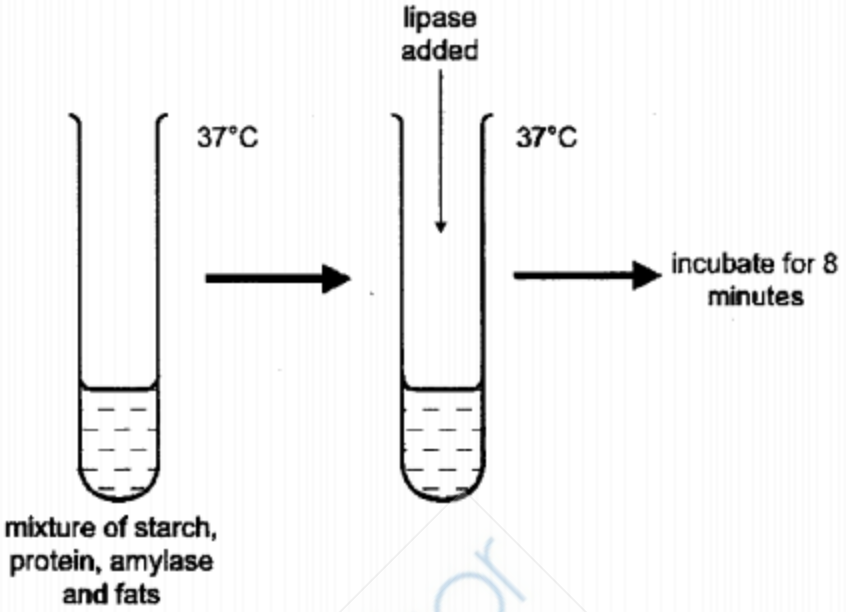
6 The table below shows the contents in five test-tubes. They are left for eight hours and then tested for amino acids.

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

Which tubes show that pepsin is an enzyme?

A 1 and 5
B 2 and 3
C 2 and 4
D 4 and 5

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



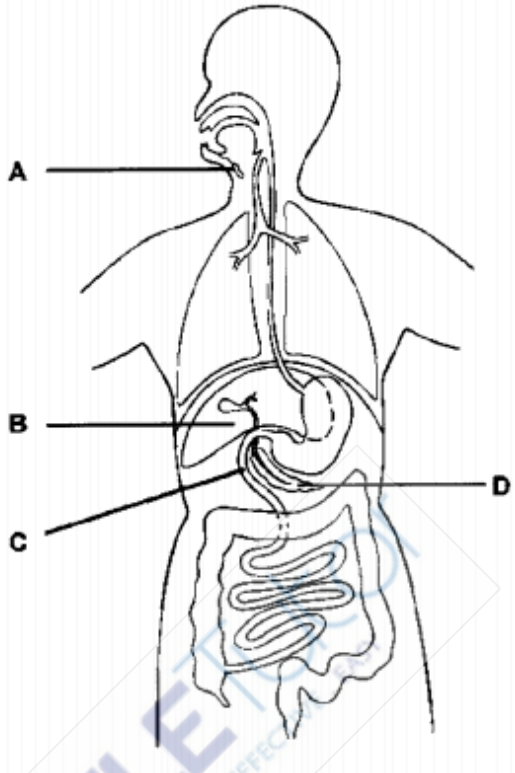
What will be in the test-tube after the incubation?

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

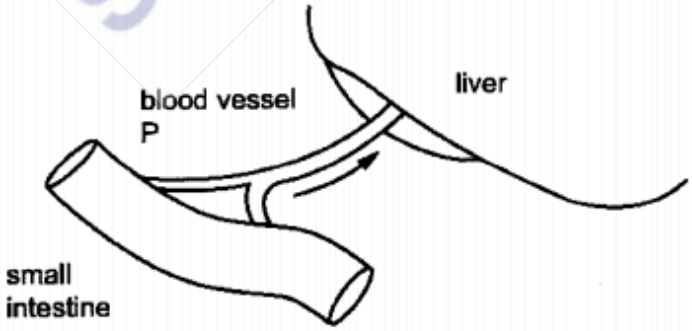
A I and II
B I, II, III and V
C I, II, IV and V
D I, III, IV and V

8 The diagram shows the human alimentary canal.

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



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

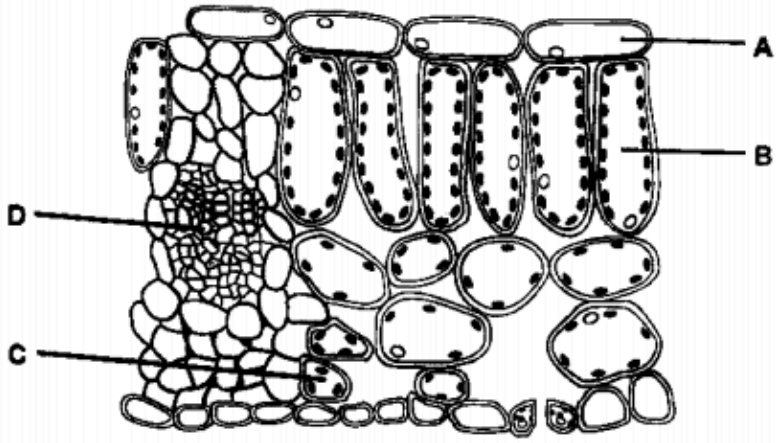


Which of the following describes the level of glucose in blood vessel P and the level of glycogen in the liver, a few hours after a large meal containing carbohydrates?

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

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

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



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

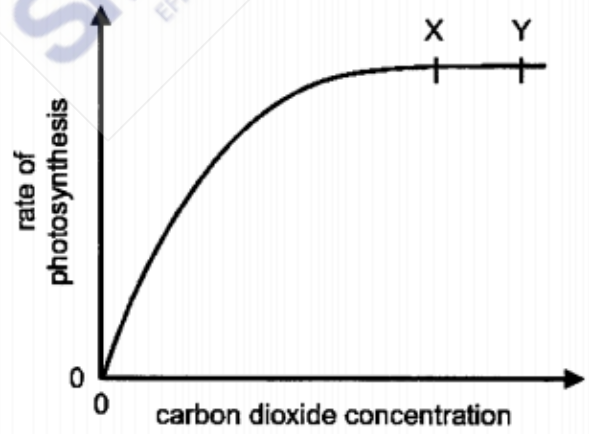
A glucose → cellulose

B glucose → glycogen

C glycogen → glucose

D glycogen → cellulose

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



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

A carbon dioxide concentration and light intensity only

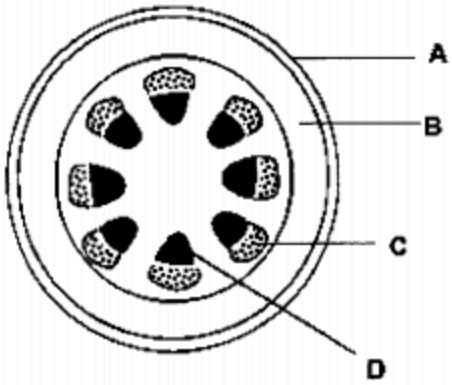
B carbon dioxide concentration and temperature only

C carbon dioxide concentration, light intensity and temperature

D light intensity and temperature only

13 The photomicrograph shows a section of a young stem.

Which labelled cells do **not** respire?



14 The table shows some characteristics of four different plants.

The plants are growing in the same environmental conditions.

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

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

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

Which region would radioactivity be detected after 1 hour?

A intercellular air space

B phloem

C stomata

D xylem

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

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

These results show that the uptake of bromide ions

A is via active transport only.

B is via diffusion only.

C occurs during aerobic respiration only.

D stops in the absence of oxygen.

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

A family history

B low fibre diet

C sedentary lifestyle

D tobacco smoke

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

Which statement is accurate?

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

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

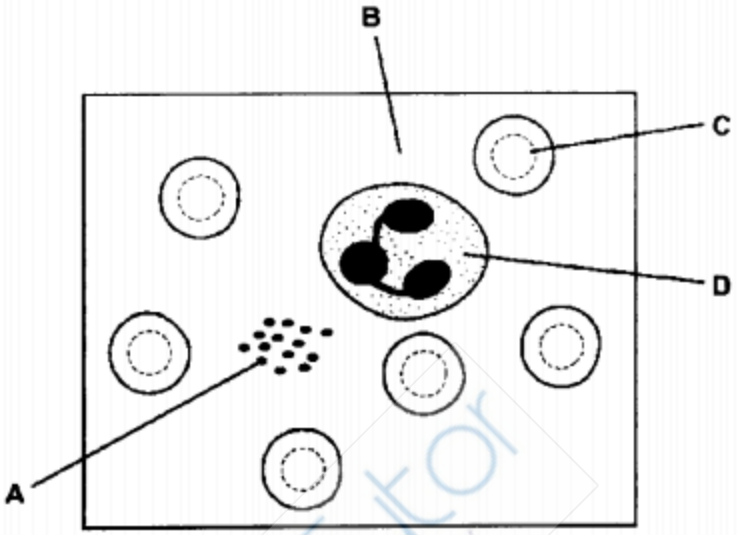
C the donated blood cannot be of blood group AB as the donated blood cells have antigen B

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

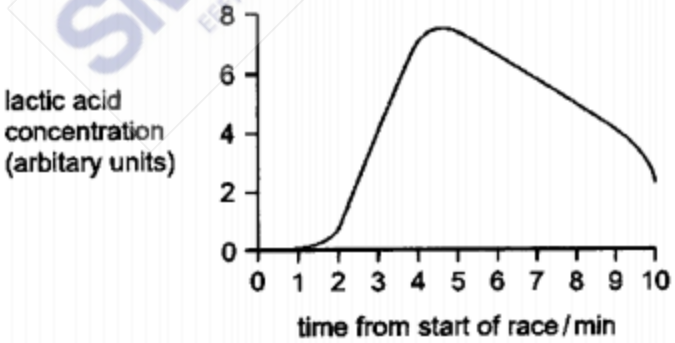
19 The diagram shows human blood, as seen under a microscope.

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

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



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



How long did the athlete run?

A 2 minutes

B 4 minutes

C 6 minutes

D 10 minutes

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

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

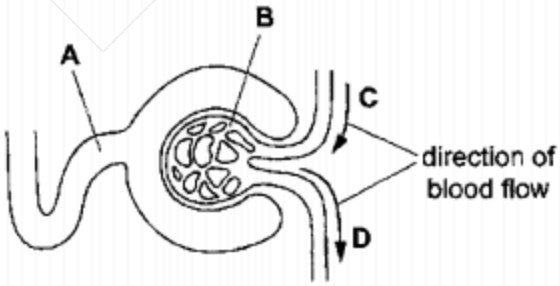
22 When a mother smokes during pregnancy, the oxygen supply to the fetus is reduced.

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

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

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

Which part contains the highest concentration of protein?



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

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

Which two processes are controlled directly by negative feedback?

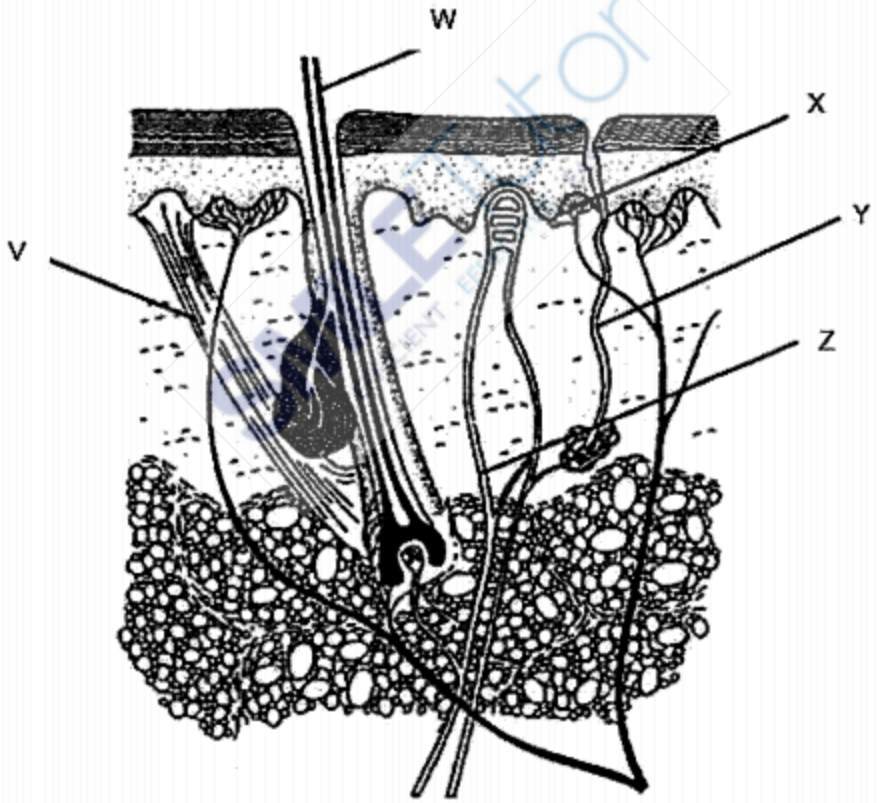
A I and III

B I and IV

C II and III

D II and IV

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



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

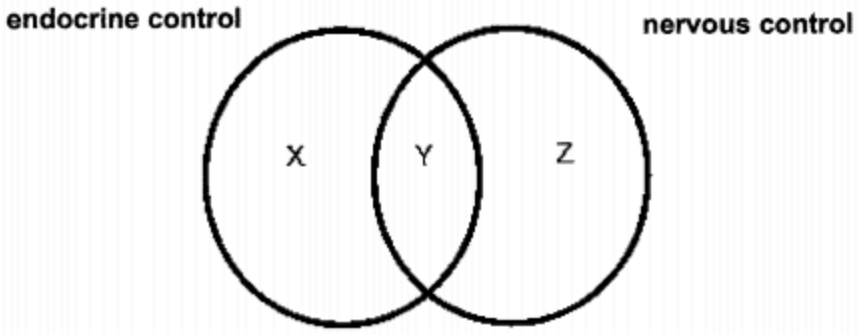
A contraction of V and Z

B detection of temperature change by W and relaxation of Z

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

D increased flow of fluid in Y and relaxation of V

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



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

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

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

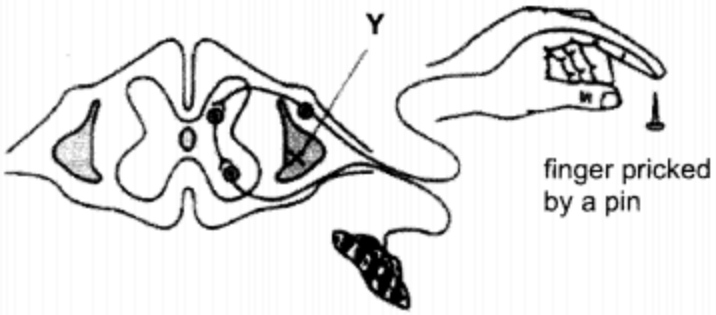
1 increased blood glucose concentration
2 increased breathing rate
3 dilated pupils
4 increased perspiration

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

A adrenaline
B anti-diuretic hormone
C glucagon
D insulin

28 The finger is accidentally pricked by a pin.

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

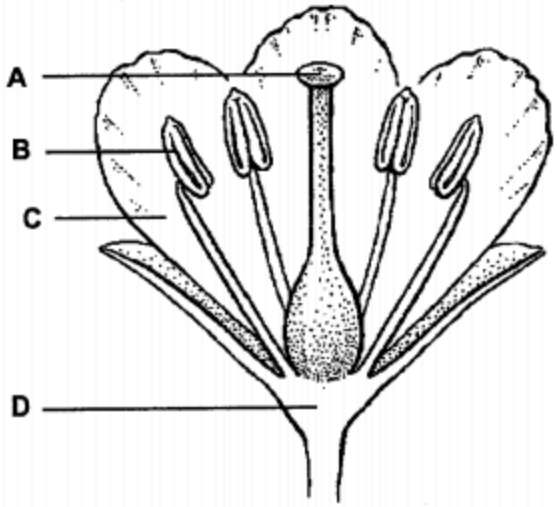


What are the effects of this pin prick?

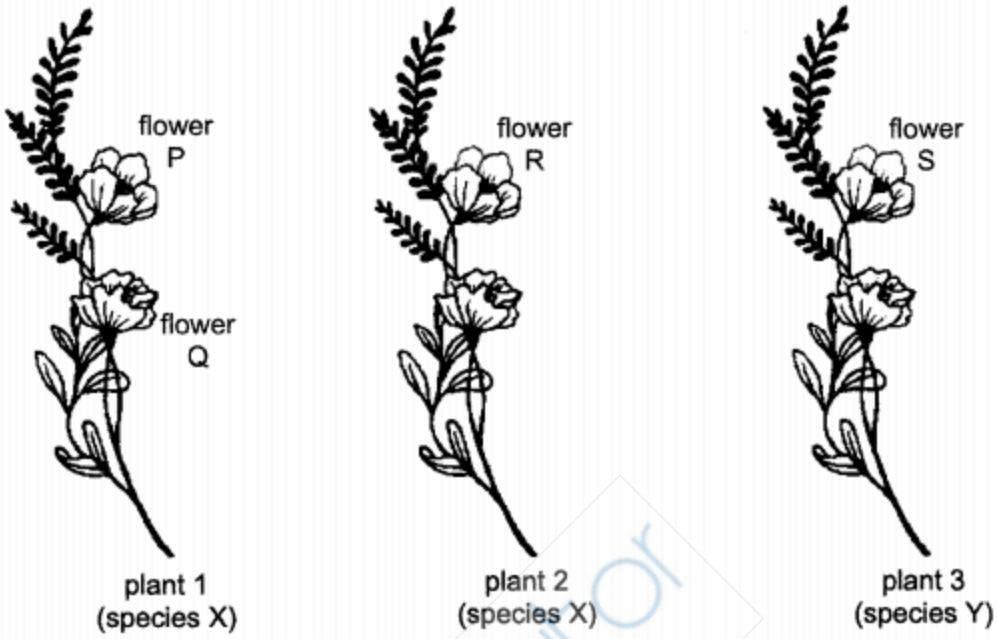
	pain felt	arm moved
A	no	no
B	no	yes
C	yes	no
D	yes	yes

29 The diagram shows a section through a flower.

Which labelled part contains gametes?



30 The diagram shows three separate flowering plants.



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

A pollen from flower Q landing on stigma of flower R

B pollen from flower R landing on stigma of flower Q

C pollen from flower R landing on stigma of flower P

D pollen from flower S landing on stigma of flower P

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

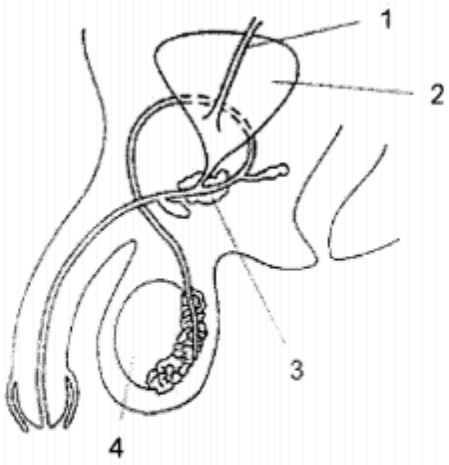
A Avoiding direct skin contact with an infected person prevents further spread of the HIV.

B Only adults can be infected by the HIV.

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

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

32 The diagram shows the male reproductive and urinary systems.



Which two structures are involved in producing semen?

A 1 and 2

B 2 and 3

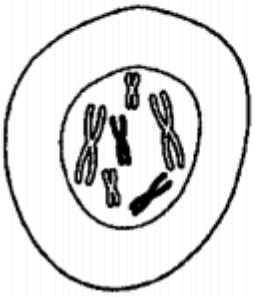
C 2 and 4

D 3 and 4

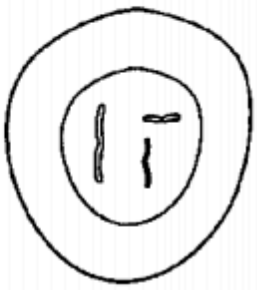
33 A cell containing three pairs of chromosomes divides by meiosis.

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

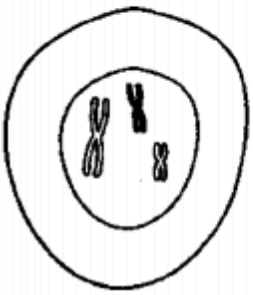
A



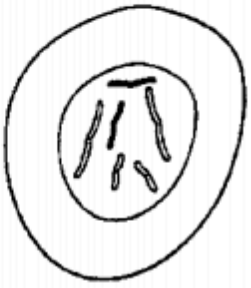
B



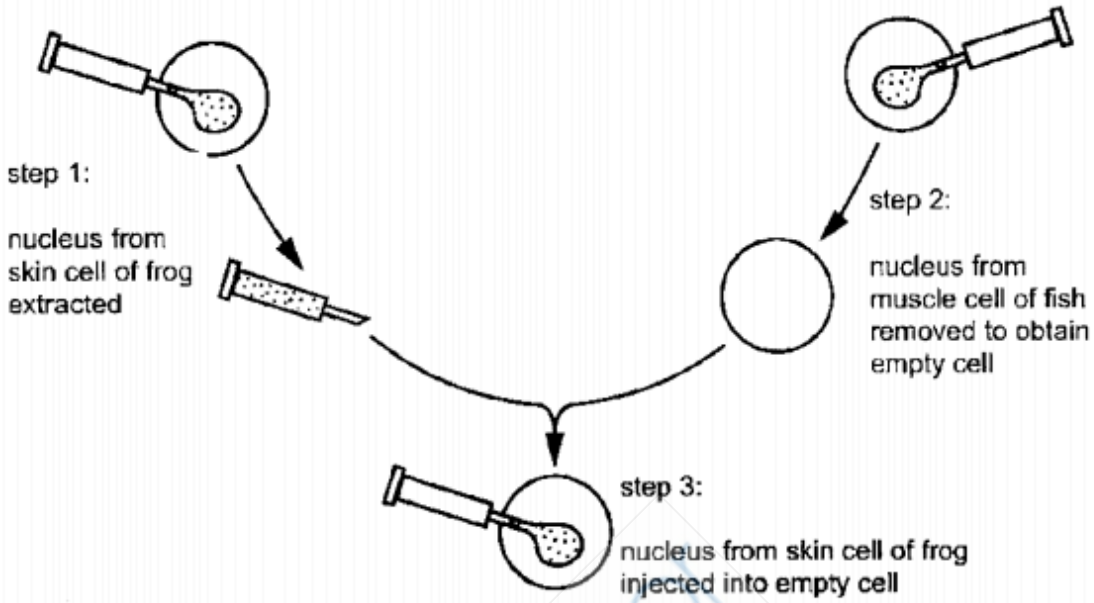
C



D



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



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

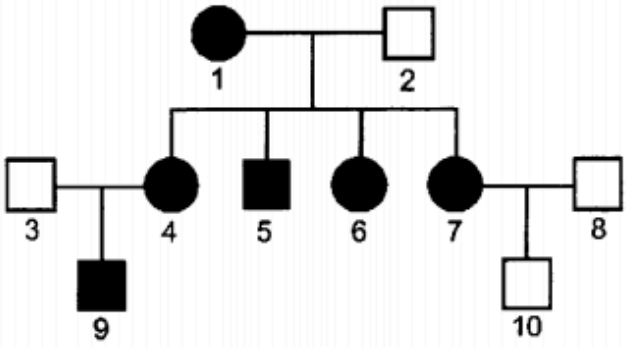
What would the cluster of cells most likely form?

A fish muscle
B fish skin
C frog muscle
D frog skin

35 Which statement about a gene is correct?

A It codes for a polypeptide.
B It is bigger in size than a DNA molecule.
C It is made up of a sequence of alleles.
D It is made up of a base with sugar and phosphate group.

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



Which individual are heterozygous for the trait?

A individuals 2 and 10
B individuals 3 and 8
C individuals 2, 3 and 10
D individuals 3, 8 and 10

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

Which of the following conclusions about this individual is correct?

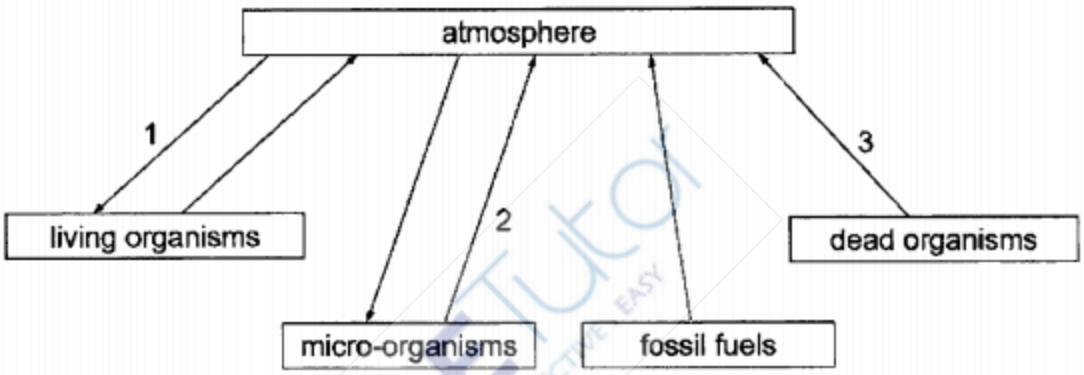
A The individual is a normal male.
B The individual is a normal female.
C The individual is a male with Down Syndrome.
D The individual is a female with Down Syndrome.

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

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

A climate
B infection by disease
C predation
D type of food available

39 The diagram below shows part of the carbon cycle.



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

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

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

Which of the following processes involve anaerobic bacteria?

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

SECTION A [50 marks]

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

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

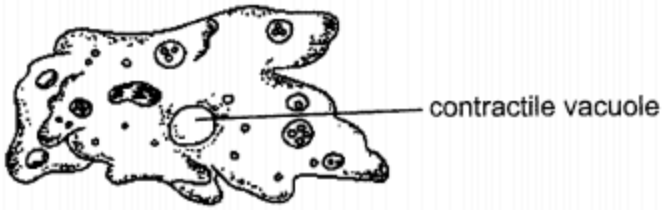


Fig. 1.1

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

Table 1.1

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

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

.....

.....

..... [2]

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

.....

.....

.....

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..... [4]

[Total: 6]

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

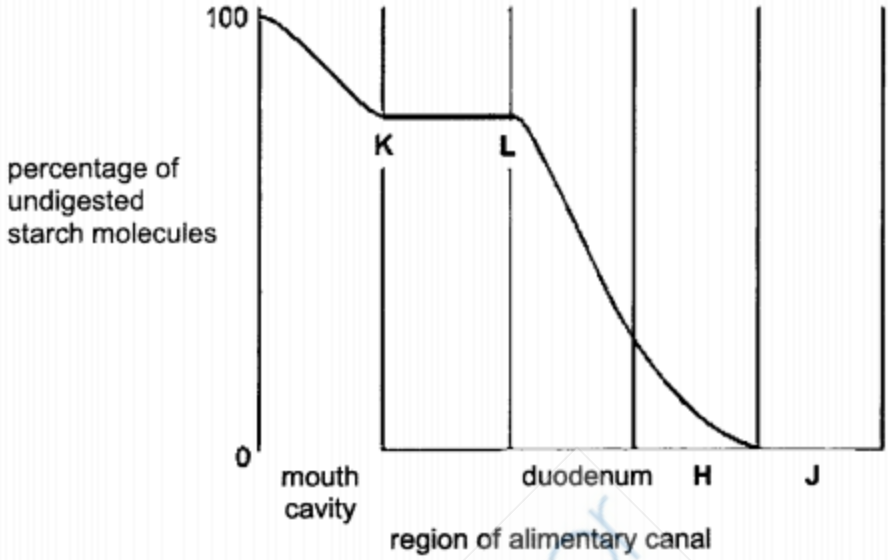


Fig. 2.1

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

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

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

.....

.....

.....

..... [3]

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

.....

.....

..... [2]

[Total: 7]

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

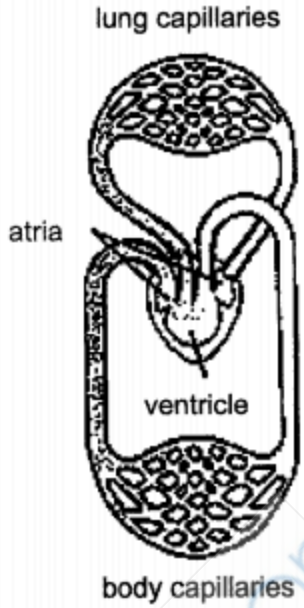


Fig. 3.1

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

..... [1]

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

.....

.....

.....

..... [2]

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

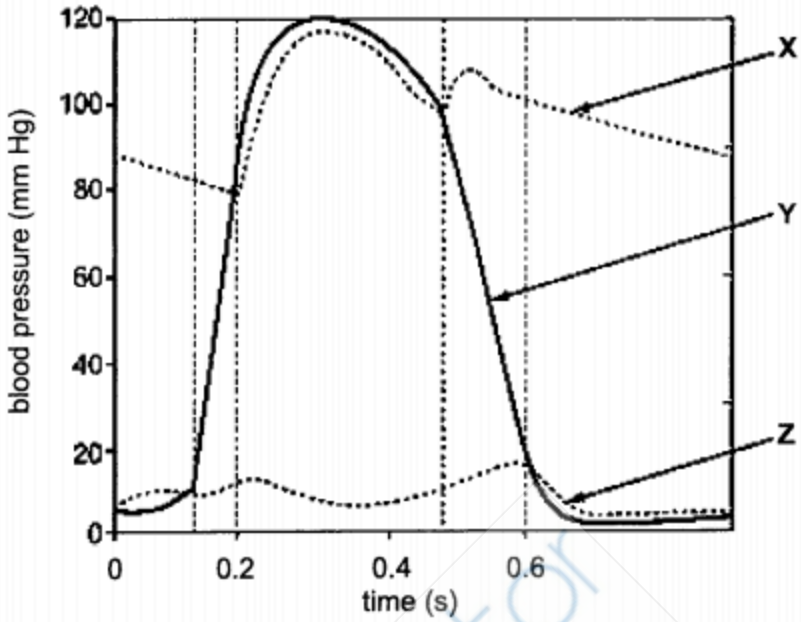


Fig. 3.2

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

left atrium: .....

left ventricle: ..... [2]

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

.....

.....

..... [2]

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

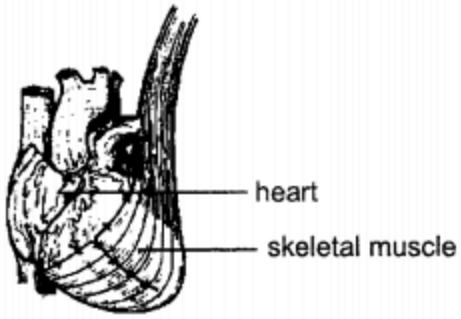


Fig. 3.3

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

Suggest and explain why this tendency is there.

.....

.....

..... [2]

[Total: 9]

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

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

.....

.....

.....

..... [3]

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

.....

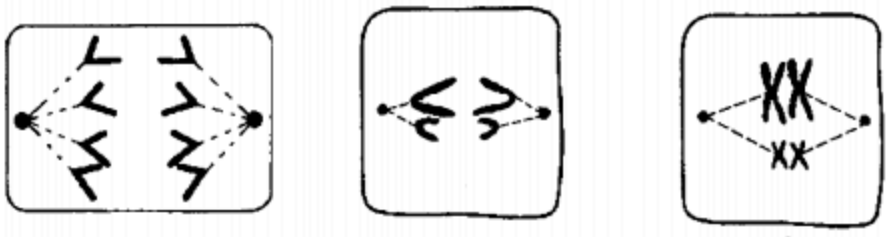
.....

.....

..... [3]

[Total: 6]

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



A B C

Fig. 5.1

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

A: .....

B: ..... [2]

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

.....

.....

.....

..... [2]

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

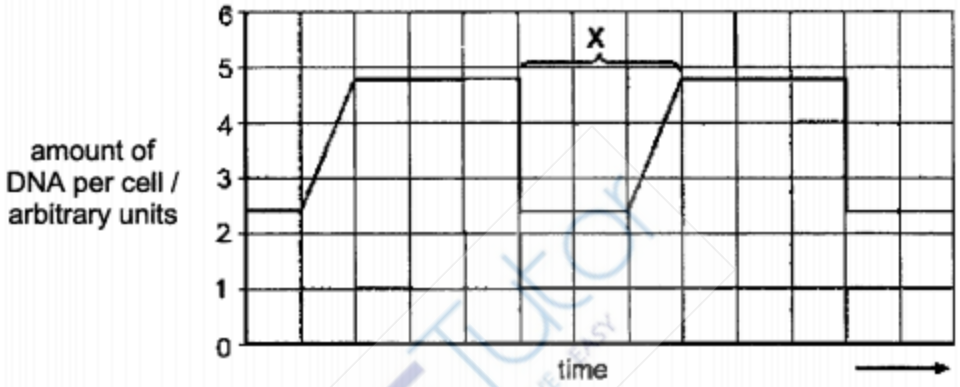


Fig. 5.2

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

.....

.....

..... [2]

[Total: 8]

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

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

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

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

[3]

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

.....

..... [2]

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

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

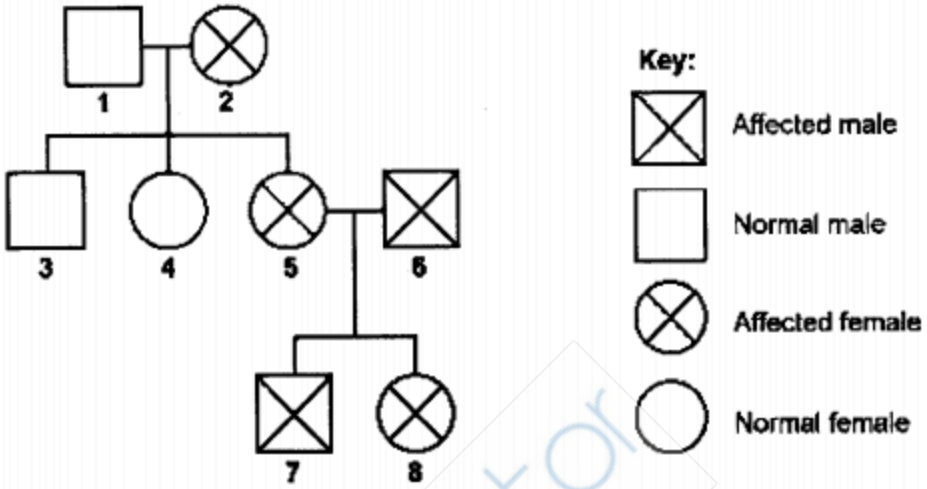


Fig. 6.1

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

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..... [3]

[Total: 8]

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

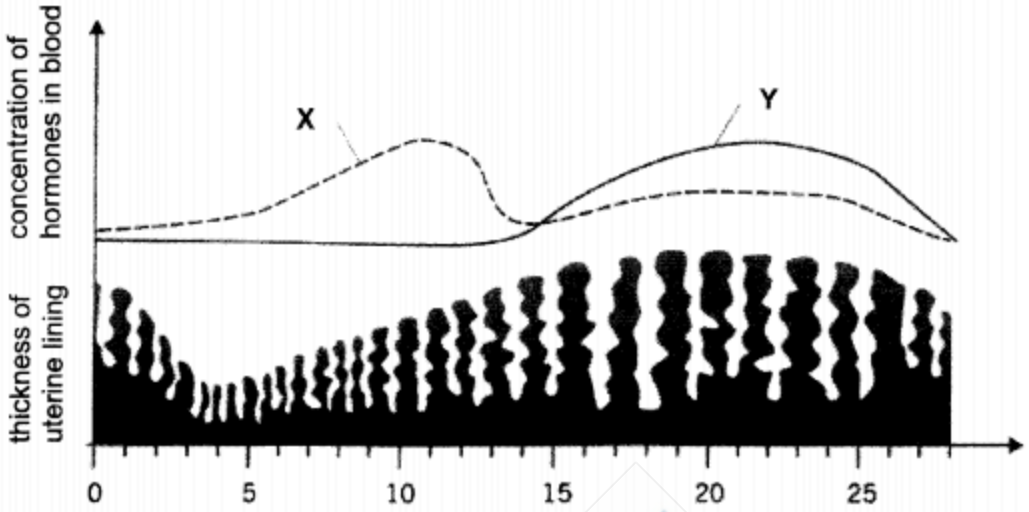


Fig. 7. 1

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

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

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

..... [1]

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

.....

.....

..... [3]

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

Suggest how these pills prevent conception.

.....

.....

..... [2]

[Total: 8]

SECTION B

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

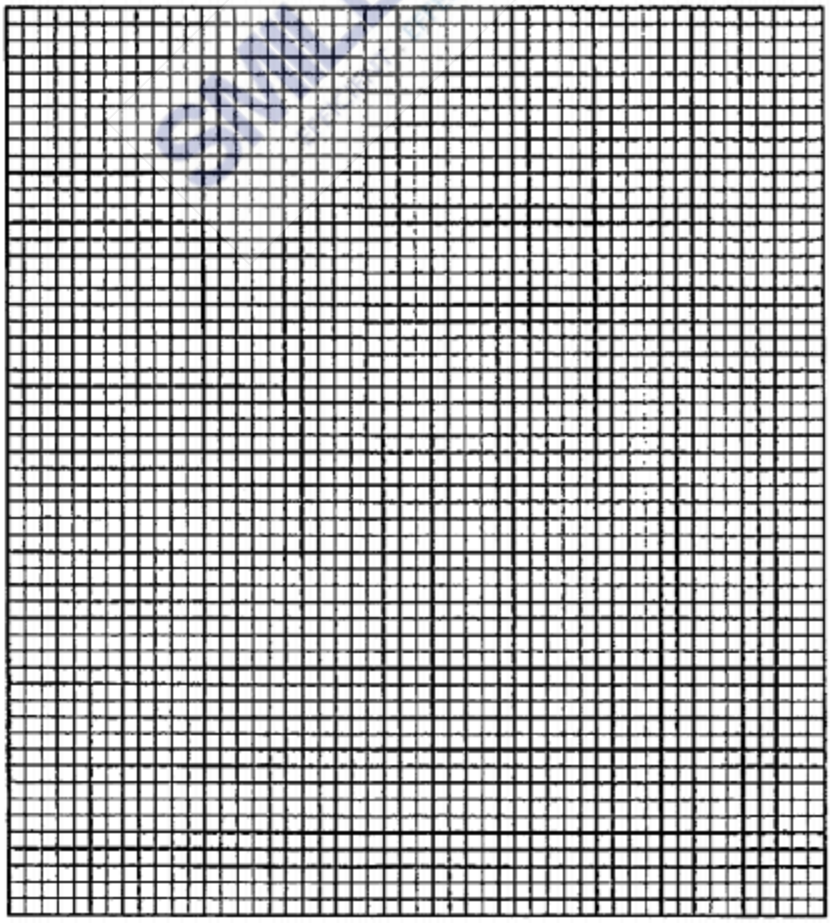
3 Daily insulin injections have been a standard treatment for most patients suffering from type 1 diabetes mellitus. However, repeated injections in the same body area may lead to some scarring and other undesired side effects. Researchers have recently developed a new way of administering insulin –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

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

Table 8.1

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

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



[4]

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

.....

.....

..... [2]

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

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

.....

.....

..... [2]

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

.....

.....

..... [2]

[Total: 10]

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

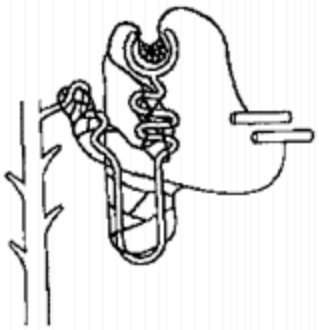


Fig. 9.1

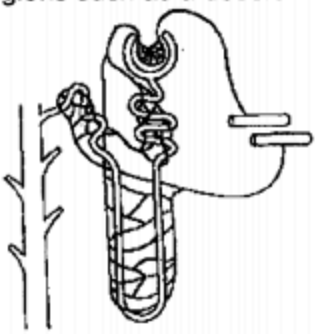


Fig. 9.2

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

.....

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.....

..... [4]

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

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..... [6]

[Total: 10]

10 EITHER

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

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..... [5]

(b) Discuss the advantages and disadvantages of wilting.

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..... [5]

[Total: 10]

10 OR

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

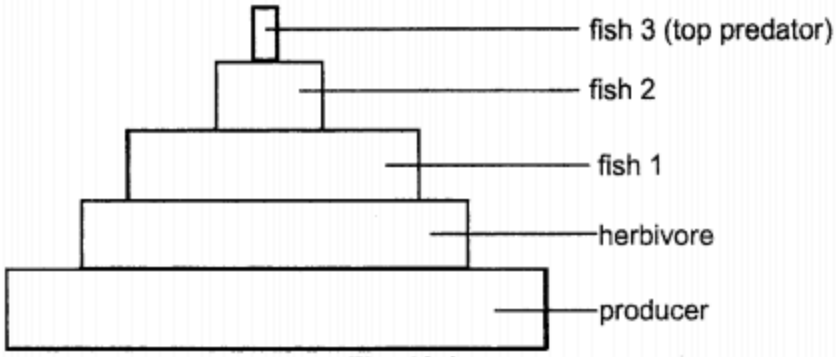

Fig. 10.1

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

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

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.....

.....

..... [4]

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

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..... [2]

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

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.....

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.....

.....

..... **[4]**

[Total: 10]

ANSWER SHEET

Paper 1 [40 marks]

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

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

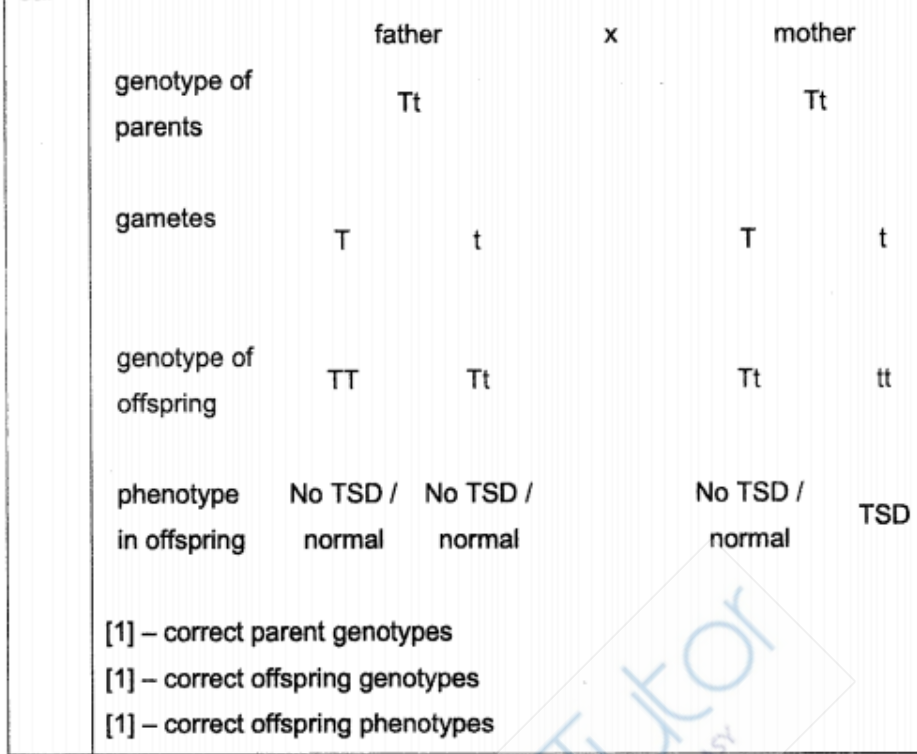
AW alternative wording
A accept
R reject

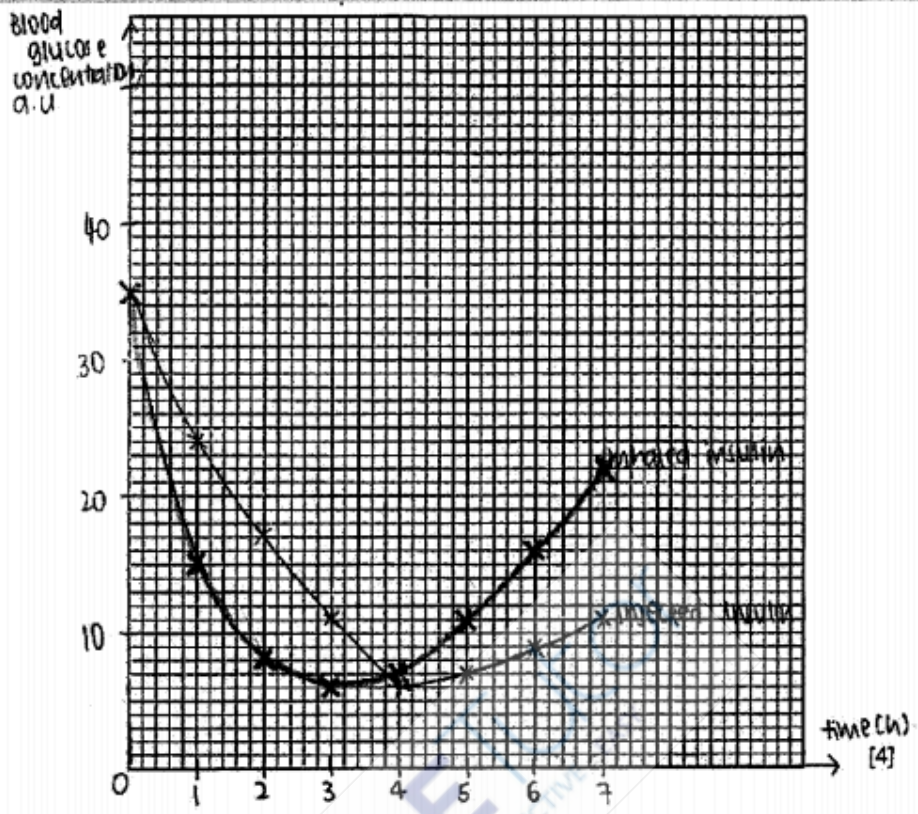
Qn	Section A: Answer [Marks]	Marks
1a	As the concentration of salt solution increase from 0 to 0.70 mol dm^{-3}, the average number of contractions decrease from 112 to 53 contractions per minute. *Relationship + data quote*	2
1b	• At low salt concentrations of 0 or 0.2 mol dm^{-3}, the water potential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

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

4a	• Light intensity increases significantly after the patient leaves the clinic and goes under the sun. • Since the iris muscles is relaxed, the pupil is unable to constrict. • Sunglasses can help to reduce intensity of light entering the eye and avoid damaging the retina/eye.	3
4b	• Ciliary muscles are relaxed / unable to contract • Suspensory ligaments unable to slacken or become taut to vary thickness of lens • Light rays not able to be sharply/accurately focused on retina, causing blurred images to be formed.	3

5ai	**A**: anaphase (mitosis) **B**: anaphase II (meiosis II)	2
5aii	• Cell C undergoes meiosis which produces haploid gametes, important for sexual reproduction which introduces genetic variation • With genetic variation, organisms have different traits and are able to colonise new habitats more effectively • And also survive changes in the environment better *Any two points*	2
5b	• Interphase • Amount of DNA doubled from 2.4 a.u to 4.9 a.u (data quote)	2

6ai	 [1] – correct parent genotypes [1] – correct offspring genotypes [1] – correct offspring phenotypes	3
6aii	• Gene mutation is a change in the nucleotide sequence in a gene. • Radiation / mutagenic chemicals	2
6b	• Recessive allele • Individual 2 is homozygous for the condition hence would pass down the allele responsible for the condition to all her offspring • But only one out of three of her offspring (3, 4, 5) were affected (as offspring heterozygous for the condition were normal) *or* otherwise, a dominant allele would cause all offspring to be affected	3
7a	**X**: estrogen **Y**: progesterone	2
7b	Repairs and thickens the uterus lining	1
7c	• Days 18 – 22 • Progesterone (hormone Y) is at the maximum level and the uterine lining is the thickest • This enables embryo to implant in the uterine wall firmly to receive nutrients and oxygen from the mother	3
7d	• Ovulation is prevented • Egg is not released into oviduct to be fertilised after sperms are ejaculated into the vagina	2

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

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

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

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

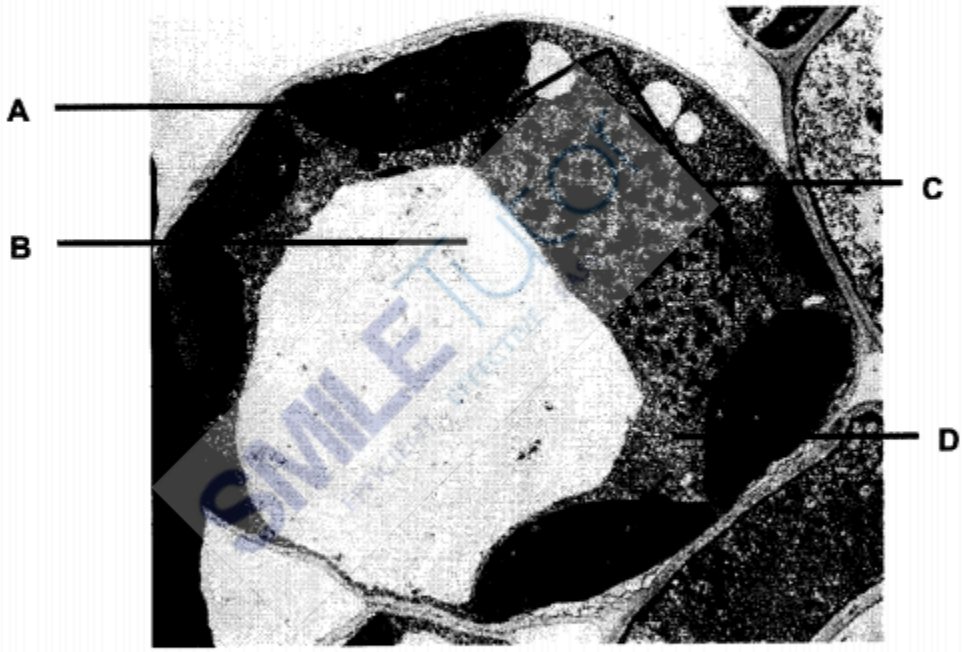
CHRIST CHURCH SECONDARY SCHOOL SA2 PAPER

1 Which structure is found **only** in plant cells?

A endoplasmic reticulum
B Golgi body
C large vacuole
D mitochondria

2 The diagram shows an electron micrograph of a plant cell.

Which labelled structure is the site of protein synthesis?



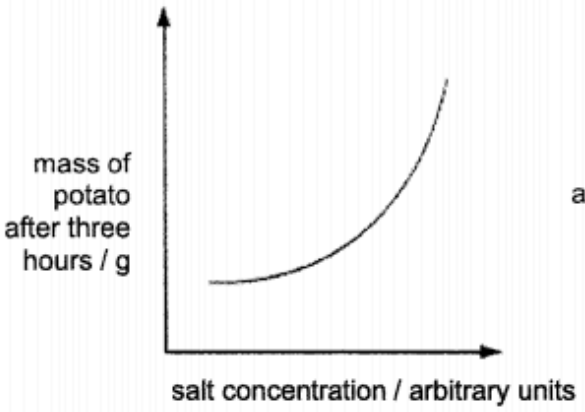
3 Which of these activities **cannot** be performed by a red blood cell?

A DNA replication
B release of oxygen
C respiration
D uptake of glucose

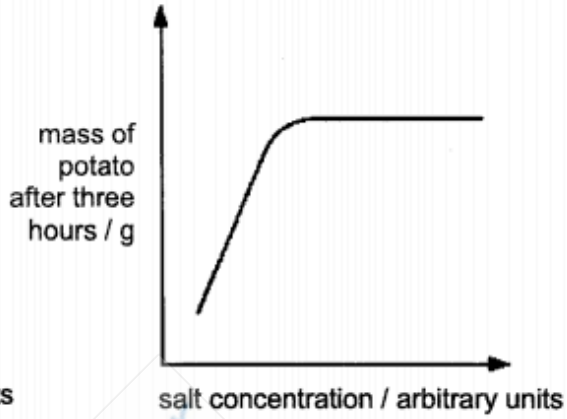
4 Identical pieces of potato are placed in salt solutions of different concentrations. After three hours, the mass of each piece of potato is measured.

Which graph shows the results of the experiment?

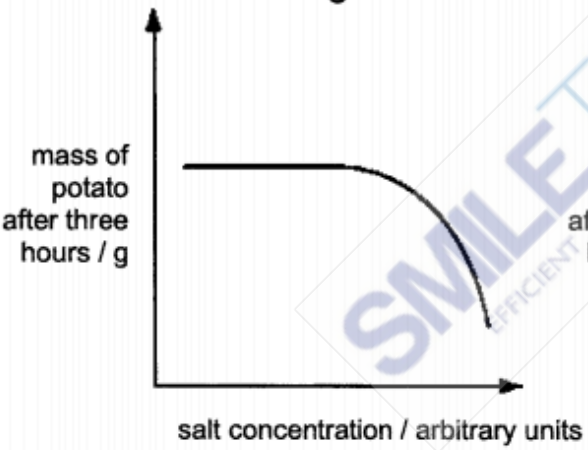
A



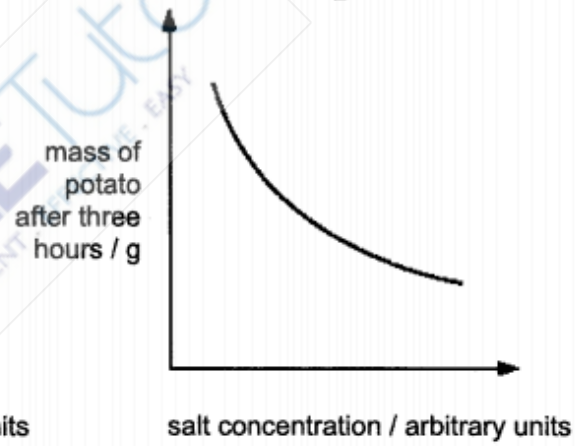
B



C



D



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

1. The shape of the active site changes when the temperature falls to 10 °C and does not return to its original shape when the temperature returns to 37 °C.

2. The active site of an inactive enzyme has a different shape as the substrate molecule.

3. The specificity of the enzyme depends on the shape of its active site.

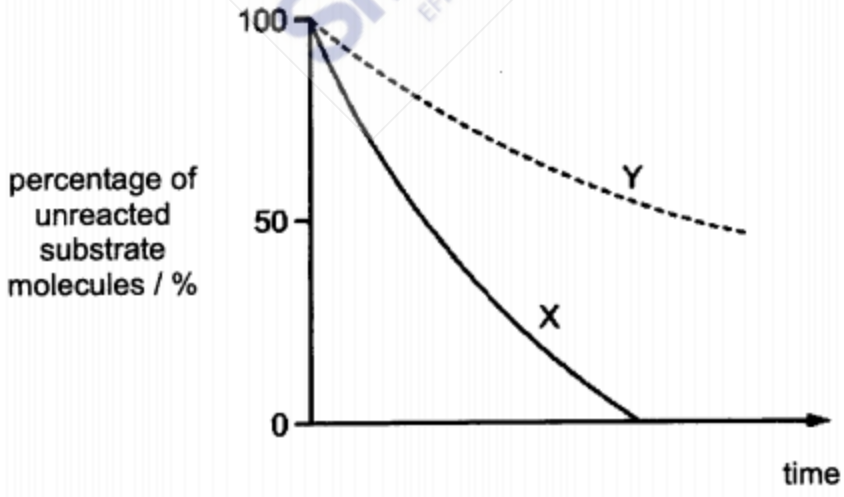
4. The shape of the active site changes when the enzyme is heated to 60 °C and does not return to its original shape when the temperature returns to 37 °C.

Which statements are correct?

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

6 Line X shows the entire course of an enzyme-catalysed reaction under optimal conditions.

The experiment was repeated with one variable changed. The results are represented by line Y.

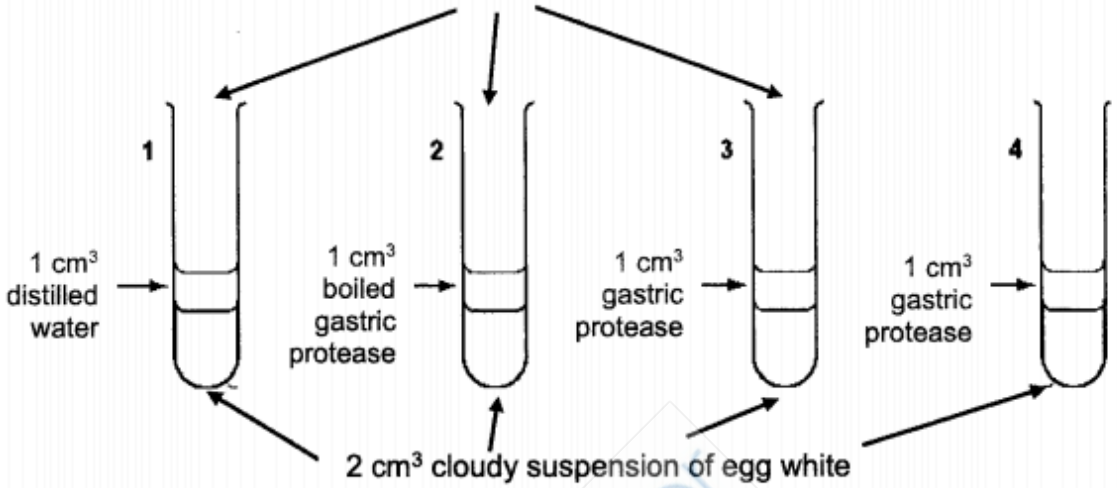


Which change in variable could give the results shown by line Y?

A decrease in enzyme concentration
B increase in enzyme concentration
C decrease in substrate concentration
D increase in pH

7 Four test-tubes were set up as shown. Fine particles of egg white protein were mixed with distilled water to make a cloudy suspension.

5 drops of dilute hydrochloric acid are added to tubes **1**, **2** and **3**.

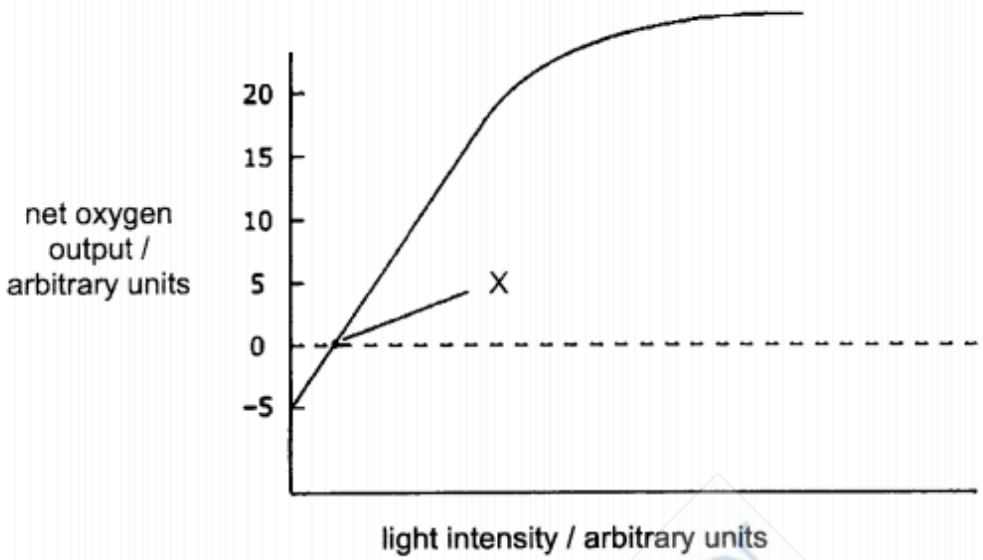


The contents of all four tubes were stirred and the tubes were then placed in a water bath at 37 °C for 20 minutes.

Which is the expected result?

	tube number			
	1	**2**	**3**	**4**
A	clear	clear	clear	clear
B	clear	cloudy	cloudy	clear
C	cloudy	cloudy	clear	cloudy
D	cloudy	cloudy	cloudy	clear

8 The graph shows the effect of changing light intensity on the rate of oxygen absorption or release by green plants.

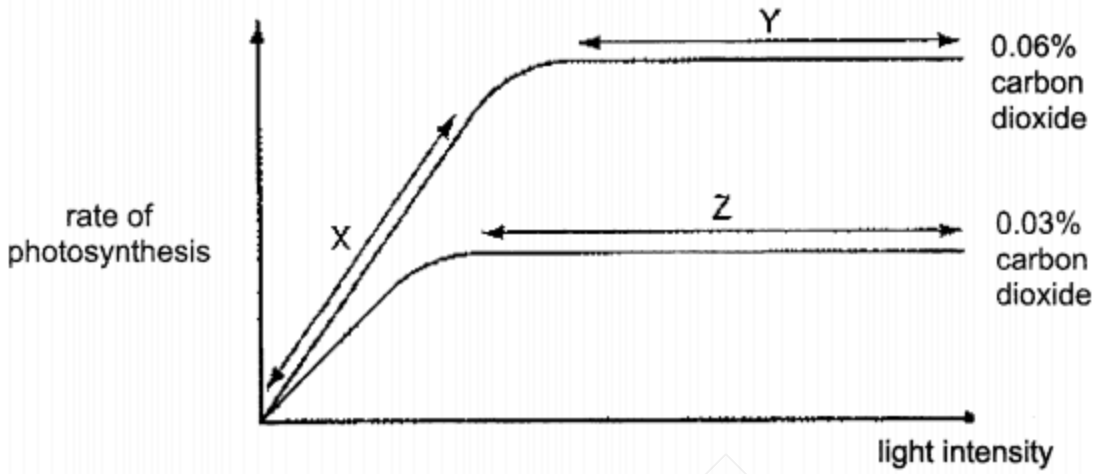


Which statements is / are correct?

1. Before X, the photosynthetic rate is less than the respiratory rate.
2. Before X, no oxygen is produced.
3. At X, only respiration is occurring.
4. After X, oxygen is not taken in.

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

9 The graph shows the rate of photosynthesis of a plant at increasing light intensities at two different carbon dioxide concentrations. The temperature is kept constant.



What may be limiting the rate of photosynthesis at X, Y and Z?

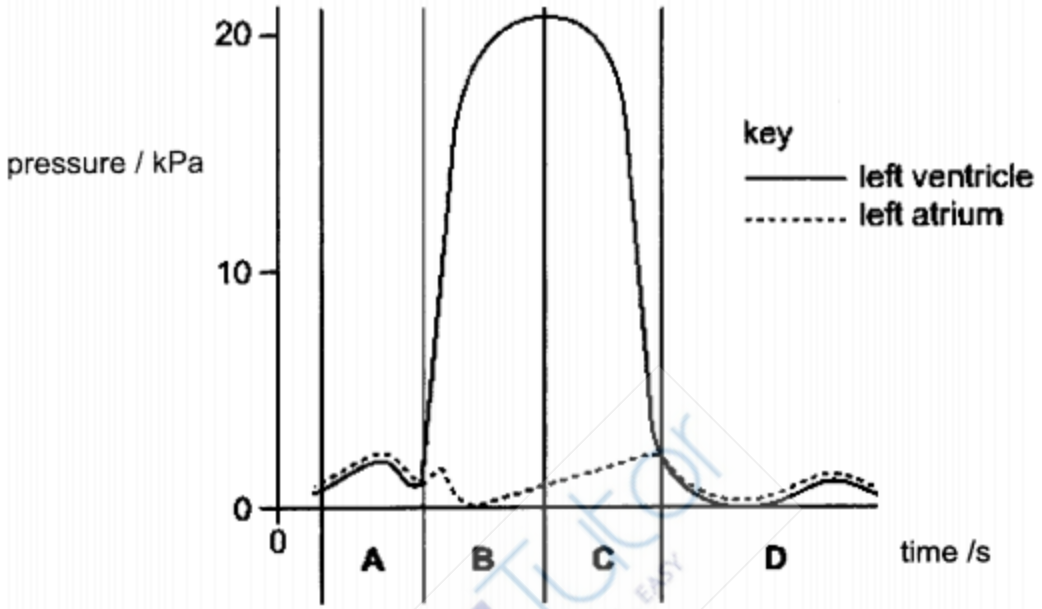
	X	Y	Z
A	carbon dioxide	light intensity	carbon dioxide
B	carbon dioxide	light intensity	light intensity
C	light intensity	carbon dioxide	carbon dioxide
D	light intensity	carbon dioxide	light intensity

10 Which process is an example of assimilation?

A formation of chromosomes from chromatin
B formation of glycogen from glucose molecules
C formation of sweat from blood plasma
D formation of urea from amino acids

11 The graph shows pressure changes in the left ventricle and the left atrium during one heartbeat.

During which period of time is the atrial systole?



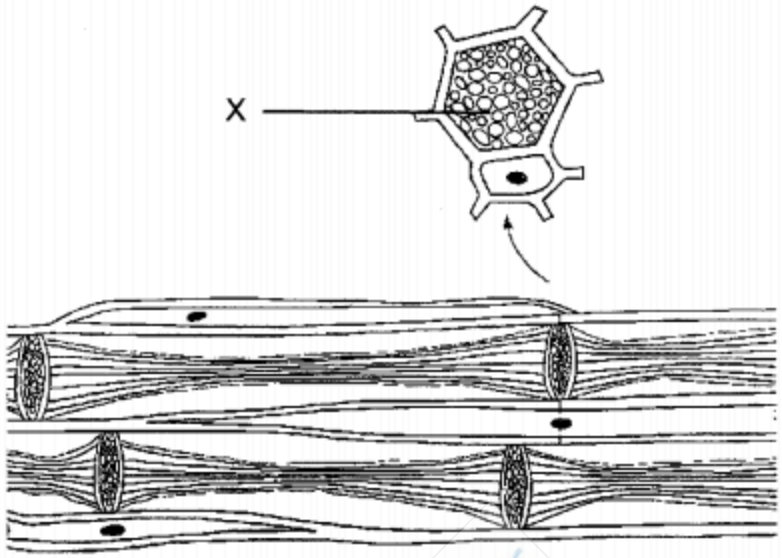
12 Which factor does **not** lead to an increased risk in coronary artery occlusion?

A diet rich in sugar
B having an allergic reaction to pollen
C increased stress at work
D smoking

13 What would likely happen if a mutation causes the leaves of a plant to have no film of moisture around their mesophyll cells?

A the leaf will wilt due to a lack of water
B oxygen in the intracellular air spaces will take a longer time to diffuse into the mesophyll cells
C carbon dioxide in the mesophyll cells will be able to diffuse into the intracellular air spaces at a faster rate
D capillary action in the leaves' xylem vessels will be stronger

14 The diagram shows a tissue in the vascular bundle of a plant.



How is cell X adapted for its function?

A thin cytoplasm to allow for faster flow of food
B hollow with no cross wall to allow for faster flow of food
C lignified cell wall to provide support for the plant
D has a lot of mitochondria to produce energy for surrounding cells

15 Which statement describes what causes water to move through the stem of a plant?

A It is moving from an area of lower water potential to an area of higher water potential.
B It is pulled up by the loss of water from the leaves.
C It is pushed by water being pumped up through the phloem.
D It is replacing water constantly used in photosynthesis.

16 Which part of a red blood cell is carbonic anhydrase found in?

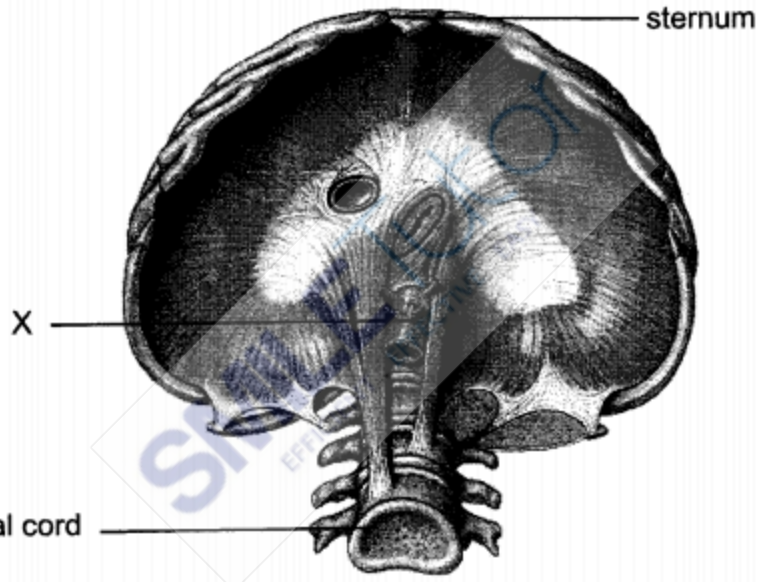
A cytoplasm
B mitochondria
C nucleus
D ribosome

17 'Forgotten baby syndrome' is the failure to remember that one's baby is in the car. This usually leads to the baby dying due to the accumulated amounts of carbon monoxide within the stationary car.

Which is the most likely effect of carbon monoxide that causes death in such scenarios?

A carbon monoxide increases the rate of artherosclerosis
B carbon monoxide binds to haemoglobin more efficiently than oxygen
C carbon monoxide damages the lining of blood vessels
D carbon monoxide leads to emphysema

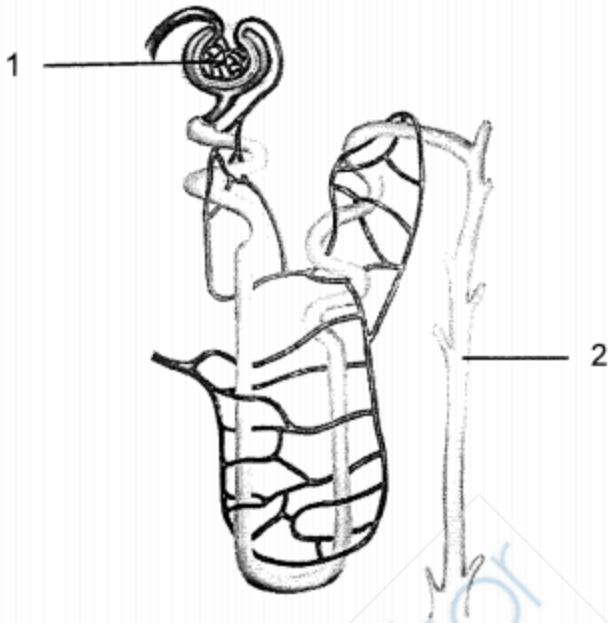
18 The diagram shows a view of the diaphragm from the bottom of the rib cage.



What is X?

A aorta
B oesophagus
C pulmonary vein
D vena cava

19 The diagram shows a nephron.



At which site does the anti-diuretic hormone have its effect and what effect does it have?

	site	effect
A	1	less water reabsorbed
B	1	more water reabsorbed
C	2	less water reabsorbed
D	2	more water reabsorbed

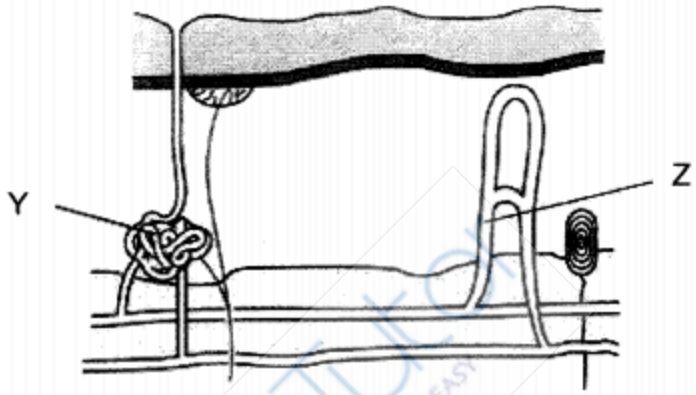
20 Which row correctly identifies the component(s) found in the glomerulus, loop of Henle and collecting duct of a healthy human nephron?

	glomerulus	loop of Henle	collecting duct
A	blood cells, urea	water, urea	glucose, urea
B	blood cells, urea	glucose, urea	blood cells, urea
C	blood cells, proteins	water, urea	water, urea
D	blood cells, proteins	glucose, urea	water, urea

21 What is meant by negative feedback?

A A change away from a set point causes a change back towards the set point.
B A change away from a set point causes further change away from the set point.
C A change towards a set point causes a change away from a set point.
D Changes away from a set point are prevented.

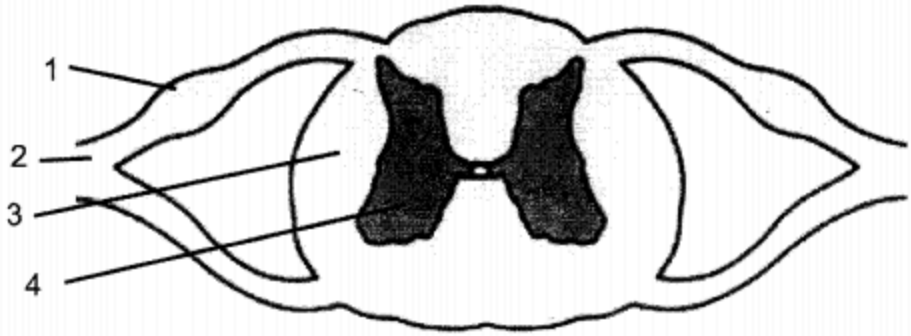
22 The diagram shows some structures in human skin.



Which labels describe the structures Y and Z in cold conditions?

	Y	Z
A	active	constricted
B	active	dilated
C	inactive	constricted
D	inactive	dilated

23 The diagram shows a longitudinal section of the human spinal cord.



Which region contains cell bodies of neurones?

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

24 An eye detects an object flying towards it. Receptors send information to the brain which causes the muscles in the eyelids to close the eyelids.

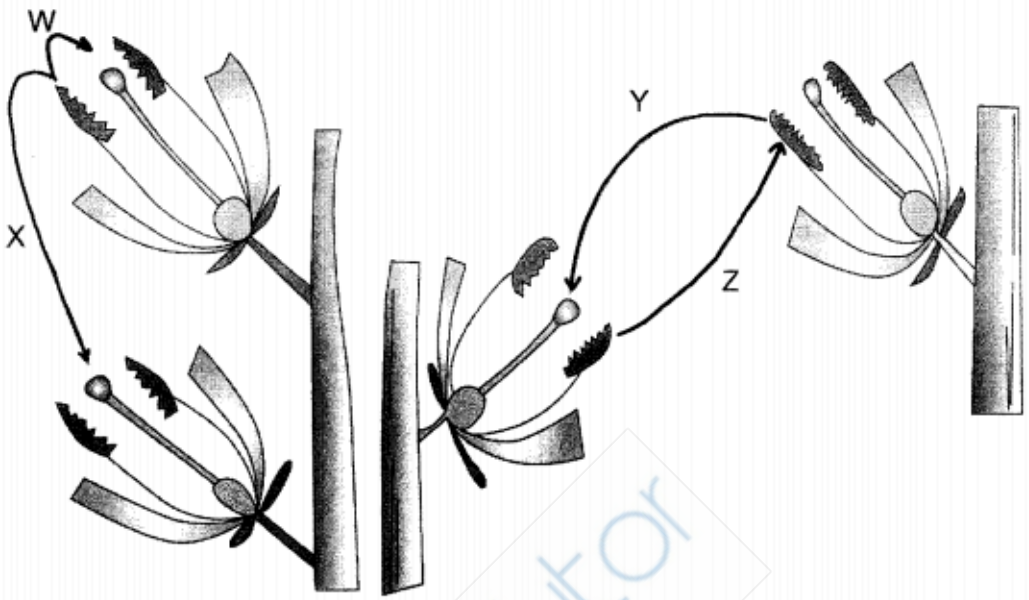
Which statement is correct for this response?

A The location of the receptor is the retina.
B The motor neurone transmits the impulse from the receptor to the brain.
C The sensory neurone transmits the impulse from the brain to the eyelids.
D Only relay neurones are involved in this response.

25 When the eye is focused on far objects, which of the following sequences gives the correct state of the lens, ciliary muscles and suspensory ligaments?

	lens	muscle	ligament
A	most convex	relaxed	slackened
B	least convex	contracted	slackened
C	least convex	relaxed	taut
D	most convex	contracted	taut

26 The diagram shows flowers on three plants of the same species. The distribution of their pollen grains by various pollinators are represented by the four arrows, W, X, Y and Z.

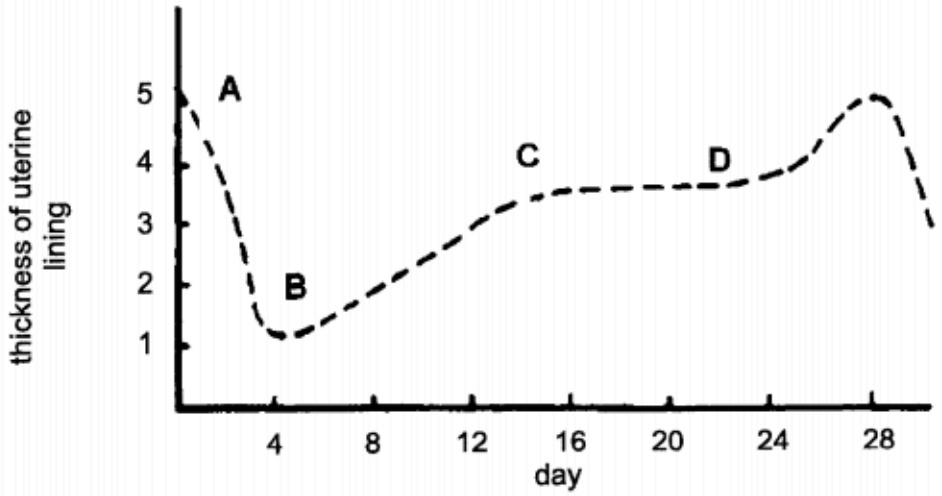


Which arrow(s) are classified correctly?

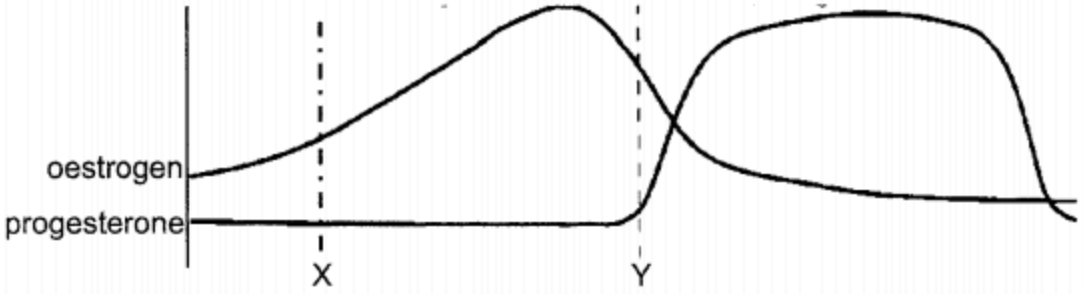
	self-pollination	cross-pollination
A	W	X and Y
B	W and X	Y
C	W and X	Y and Z
D	Y and Z	W and X

27 The diagram shows the variation in the thickness of the uterine lining of a female over 28 days.

Which point best represents the fertile period of the female?



28 The diagram shows the relationship between oestrogen and progesterone in the blood of a female over a period of time.



What happens at point X and point Y?

	X	Y
A	menstruation	ovulation
B	menstruation	repair of endometrium
C	repair of endometrium	menstruation
D	repair of endometrium	ovulation

29 The diagram shows a cell undergoing meiosis.

Which cell correctly shows the resultant daughter cell produced at the end of meiosis?

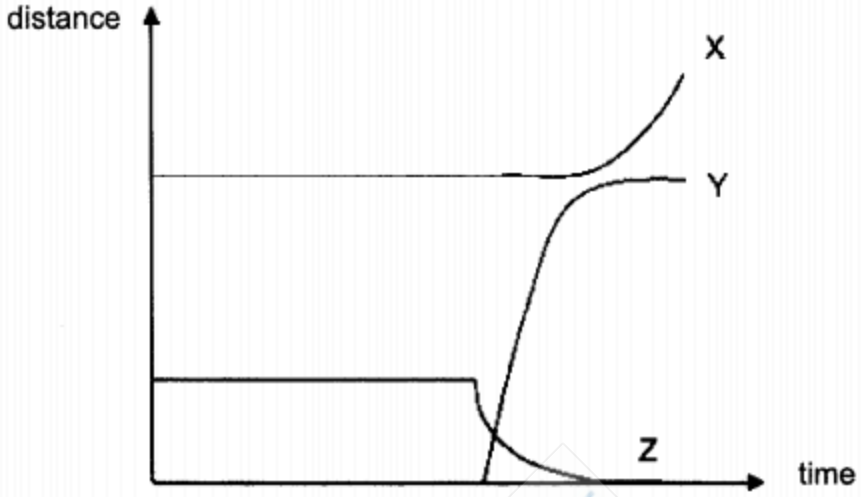
A

B

C

D

30 The graph shows various measurements taken in a cell, during mitosis, from metaphase onwards.



Which row correctly identifies each graph?

	X	Y	Z
A	distance between poles of spindle	distance between sister chromatids	distance between pole and connected centromere
B	distance between poles of spindle	distance between pole and connected centromere	distance between sister chromatids
C	distance between sister chromatids	distance between poles of spindle	distance between pole and connected centromere
D	distance between pole and connected centromere	distance between poles of spindle	distance between sister chromatids

31 Which process contributes to variation in humans?

A crossing over between non-sister chromatids
B DNA replication
C independent assortment of homologous chromosomes
D random fertilisation

32 Which property does **not** correctly represent homologous chromosomes?

A same allele
B same gene
C same gene loci
D one from maternal side and one from paternal side

33 The chromosomes in four human cells are examined.

Which is an example of chromosome mutation?

	total number of chromosomes	number of X chromosomes	number of Y chromosomes
A	23	0	1
B	23	1	0
C	46	1	2
D	46	2	0

34 Bacteria can be used to produce human insulin.

Some stages involved in the transfer of the gene responsible for insulin production from a human to a bacterium are listed.

1. Cut the gene from the human chromosome.
2. Identify the gene controlling insulin formation.
3. Extract and purify the human insulin from the mixture in the fermenter.
4. Transform the bacteria with the recombinant plasmid.
5. Allow the transgenic bacteria to reproduce in a fermenter.

What is the correct sequence of the stages?

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

35 Where do transcription and translation occur in cells?

	transcription	translation
A	nucleus	nucleus
B	cytoplasm	cytoplasm
C	cytoplasm	nucleus
D	nucleus	cytoplasm

36 Which concept of heredity can the human ABO group **not** be used as an example to explain?

A codominance
B heterozygous
C mutation
D multiple alleles

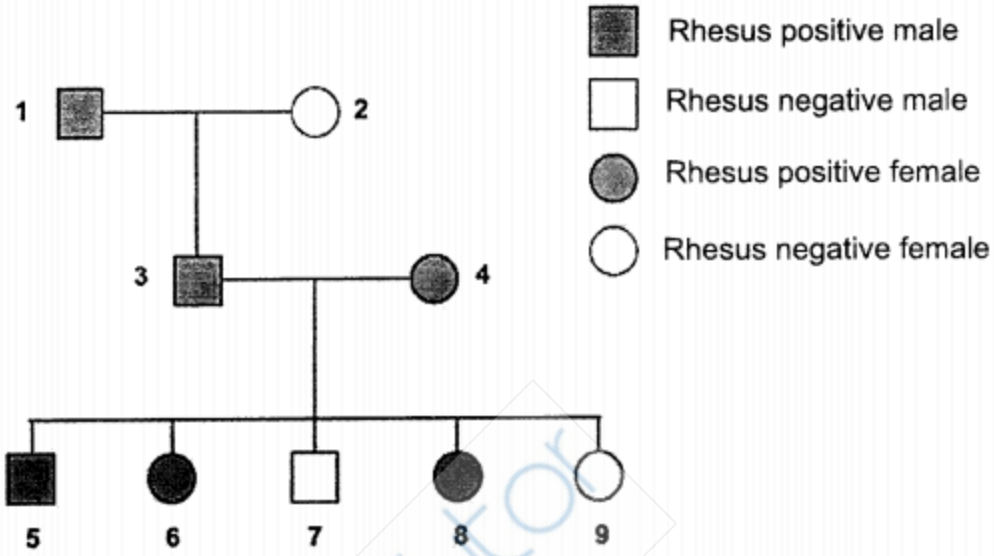
37 A species of rabbit has the length of their tail controlled by the alleles T and t. Rabbits with genotype TT have long tails and those with genotype Tt have short tails. Rabbit zygotes with genotype tt do not grow into an embryo.

Two heterozygous rabbits mate.

What proportion of their live offspring will be heterozygous?

A 25%
B 50%
C 67%
D 100%

38 The Rhesus blood group is genetically controlled. The gene for the Rhesus blood groups has two alleles. The allele for Rhesus positive, R, is dominant to that for Rhesus negative, r. The diagram shows the inheritance of the Rhesus blood group in one family.



What is likely to be the genotype of individual 9?

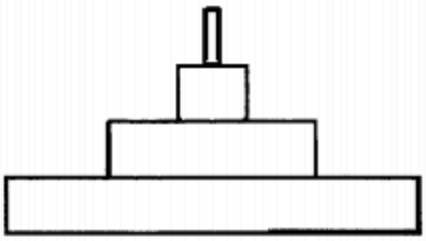
A RR
B Rr
C rr
D cannot be determined

39 A food chain is shown below.

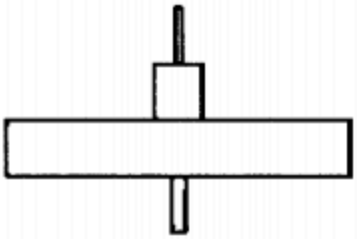
tree → caterpillars → birds → snakes

Which diagram represents a pyramid of energy for the food chain?

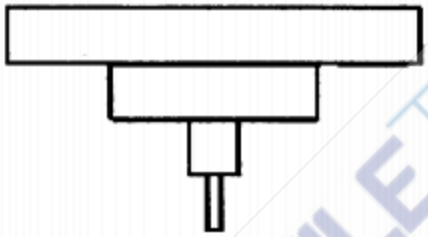
A



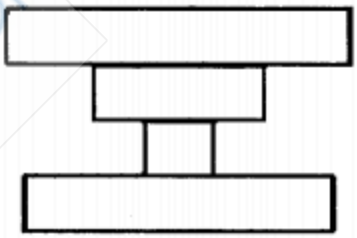
B



C



D



40 When nitrates enter a lake, they cause rapid growth of algae on the surface of the water.

1. Fish and other aquatic animals die.
2. Producers die and decomposition increases.
3. The concentration of dissolved oxygen in the water decreases.
4. There is an increase in aerobic respiration by decomposers.

Which of the above are possible consequences?

A 2 only
B 1 and 3 only
C 2 and 4 only
D all of the above

Section A

Answer **all** questions.

Write your answer in the spaces provided.

1 Fig. 1.1 shows peristalsis in the stomach. The constrictions are represented by the arrows.

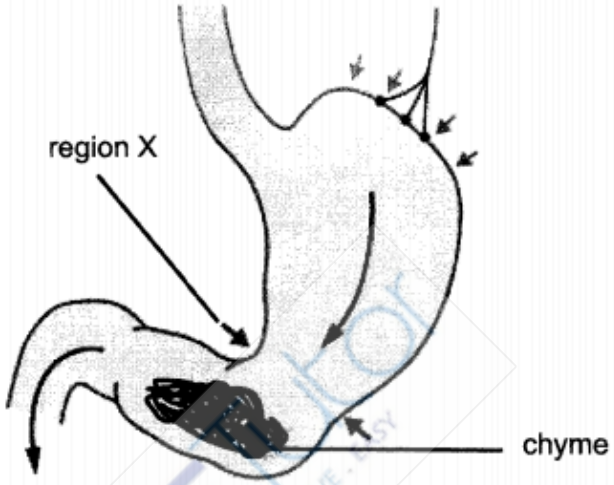


Fig. 1.1

(a) State two functions of peristalsis in the stomach.

.....

..... [2]

(b) Region X is the immediate region behind the chyme.

Describe the action of the muscles in the stomach wall to bring about the constriction in the stomach shown in region X.

.....

..... [1]

(c) Suggest a reason why babies frequently regurgitate their food.

..... [1]

[Total: 4]

2 Fig. 2.1 shows variation in the pressure of blood as it passes through successive blood vessels.

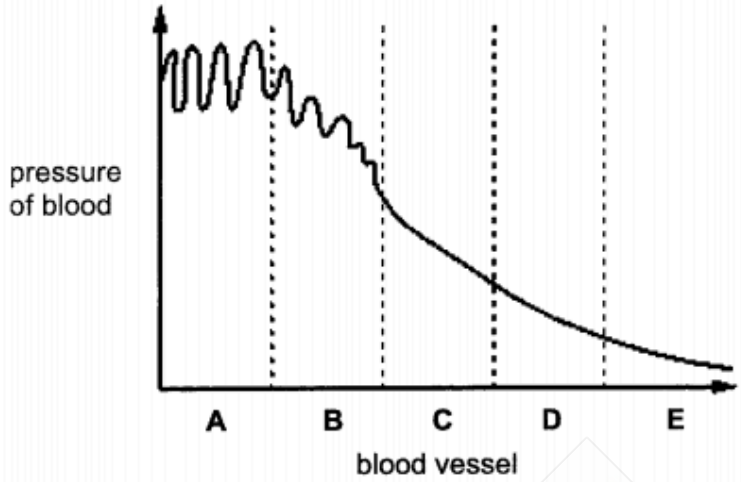


Fig. 2.1

(a) Write the type of each blood vessel next to the correct letter in the table. Choose names from the list below.

vein **artery** **venule** **arteriole** **capillary**

	type of blood vessel
A	
B	
C	
D	
E	

[2]

(b) The hepatic portal vein transports glucose from the duodenum to the liver.

State what happens to the glucose once it reaches the liver.

..... [1]

(c) The hepatic portal vein also transports alcohol to the liver.

Describe how excessive consumption of alcohol could harm the liver.

.....

..... [2]

3 Cactus plants live in hotter and drier parts of the world than money plants.

Fig. 3.1 shows how the size of stomatal openings in these two plants varies during a 24 hour period.

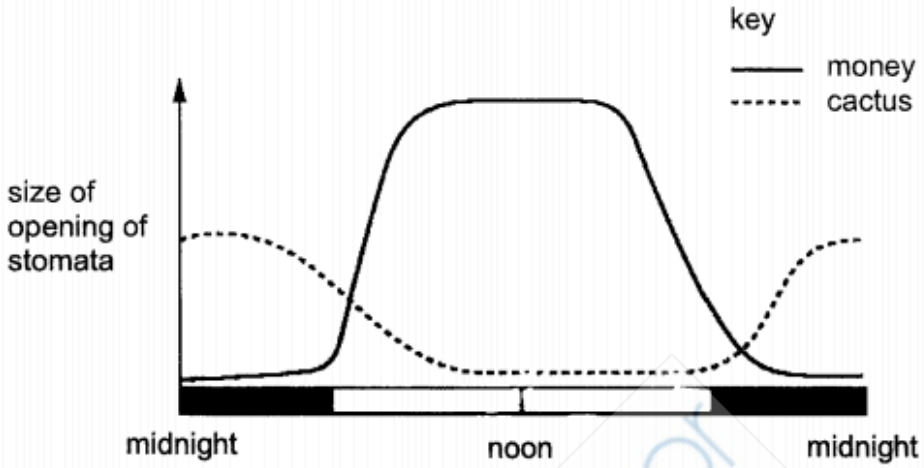


Fig. 3.1

(a) Explain how the presence of sunlight leads to the opening of the stomata in money plants.

.....

.....

.....

.....

.....

..... [3]

(b) Suggest a reason why the cactus plant would want to open their stomata at night.

..... [1]

A student investigated the distribution of stomata in the upper and lower epidermis of plant leaves. Five different plant species were investigated and the results are shown in table 3.1.

Table 3.1

	number of stomata per mm^2	
species	upper epidermis	lower epidermis
A	3	152
B	35	111
C	77	187
D	9	108
E	40	86

(c) (i) Identify a pattern in the data about the distribution of stomata in the five species.

..... [1]

(ii) Using information from table 3.1, predict and explain which species will wilt the fastest if it is not watered for a long period of time.

species .....

explanation ..... [2]

(iii) State an advantage of wilting.

..... [1]

[Total: 8]

4 (a) Explain the role of chlorophyll in photosynthesis.

.....

..... [2]

(b) A young, growing plant was planted in a pot of soil. The parts of the plant that were above the soil were placed in a sealed transparent bag containing radioactive carbon dioxide. It was then left in the light.
After six hours, radioactive carbon was found in the roots and the soil.

Explain the presence of the radioactive carbon in the roots and the soil.

.....

.....

.....

.....

.....

.....

.....

..... [5]

[Total: 7]

5 (a) State the role of the cilia in the trachea.

.....

..... [2]

(b) (i) An inherited genetic condition called primary ciliary dyskinesia causes the cilia in the trachea to have defective function.

Predict what could happen when the cilia lose its function.

.....

..... [2]

(ii) Name a substance in tobacco smoke that has the same effect on the cilia.

..... [1]

6 Fig. 6.1 shows the concentration of glucose in the blood after a patient has an adrenaline injection.

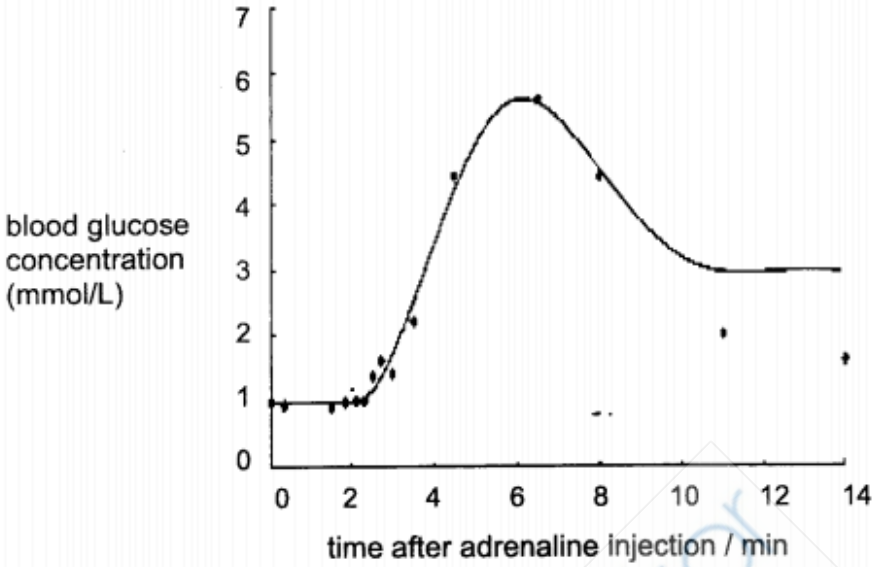


Fig. 6.1

(a) Use data from Fig. 6.1 to describe the effect that adrenaline has on the blood glucose concentration.

.....

.....

..... [2]

(b) Explain what happened to the adrenaline in the blood after 6 minutes.

.....

.....

..... [2]

(c) Adrenaline can be secreted by the human body as well.

State a situation in which adrenaline will be released by the body.

.....

..... [1]

(d) State three differences between nervous control and endocrine control.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 8]

7 Fig. 7.1 shows an embryo attached to the placenta of its mother.

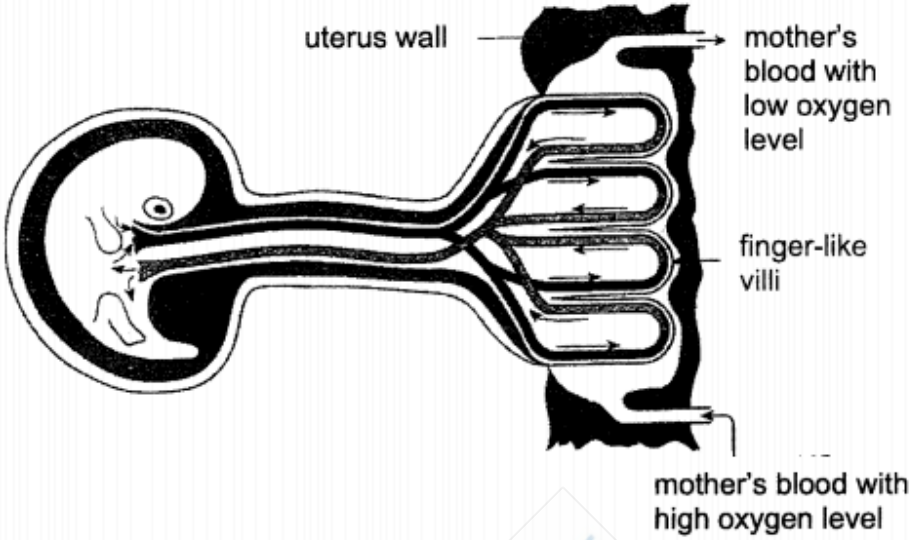


Fig. 7.1

(a) Using Fig. 7.1, explain one way in which the placenta is similar to the small intestine in terms of its structure and function.

.....

.....

..... [2]

(b) The placenta is an endocrine gland.

Name the hormone secreted by the placenta and state its function.

hormone .....

function ..... [1]

(c) Describe the sequence of events after fertilisation to the stage shown in Fig. 7.1.

.....

.....

.....

.....

..... [3]

8 Sickle-cell anaemia is a condition that results in defective red blood cells. It is known to be caused by a change in structure of the haemoglobin gene. The altered gene is recessive.

(a) (i) State the term used to describe a change in gene structure.

..... [1]

(ii) Explain the term recessive.

.....

..... [1]

(iii) A patient with the sickle-cell condition has parents who both do not have it.

Complete the genetic diagram to explain how the above is possible.

Use **Hb^A** to represent the normal haemoglobin allele and **Hb^S** to represent the altered haemoglobin allele.

parental phenotypes	Normal Hb	x	Normal Hb
parental genotypes	.....	x	.....
gametes	....		....
offspring genotypes	....		....

[3]

(b) Explain why sickle-shaped red blood cells carry less oxygen.

.....

..... [2]

[Total: 7]

Section B

Answer **three** questions.

Question **11** is in the form of an **Either/Or** question. Only one part should be answered.

9 Dengue is a disease caused by a virus spread through the bite of an infected *Aedes* species mosquito.

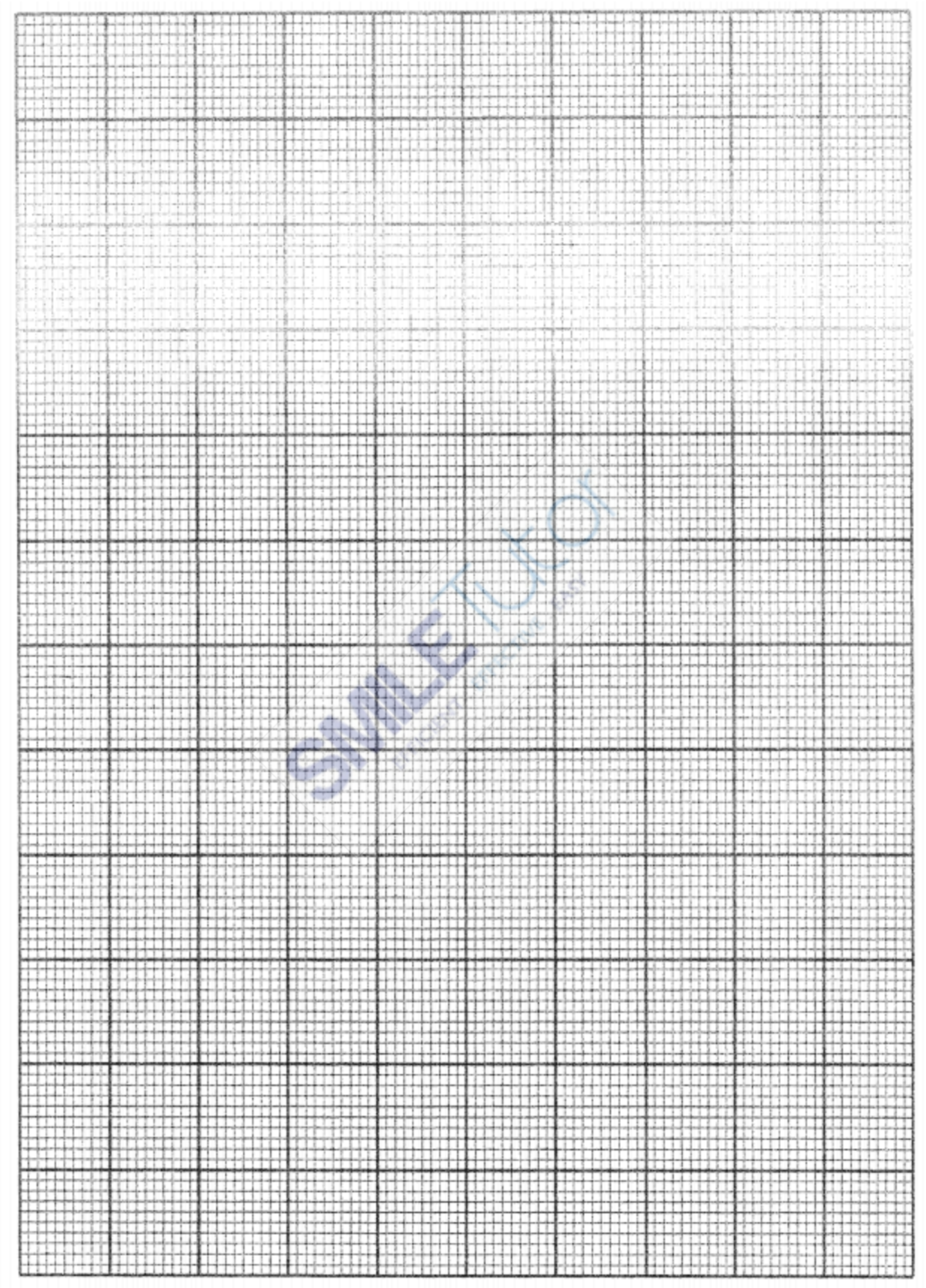
One of the key symptoms of the disease is a decrease in platelet count. Table 7.1 shows the platelet count of an infected patient by day of infection. Platelet count is represented by the number of platelets per litre (L) of blood.

Table 9.1

day of infection	platelet count ($x10^9$ / L)
1	144
2	97
3	90
4	75
5	70
6	56
7	40

(a) Plot of graph of these data and draw a best-fit line.

[4]



(b) On day 4, the doctor advised the patient not to fall because the platelet count was too low.

State a consequence that could ensue if the patient falls.

.....

..... [1]

(c) Describe the role of platelets in protecting the body from infection by pathogens.

.....

.....

.....

.....

.....

..... [3]

(d) Genetically modified (GM) *Aedes* mosquitoes have been released into the wild in an effort to control the mosquito population. These mosquitoes carry a gene that result in female offspring dying before they reach adulthood.

Explain how this could potentially be harmful if the release of GM mosquitoes is not regulated.

.....

.....

.....

..... [2]

[Total: 10]

10 Excretion is the process of removing waste products of metabolism from the body.

(a) Name the main product of metabolism that is excreted from the human body by each organ.

skin .....

lungs ..... [2]

(b) The kidney is one of the main excretory organs of the body. Its smallest functional unit is the nephron.

State the two main functions of the nephron.

1 .....

2 ..... [2]

(c) Fig. 10.1 shows a nephron.

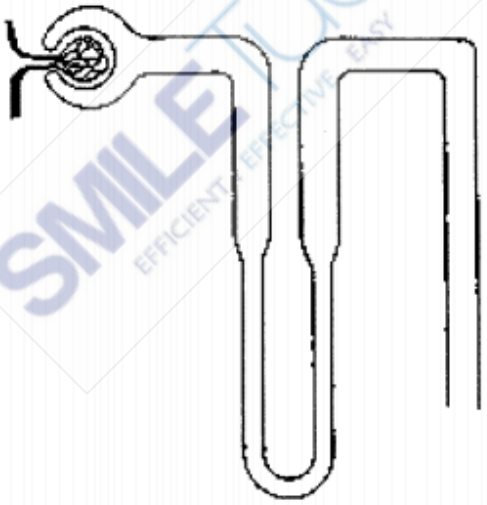


Fig. 10.1

State one way in which Fig. 10.1 does **not** accurately represent the human nephron.

.....

..... [1]

(d) Urinary tract infection (UTI) is caused by a bacteria that infects the urethra and bladder. Fosfomycin is an antibiotic used to kill the bacteria. It is ingested orally.

Explain in detail how Fosfomycin in the small intestine is able to reach the bacteria in the urethra.

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

[Total: 10]

11 Either

Table 11.1 shows the changes in glucose concentration in blood obtained by a healthy person who monitored his glucose levels after ingesting a meal.

Table 11.1

time after a meal / min	glucose levels / mg/dL
0	90
30	151
60	137
90	118
120	105
180	92
240	91

(a) Use the data from table 11.1 to describe how the person's blood glucose changed with time after the meal.

.....

.....

..... [3]

(b) Describe how the blood glucose concentration was returned to normal after the meal.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

(c) Diabetes can be treated by injection of insulin.
Insulin can now also be taken in by breathing it in.
Suggest how insulin taken by breathing it in enters the blood.

.....

.....

..... [2]

[Total: 10]

11 Or

A student investigated the flow of biomass and energy on a farm. The farm grows wheat and harvests the wheat as animal feed, to feed to the animals, which are kept in sheds where they are not allowed to move a lot.

The student investigated the efficiency of this method of producing food for humans. The food chain is shown below.

wheat → animal → human

Table 11.1 shows the results of the investigation.

Table 11.1

area of wheat field / m^2	250
energy from the sun that is available to the wheat crop / kJ	90 000 000
biomass of animal feed from the harvested wheat crop / kg	140
energy in 140 kg of animal feed / kJ	2 000 000
increase in mass of animals fed 140 kg feed / kg	50
energy in 50 kg meat that could be transferred to humans / kJ	380 000

(a) Table 11.1 shows how much energy 140 kg of animal feed has.

Suggest three reasons why only a small proportion of that energy is available to be transferred to humans.

1 .....

.....

2 .....

.....

3 .....

..... [3]

(b) Calculate the energy in the meat that could be transferred to humans, as a percentage of the energy in the animal feed. Show your working.

answer ..... % [2]

(c) Using information from table 11.1, explain why it is more efficient for humans to consume food from the first trophic level, rather than from the second trophic level.

.....

.....

.....

..... [3]

(d) Another student in another city repeated the investigation using the same species of animals and obtained different results.

Suggest two reasons for the different set of results obtained.

1 .....

.....

2 .....

..... [2]

[Total: 10]

ANSWER SHEET

Paper 1 [40 marks]

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

Paper 2 Section A [50 marks]

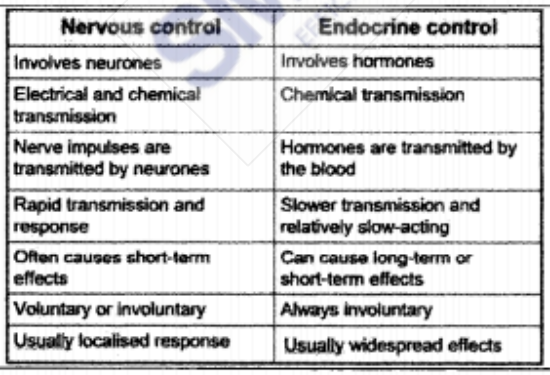
		Answer	Remarks	Marks
1	(a)	Mix the bolus with hydrochloric acid and enzymes Push the chyme into the small intestine		2
	(b)	Circular muscles contract Longitudinal muscles relax	Both correct – 1m	1
	(c)	Gut muscles not fully developed Weaker peristalsis Stomach too small	Any 1	1
Total				4

		Answer	Remarks	Marks
2	(a)	A – artery B – arteriole C – capillary D – venule E – vein	0-2 correct – 0m 3-4 correct – 1m	2
	(b)	Used for respiration Excess converted to glycogen for storage Excess converted to fats for storage	Any 1	1
	(c)	Causes liver cirrhosis / hardening of liver to eventually lead to liver cancer		2
Total				9

		Answer	Remarks	Marks
3	(a)	1. Guard cells photosynthesise 2. increase in sugar / uptake of k+ ions 3. leads to decrease in water potential in guard cells 4. water molecules move into guard cells by osmosis 5. guard cells become more turgid 6. and more curved as a result of their uneven cell wall	Any 2 + point 6	3
	(b)	Maximise transpiration pull to draw in more water through the roots Allow for gaseous exchange to take place.	Any 1	1
	(c)(i)	There is a greater density / number of stomata in the lower epidermis than upper epidermis.	OWTTE	1
	(c)(ii)	species C it has the greatest density / number of stomata		2
	(c)(iii)	It reduces rate of transpiration and photosynthesis It reduces water loss	Any 1	1
Total				8

		Answer	Remarks	Marks
4	(a)	absorb light energy convert it into chemical energy		2
	(b)	radioactive carbon dioxide diffuses into the leaves used in photosynthesis incorporated into sucrose for transport / translocation to the roots root cells respire, using the radioactive glucose to produce radioactive carbon dioxide which diffuses into the soil	Any 5	5
Total				7

		Answer	Remarks	Marks
5	(a)	1. They are constantly moving 2. to sweep mucus and foreign particles up from the trachea to the pharynx		2
	(b)(i)	1. mucus and bacteria will flow into the bronchi 2. to cause persistent coughing 3. lung infection / chronic bronchitis	1st point + any 1 other point	1 1
	(b)(ii)	Tar		1
Total				5

		Answer	Remarks	Marks
6	(a)	Adrenaline brings about a 500% increase in blood glucose concentration 6 mins after injection	Reject: no manipulation of data / no mention of time	1 1
	(b)	the adrenaline was transported to the liver by the blood to be broken down and excreted through the kidneys	Any 2	2
	(c)	Danger / excitement	OWTTE	1
	(d)		Any 3 points	3
Total				9

Nervous control	Endocrine control
Involves neurones	Involves hormones
Electrical and chemical transmission	Chemical transmission
Nerve impulses are transmitted by neurones	Hormones are transmitted by the blood
Rapid transmission and response	Slower transmission and relatively slow-acting
Often causes short-term effects	Can cause long-term or short-term effects
Voluntary or involuntary	Always involuntary
Usually localised response	Usually widespread effects

		Answer	Remarks	Marks
7	(a)	1. Villi increases surface area to volume ratio 2. to allow for faster diffusion of substances		2
	(b)	progesterone thickens the uterine lining / recruits blood capillaries	Hormone / function wrong – 0m	1

	(c)	1. zygote 2. a ball of cells (embryo) is formed 3. swept by cilia in the Fallopian tube to the uterus 4. embryo implants in the uterine wall	Any 3	3
Total				6

		Answer	Remarks	Marks
8	**(a)(i)**	mutation		1
	(a)(ii)	an allele that does not express in phenotype if a dominant form is present / an allele that only expresses in phenotype in the homozygous condition		1
	(a)(iii)	Correct parental genotypes $Hb^A Hb^S$ for both Correct gametes Hb^A,, Hb^S, Hb^A, Hb^S Correct offspring genotypes Hb^AHb^A, Hb^AHb^S, Hb^AHb^S, Hb^SHb^S		1 1 1
	(b)	1. Sickle-shaped red blood cells have no biconcave shape / less surface area to volume ratio 2. abnormal haemoglobin 3. rate of oxygen diffusion into them is low	Points 1 + 3 Or Points 2 + 3	2
Total				7

Paper 2 Section B [30 marks]

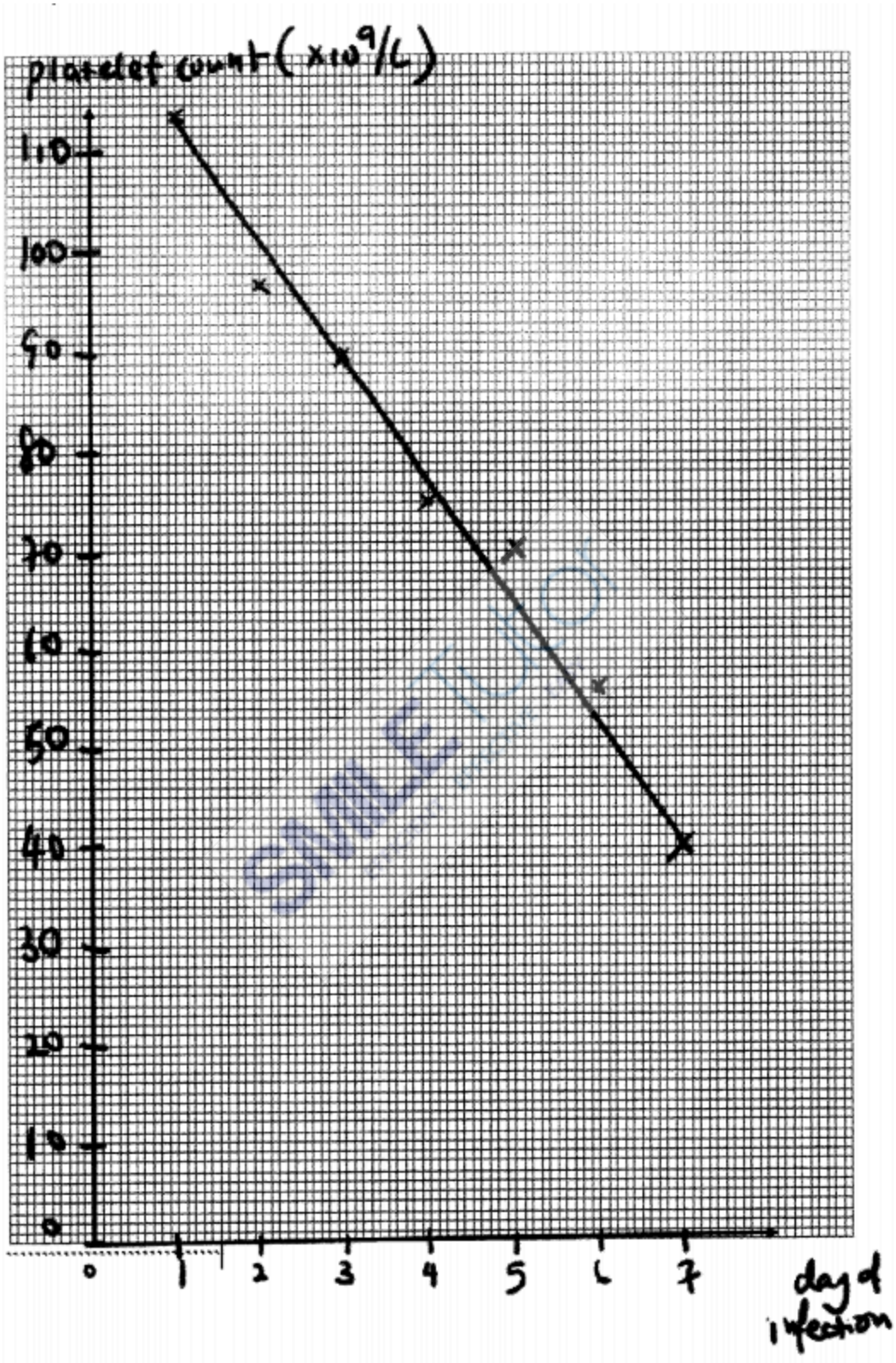
		Answer	Remarks	Marks
9	(a)	S – scale L – best fit line A – axis titles with units P – plotting points		1 1 1 1
	(b)	Bleeding may not stop Internal bleeding may result	Accept other valid points	1
	(c)	1. causes clotting 2. fibrinogen to insoluble fibrin 3. fibres trap cells 4. scab formed 5. prevents entry of pathogens into blood	Any 3	3
	(d)	1. population of mosquitoes will drop drastically 2. resulting in the population of predators of mosquitoes decreasing as well, causing an imbalance in the food web	OWTTE Reject: affect food web / imbalance to food web (if details are not provided)	2
Total				10

		Answer	Remarks	Marks
10	(a)	Skin: urea / excess water / excess salts Lungs: carbon dioxide		1 1
	(b)	1. Excretion 2. Osmoregulation		1 1
	(c)	1. The proximal and distal tubules are not convoluted. 2. Blood capillaries surrounding the nephron tubules are not shown	Any 1 Accept: AVP	1
	(d)	1. Fosfomycin is absorbed into the bloodstream 2. It enters the kidneys via the renal artery 3. Renal artery branches out into the afferent arteriole, which is wider in diameter than the efferent arteriole 4. The high blood pressure pushes the Fosfomycin through the glomerulus of the nephrons 5. in a process called ultrafiltration 6. Fosfomycin is not selectively reabsorbed in the nephron	Any 5	5

		7. It goes through the collecting duct / renal pelvis 8. into the ureter, which leads to the bladder.		
Total				10

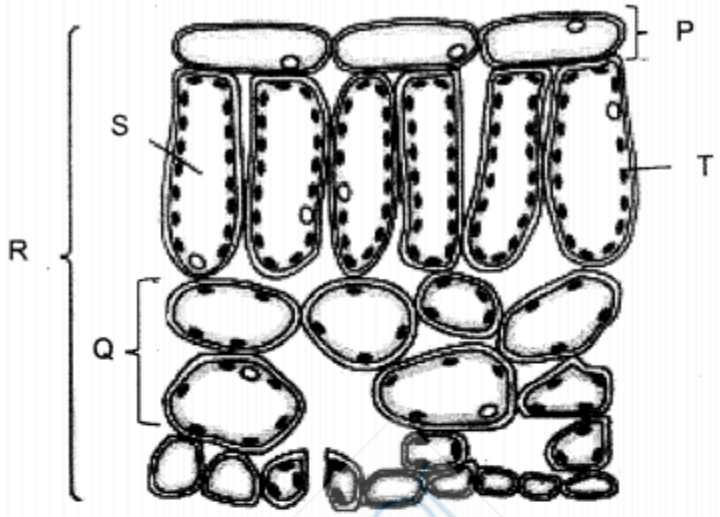
	E	Answer	Remarks	Marks
11	(a)	immediately after the meal, blood glucose levels is at 90 mg/dL	Must quote data from table	1
		there is a steep increase to 151 mg/dL after 30 mins / an increase of 61mg/dL/blood glucose reached a maximum of 151 mg/dL after 30 mins	Include at least 1 manipulation of data, otherwise max 2m	1
		After which, there is a gradual decrease in blood glucose levels to 91 mg/dL after 4 hours / blood glucose level falls from 151 mg/dL to 91 mg/dL / a decrease of 60 mg/dL		1
	(b)	Any 2 1. Blood glucose concentration above the norm is the stimulus 2. detected by receptor cells in the Islets of Langerhans in the pancreas 3. Islets of Langerhans secrete more insulin as a corrective mechanism		1 1
		Any 2 effects of insulin Insulin results in 1. increased permeability of cell membranes to glucose 2. liver and muscle cells converting excess glucose to glycogen for storage 3. increased oxidation of glucose through respiration		1 1
		Blood glucose concentration decreases back to normal as a negative feedback		1
	(c)	1. Insulin vapour will be in higher concentration in the alveoli 2. Insulin will diffuse into capillaries	Reject: diffusion into blood vessel/artery/vein	2
Total				10

	O	Answer	Remarks	Marks
11	(a)	1. not all parts of the animal are consumed by humans 2. energy is used for growth / making proteins / enzymes / reproduction 3. energy required to keep the animal warm / for homeostasis 4. energy lost to surroundings through heat 5. some animals are diseased and not consumed by humans 6. energy lost to decomposers 7. energy lost through excretion / faeces	Any 3 Reject: animal can run around / escape Accept: AVP	3
	(b)	$\frac{380000}{2000000} \times 100\% = 19\%$	Reject: x100% not shown	1 1
	(c)	1. less energy is available at higher trophic levels 2. 2 000 000 kJ available at first trophic level but 380 000 kJ available from second trophic level 3. only 19% of the energy in wheat crop is transferred to humans / 81% lost 4. energy is lost to surroundings as heat	Any 3 Include at least 1 manipulation of data, otherwise max 2m	3
	(d)	1. Area of wheat field used could be different 2. Type of wheat used could be different 3. Different methods of preparing the animal feed	Any 2 Accept: AVP	2
Total				10



COMPASSVALE SECONDARY SCHOOL SA2 PAPER

1 The diagram shows a section through a leaf.



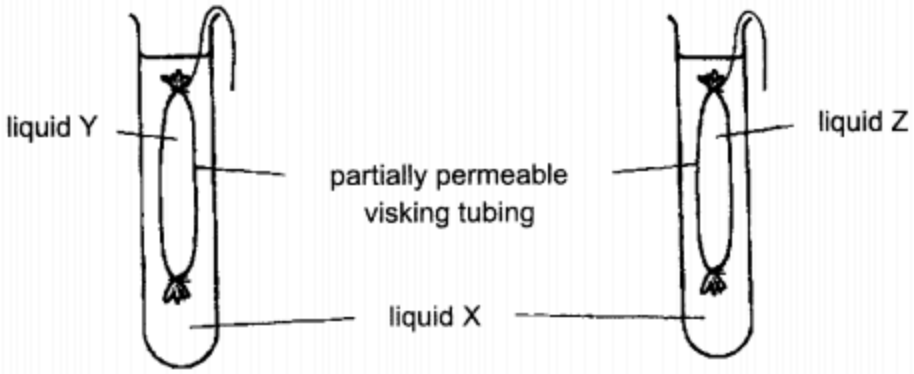
Which shows the correct level of organisation of different parts of the leaf?

	organ	tissue	cell	organelle
A	R	Q	T	P
B	Q	S	P	R
C	R	P	S	T
D	T	Q	S	R

2 Which structure(s) can be seen in a human sperm cell when viewed under a light microscope?

	nucleus	ribosome	mitochondria
A	√	√	√
B	X	X	√
C	√	√	X
D	√	X	X

3 The apparatus was set up as shown in the diagram.



After 30 minutes, the partially permeable tubing containing liquid Y had collapsed while the tubing containing liquid Z was firm.

Which would be a correct description of the liquids at the start of the experiment?

	liquid X	liquid Y	liquid Z
A	10% sucrose solution	water	25% sucrose solution
B	25% sucrose solution	10% sucrose solution	water
C	water	25% sucrose solution	10% sucrose solution
D	10% sucrose solution	25% sucrose solution	water

4 The table shows the rate at which two sugars are absorbed into the lining of the small intestine of a person. The rates are shown for a healthy person and for one who has been subjected to a respiratory poison.

type of sugar	rate of absorption / arbitrary units	
	healthy person	poisoned person
ribose	120	43
raffinose	39	39

Which statement is true?

A Ribose is absorbed by diffusion and active transport.

B Ribose is absorbed by active transport only.

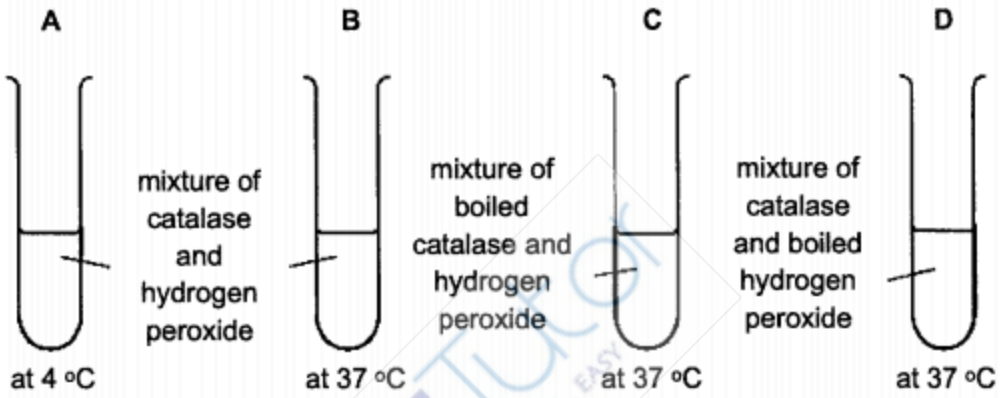
C Raffinose is absorbed by active transport only.

D Both ribose and raffinose are absorbed by diffusion and active transport.

5 Which molecule is **not** made up of glucose?

A cellulose
B glycerol
C glycogen
D starch

6 The diagram shows an experiment on enzyme activity. The test-tubes contain hydrogen peroxide and the enzyme catalase.



In which test-tube is the enzyme inactive?

7 Some statements about the active site of a lipase molecule are listed.

1 It accounts for the specificity of the lipase.
2 It can be used once only.
3 It is altered irreversibly at 10 °C.
4 It lowers the activation energy needed for chemical reactions.
5 It has the same shape in acidic and alkali conditions.

Which statements are correct?

A 1 and 3 only
B 1 and 4 only
C 2, 3 and 5 only
D 2, 4 and 5 only

8 Which of the following explains the importance of chemical digestion?

A to speed up the rate of enzyme action

B to build up large insoluble molecules from small and soluble molecules

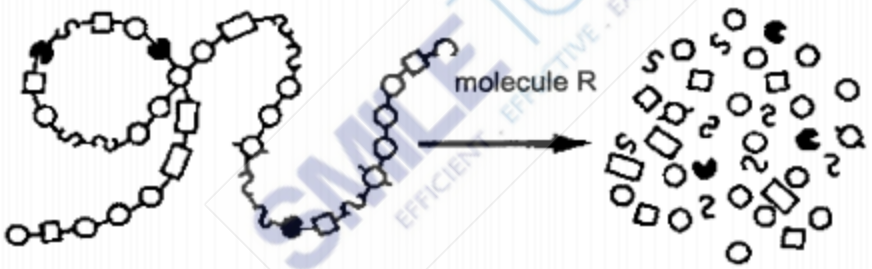
C to break down large food molecules into smaller and soluble molecules which can then be absorbed into the bloodstream

D to break up food into smaller pieces which provide a larger surface area to volume ratio for enzyme action

9 Which function of the liver is correctly paired with the chemical involved?

	function	chemical
A	deamination	glycogen
B	detoxification	alcohol
C	excretion	urea
D	storage	amino acids

10 The diagram below shows a reaction that occurs in the alimentary canal.



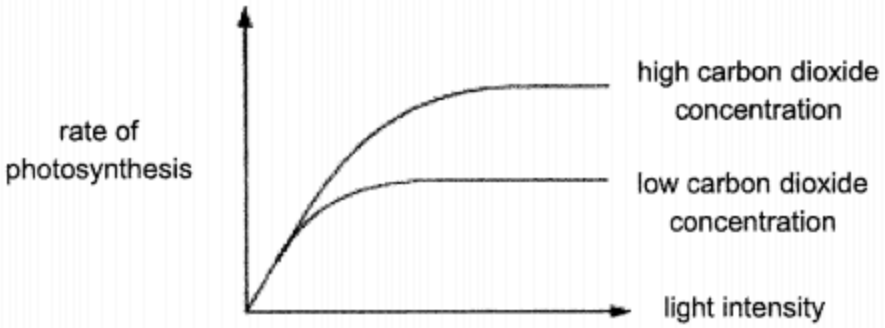
Which option states where the above reaction occurs and the identity of molecule R?

	where the reaction occurs	molecule R
A	mouth	amylase
B	stomach	pepsin
C	duodenum	maltase
D	duodenum	protease

11 What is a result of the action of stomata?

	action of stomata	result
A	closed	no water is lost from leaves
B	closed	photosynthesis stops immediately
C	open	carbon dioxide diffuses in during daylight
D	open	oxygen and water vapour diffuse out at night

12 The graph shows the effects of carbon dioxide concentration and light intensity on the rate of photosynthesis.



What can be deduced from the graph?

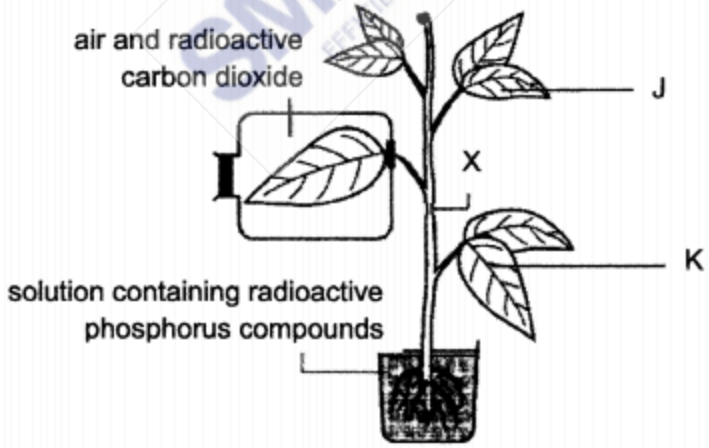
A Carbon dioxide concentration limits the rate of photosynthesis at low light intensity.

B Light intensity and carbon dioxide concentration limit the rate of photosynthesis.

C The rate of photosynthesis is proportional to light intensity.

D Temperature affects the rate of photosynthesis.

13 An experiment was set up as shown below, to study the movement of substances in a plant. A ring of tissues was removed at X, leaving only the woody inner part exposed. After several hours, the relative amounts of radioactive carbon and phosphorus compounds in different parts of the plant were measured.



Which statement is true?

A Radioactive carbon compounds were found in both leaves J and K.

B Radioactive carbon compounds can only be found in the roots and radioactive phosphorus compounds were found in both leaves J and K.

C Radioactive phosphorus compounds were found in both leaves J and K and radioactive carbon compounds were found in leaf J but not in leaf K.

D Radioactive phosphorus compounds were found in leaf K but not in leaf J.

14 Which of the following is **not** true of wilting?

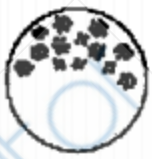
A Wilting occurs when rate of transpiration exceeds rate of water absorption.

B Increased temperature and humidity increase chances of wilting.

C Guard cells are flaccid and stomata close during wilting.

D Less starch is produced during wilting.

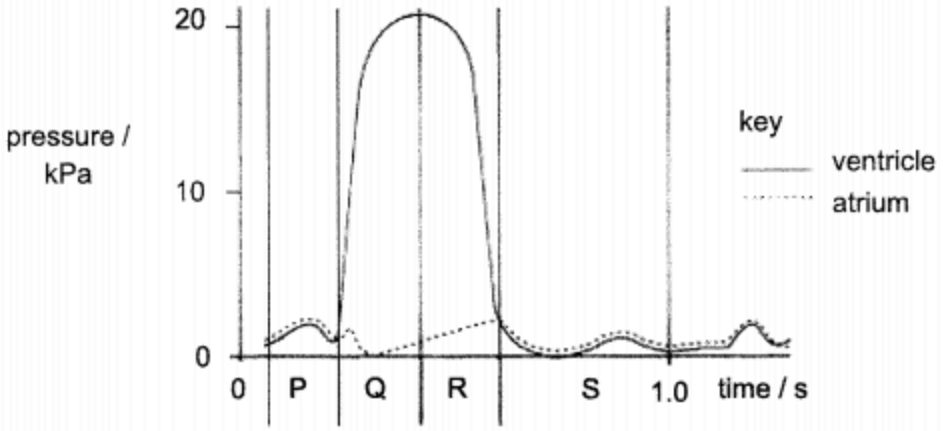
15 The blood of three people S, T and U were tested to determine their blood groups. The results are shown below.

blood of person	S	T	U
plasma from blood of group A	 clumping	 clumping	 no clumping
plasma from blood of group B	 no clumping	 clumping	 no clumping

Which of the following shows the correct blood types of people S, T and U?

	S	T	U
A	A	AB	O
B	B	AB	O
C	A	O	AB
D	B	O	AB

16 The graph shows pressure changes in the left ventricle and the left atrium in one cycle of contraction of the heart.



Which statement correctly describes the events that occur at different periods, P, Q, R and S of the cardiac cycle?

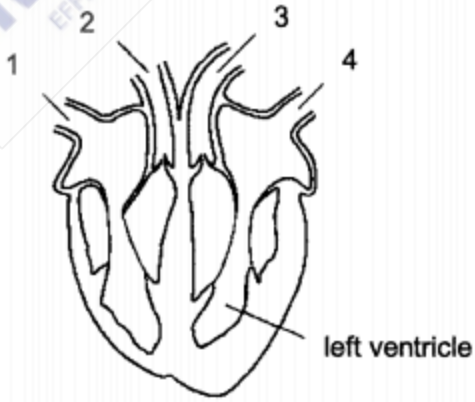
A Muscles of the atria wall relax and bicuspid vales open at period P.

B Muscles of the ventricle wall contract and bicuspid valves close at the start of Q.

C Muscles of the ventricle wall contract and bicuspid valves open at the start of R.

D Blood is filling up the heart and bicuspid valves close at period S.

17 The diagram shows a vertical section through the heart.



What are the functions of the numbered blood vessels?

	carries blood to body	carries blood to lungs	carries blood from lungs	carries blood from body
A	1	4	3	2
B	2	1	3	4
C	2	3	4	1
D	3	2	4	1

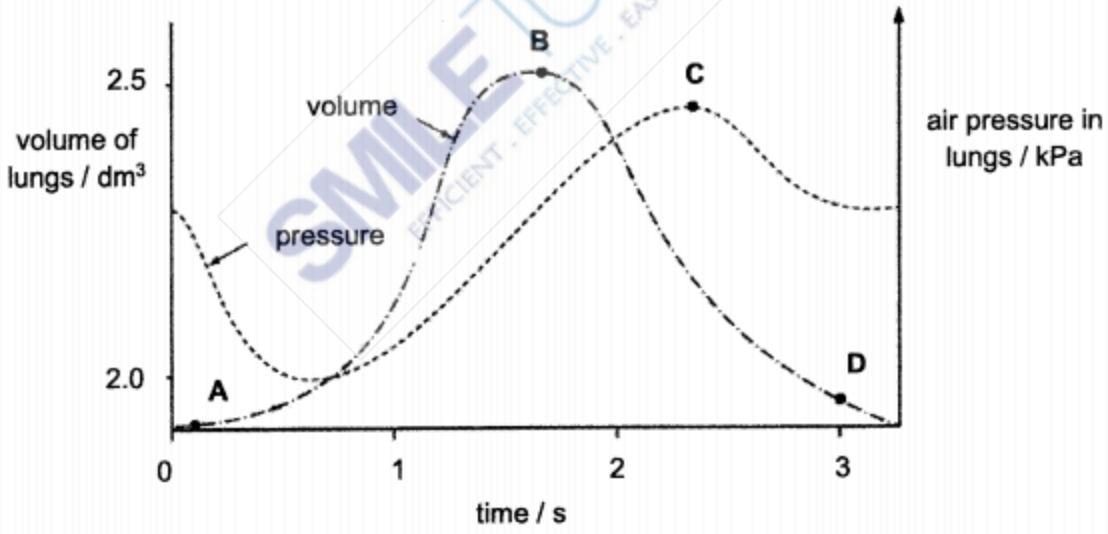
18 Some changes in the concentrations of chemicals in contracting muscles are listed.

1 decrease in glucose
2 decrease in oxygen
3 increase in amino acid
4 increase in carbon dioxide

Which changes lead to lactic acid production?

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

19 The graph shows how the pressure and volume inside the lungs change during one complete breath.



At which point are the muscles of the diaphragm starting to relax?

20 Which of the following is a harmful effect of carbon monoxide in cigarette smoke?

A increased risk of blood clots
B increased risk of lung cancer
C breakdown of alveolar walls
D increased deposition of fats in blood vessels

21 Two organs secrete substances which affect the body.

organ 1 ⟶ product 1
organ 2 ⟶ product 2

Negative feedback control of product 2 would be achieved if

A Product 1 counteracts product 2.

B Product 1 reinforces the effect of product 2.

C Product 2 inhibits organ 1 and product 1 stimulates organ 2.

D Product 2 stimulates organ 1 and product 1 stimulates organ 2.

22 Organisms that live in the hot and dry deserts need to conserve water.

Which features will help them adapt to the environment and reduce water loss?

	sweat glands	collecting duct	secretion of anti-diuretic hormone
A	more	shorter	less
B	more	longer	more
C	less	shorter	less
D	less	longer	more

23 Which is **not** an example of excretion?

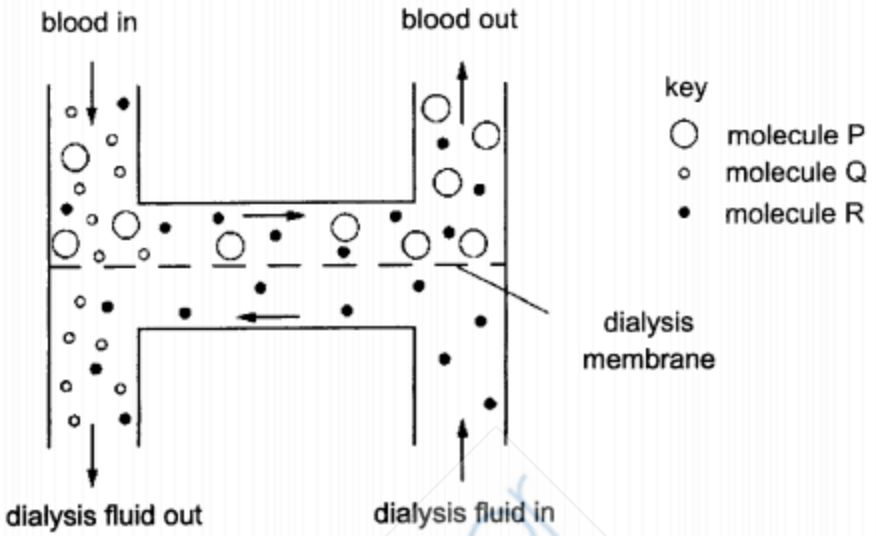
A Carbon dioxide is breathed out from the lungs.

B Undigested food leaves the body through the anus.

C Urea leaves the body in urine.

D Water is removed from the kidneys and leaves the body through the urethra.

24 The diagram shows what happens to molecules of glucose, protein and urea as blood passes through a kidney dialysis machine.



What are molecules P, Q and R?

	molecule P	molecule Q	molecule R
A	glucose	protein	urea
B	glucose	urea	protein
C	protein	glucose	urea
D	protein	urea	glucose

25 In a reflex action, the arm pulls away after touching a hot object.

What is the role of the brain in this nervous response?

	receives information	co-ordinator of arm movement
A	√	√
B	√	X
C	X	√
D	X	X

26 When a person looks up from reading a book to look out of the window, a reflex response occurs in the eye.

Which shows the pathway taken by nerve impulses in this reflex response?

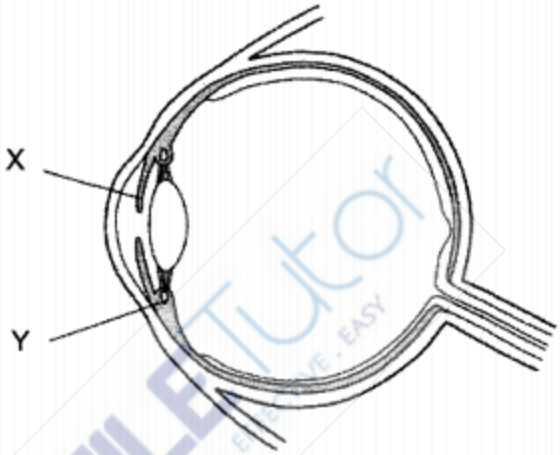
A pupil → optic nerve → brain and spinal cord → ciliary muscle

B pupil → lens → retina → optic nerve → brain → iris muscle

C retina → optic nerve → brain and spinal cord → iris muscle

D retina → optic nerve → brain → ciliary muscle

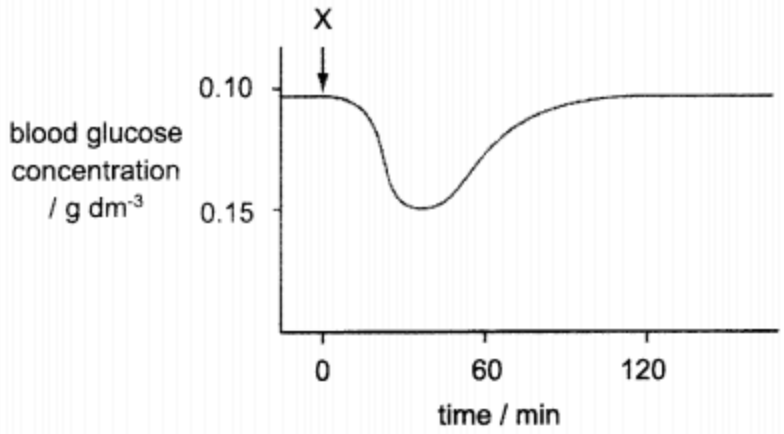
27 The diagram shows the human eye in section.



What happens to the muscles at X and muscles at Y when the eye focuses on a near object in bright light?

	X	Y
A	contract	contract
B	contract	relax
C	relax	contract
D	relax	relax

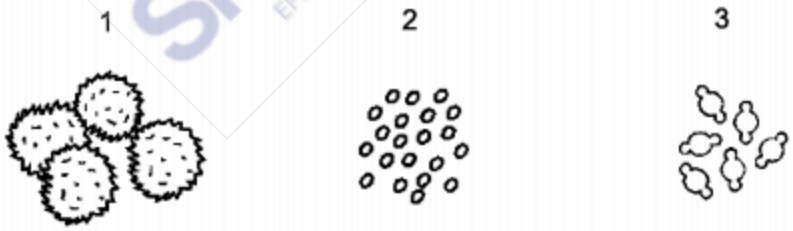
28 The graph shows the changes in blood glucose concentration following the injection of a small amount of a substance into the blood of a person at time X.



Which substance was injected at time X?

A adrenaline
B bile
C glucagon
D insulin

29 The diagrams show pollen grains from three different species of plant as they appear under the microscope. The diagrams are all to the same scale.



Which pollen grain(s) is/are involved in insect pollination?

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

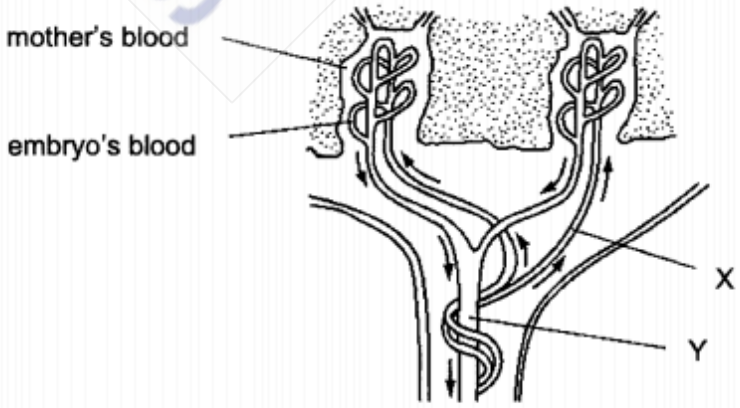
30 Which row correctly describes the type of plant reproduction that involves self-pollination?

	type of reproduction	offspring compared with parents
A	asexual	genetically different
B	asexual	genetically identical
C	sexual	genetically different
D	sexual	genetically identical

31 Which row shows the effects of estrogen and progesterone?

	high levels for ovulation	high levels needed to stop development of more ova	maintains the uterus lining	repairs the uterus lining
A	estrogen	progesterone	progesterone	estrogen
B	estrogen	progesterone	estrogen	progesterone
C	progesterone	estrogen	estrogen	progesterone
D	progesterone	estrogen	progesterone	estrogen

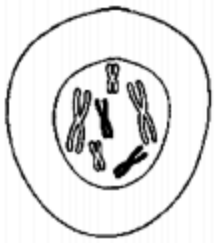
32 The diagram shows how the blood of a human embryo flows close to the mother's blood in the placenta.



Which substances are present at X in higher concentrations than at Y?

A carbon dioxide and glucose
B carbon dioxide and urea
C glucose and oxygen
D glucose and urea

33 The diagram shows chromosomes during mitosis.



How many pairs of homologous chromosomes are shown and which stage of mitosis is shown?

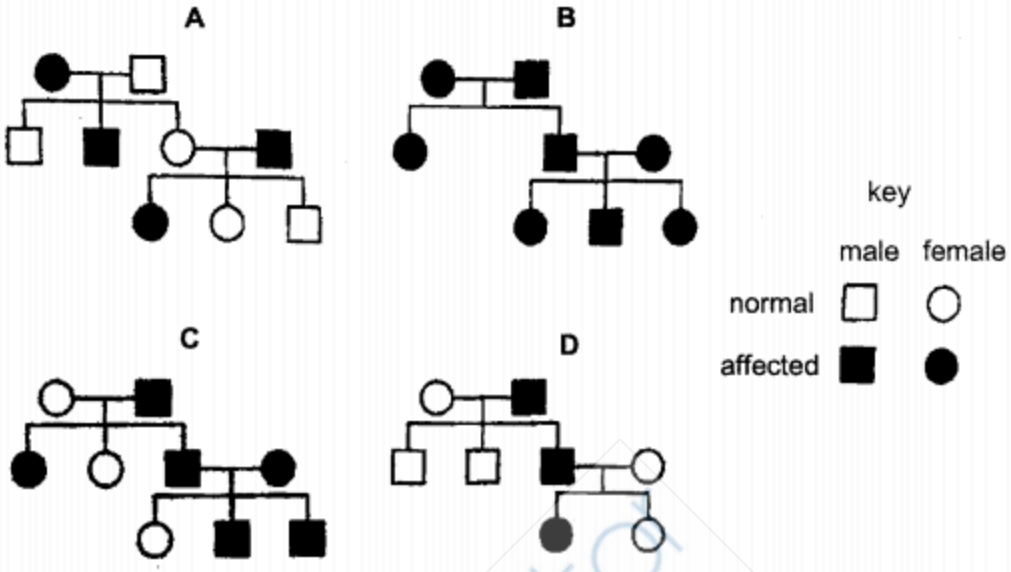
	number of pairs of homologous chromosomes	stage of mitosis
A	3	prophase
B	3	telophase
C	6	prophase
D	6	telophase

34 Which pair of gametes will result in a female with Down's Syndrome?

	number of chromosomes in ovum	number of chromosomes in sperm
A	22 + 1X	22 + 1Y
B	22 + 1Y	23 + 1X
C	23 + 1X	22 + 1X
D	23 + 1X	22 + 1Y

35 The inheritance pattern of an abnormal condition in four families is shown.

Which family proves that the condition must be caused by a dominant allele?



36 Which statement about chromosomes is correct?

A Chromosomes are long DNA molecules called genes which are divided into sections.

B Chromosomes include a long molecule of DNA divided into sections called genes.

C Chromosomes include genes which are divided into sections called DNA molecules.

D Genes include long DNA molecules called chromosomes.

37 The table shows the results of mapping 100 nucleotides on a single strand of DNA.

nucleotide	quantity
adenine	22
cytosine	20
guanine	47
thymine	11

How many thymine nucleotides will there be on the strand of DNA that is complementary to this strand?

A 11

B 20

C 22

D 28

38 Which process would result in a transgenic organism?

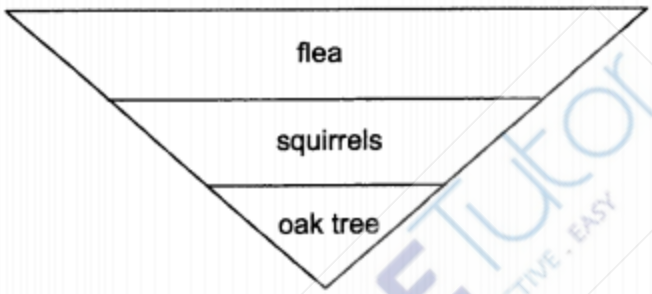
A adding a chemical to embryo plants that causes the diploid chromosome number to double which makes the plant produce larger fruit

B crossing two different varieties of the same species of plant to obtain high yield crops resistant to insect pests

C fusing an egg cell without a nucleus from one animal with a diploid cell from a related species

D inserting gene from one species into the egg cell of a different species to make the animal produced grow faster

39 A pyramid of numbers is shown.



Which statement best explains why the pyramid is inverted?

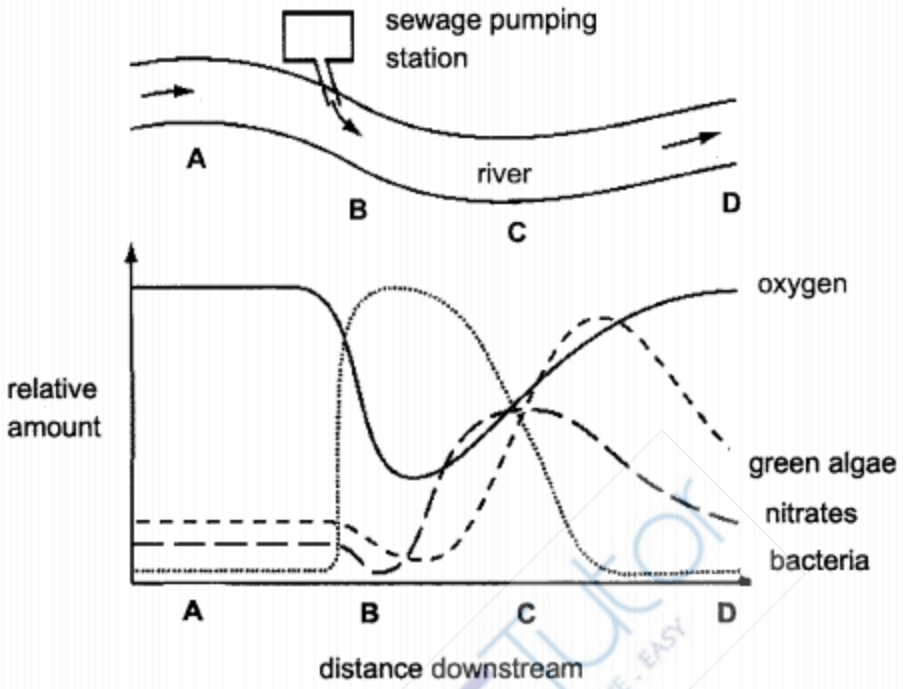
A Each trophic level has organisms of a smaller size than the one below.

B The oak tree is of the lowest biomass compared to the squirrels and fleas.

C The fleas and squirrels die out at a much faster rate than the oak tree.

D There is an overpopulation of higher consumers, resulting in drastic decline in the lower trophic levels.

40 The diagram shows part of a river into which sewage is being pumped. Some of the effects of adding sewage to the river are shown in the graph.



At which point in the river are decomposers most active?

Section A

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

The total marks for this section is 50.

1 Biological molecules are essential for the survival of living cells.

(a) Five statements about water are listed below:

i. It cools a surface from which it evaporates.

ii. It is used as a solvent.

iii. It is involved in many metabolic reactions.

iv. It has high specific heat capacity.

v. There is cohesion between its molecules.

State which statement(s) above make water suitable for the following functions:

(i) to use in a blood transport system .....

(ii) to move up the xylem via transpiration pull .....

[2]

(b) Complete the table below on the various food tests for different biological molecules.

biological molecule	test reagent(s)	observation if present
glucose		
protein		
fat		

[3]

2 Cystic fibrosis is a genetic condition in humans that results from a failure to inherit a particular dominant allele of a gene.

(a) Explain the terms *gene* and *allele*.

gene .....

.....

.....

allele .....

.....

.....

[2]

(b) Use a fully labelled genetic diagram to determine the chance of a child inheriting cystic fibrosis from two heterozygous parents.

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

chance of child inheriting cystic fibrosis: ..... [3]

(c) Fig. 2.1 shows some of the main regions of the alimentary canal in a person.

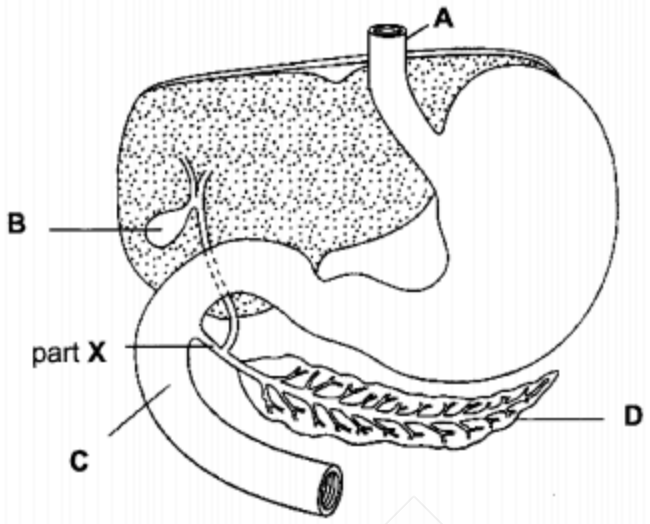


Fig. 2.1

(i) Name the parts labeled **A** to **D**.

A ..... **B** .....

C ..... **D** .....

[2]

(ii) One effect of cystic fibrosis is that part **X** becomes blocked with mucus.

Suggest and explain how this condition affects the nutrition of a person.

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..... [4]

[Total: 11]

3 There are many different drugs available to treat high blood pressure. Fig. 3.1 shows the mean heart rates of two groups of people, **J** and **K**, over a five-year period.

From the start, and throughout the period, people in group **K** were treated with a drug called a beta-blocker.

Group **J** did not take any form of medication.

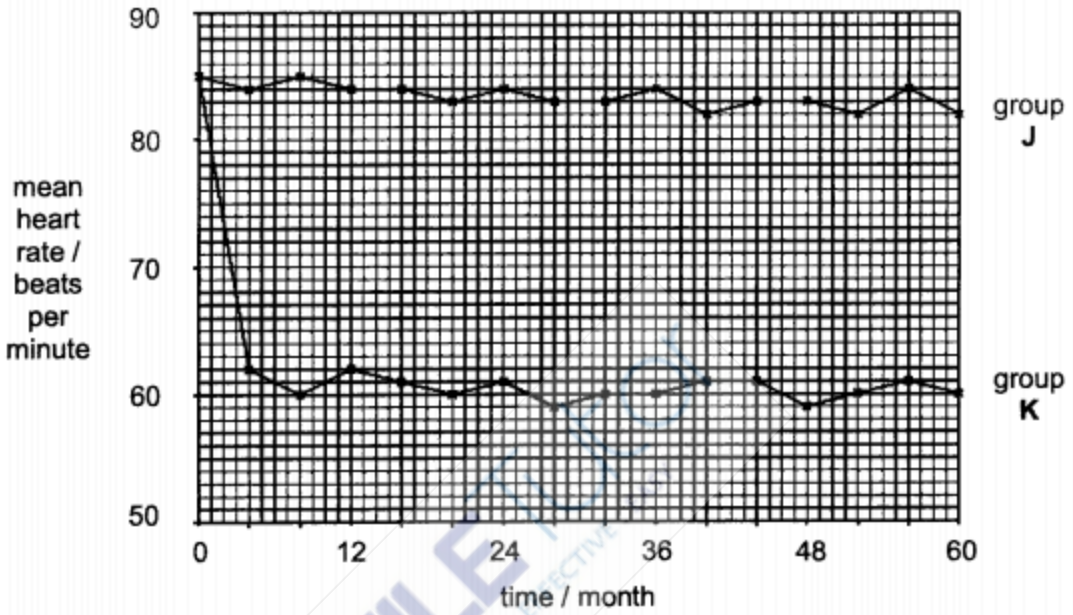

Fig. 3.1

(a) Using information from Fig. 3.1, describe the effect on the mean heart rate of taking beta-blockers.

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..... [2]

(b) On Fig. 3.1, draw a curve to show the expected effect on the mean heart rate of Group **J** if, after three years, half of them started to take beta-blockers.

[2]

(c) Suggest how the change in mean heart rate for group **K** may treat high blood pressure.

.....

..... [1]

(d) Some other drugs reduce blood pressure by having an effect on blood vessels. Suggest and explain how these drugs may cause a decrease in blood pressure.

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..... [2]

[Total: 7]

4 Fig. 4.1 shows stages in the development of human twins.

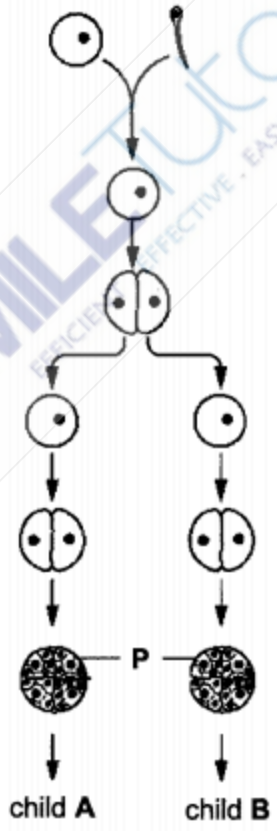

Fig. 4.1

(a) On Fig. 4.1, draw lines to label each of the following:

- a gamete
- a zygote

[2]

(b) Explain how the first division of meiosis is involved in the formation of gametes.

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.....

..... [2]

(c) Describe the sequence of events that occur after structure **P** is formed which enable it to develop and survive in the uterus.

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..... [4]

(d) Explain why child **A** and **B** have the same blood type but different weight when born.

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..... [2]

[Total: 10]

5 Fig. 5.1 shows the flow of energy within a biological system.

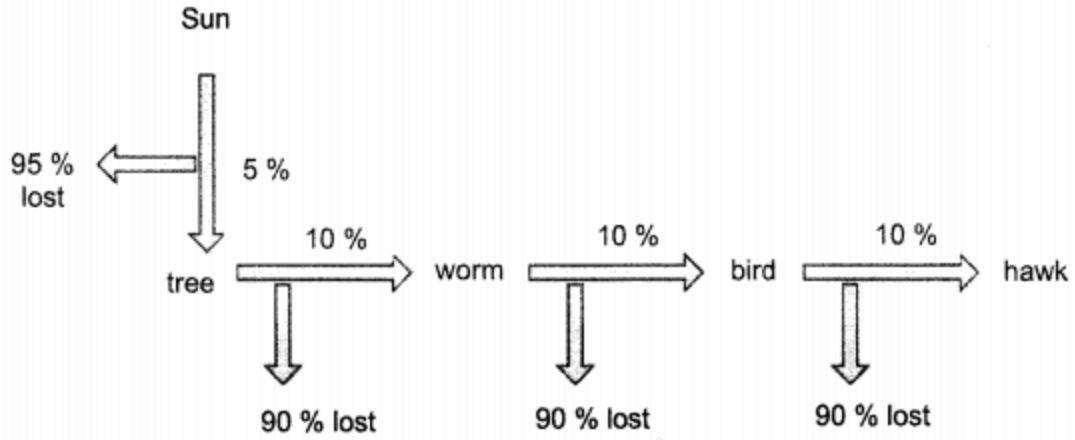

Fig. 5.1

(a) The energy flow in Fig. 5.1 is non-cyclical.

Use Fig. 5.1 to explain the term *non-cyclical*.

Include information about the source of energy for the food chain in your answer.

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..... [3]

(b) Suggest two reasons why only 5% of the energy from the Sun passes to the tree.

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..... [2]

(c) Fig. 5.2 shows two possible uses of the same area of land to produce food.

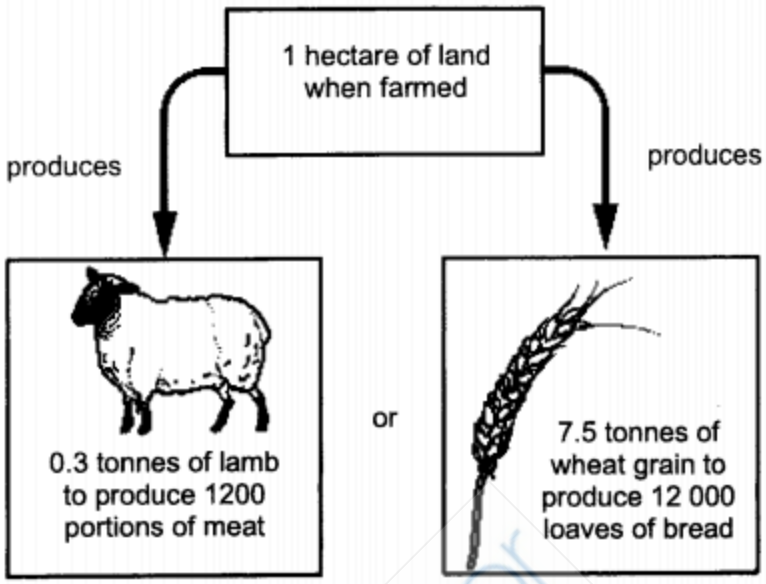

Fig. 5.2

Use the information in Fig. 5.1 and 5.2, and your own knowledge, to explain why it is possible to feed a greater number of people if the area of land is used to farm crops rather than to farm animals.

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..... [3]

[Total: 8]

6 (a) Fig. 6.1 shows the percentage of energy provided by anaerobic respiration when athletes run in races of different distances.

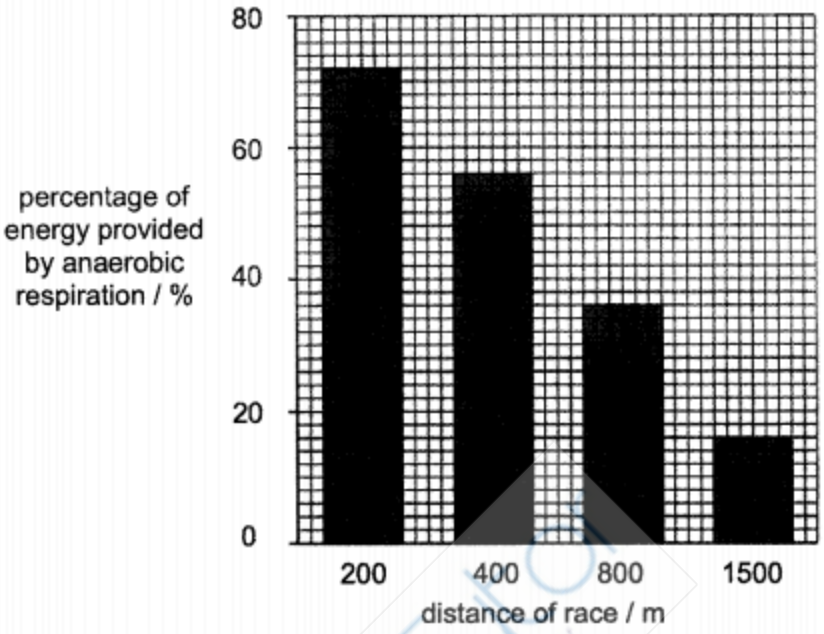

Fig. 6.1

(i) State the word equation for anaerobic respiration.

..... [1]

(ii) Describe and explain the results shown in Fig. 6.1.

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..... [4]

(b) In an investigation the volume of sweat produced by a student was measured when running while carrying different masses in a bag.

Table 6.2

mass of content of bag / kg	volume of sweat produced / arbitrary units
0	6
3	7
6	9
9	13

(i) Calculate the percentage increase in sweat production when running with a 9 kg bag.
Give your answer to the nearest whole number. Show your working.

answer: ..... [1]

(ii) Explain the percentage increase in sweat production as the mass of content of bag increases.

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..... [3]

[Total: 9]

Section B

Answer **all** the questions in this section. The last question is in the form of either/or and only one of the alternatives should be attempted.

The total marks for this section is 30.

7 **(a)** Describe the role of chloroplasts in photosynthesis.

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..... [2]

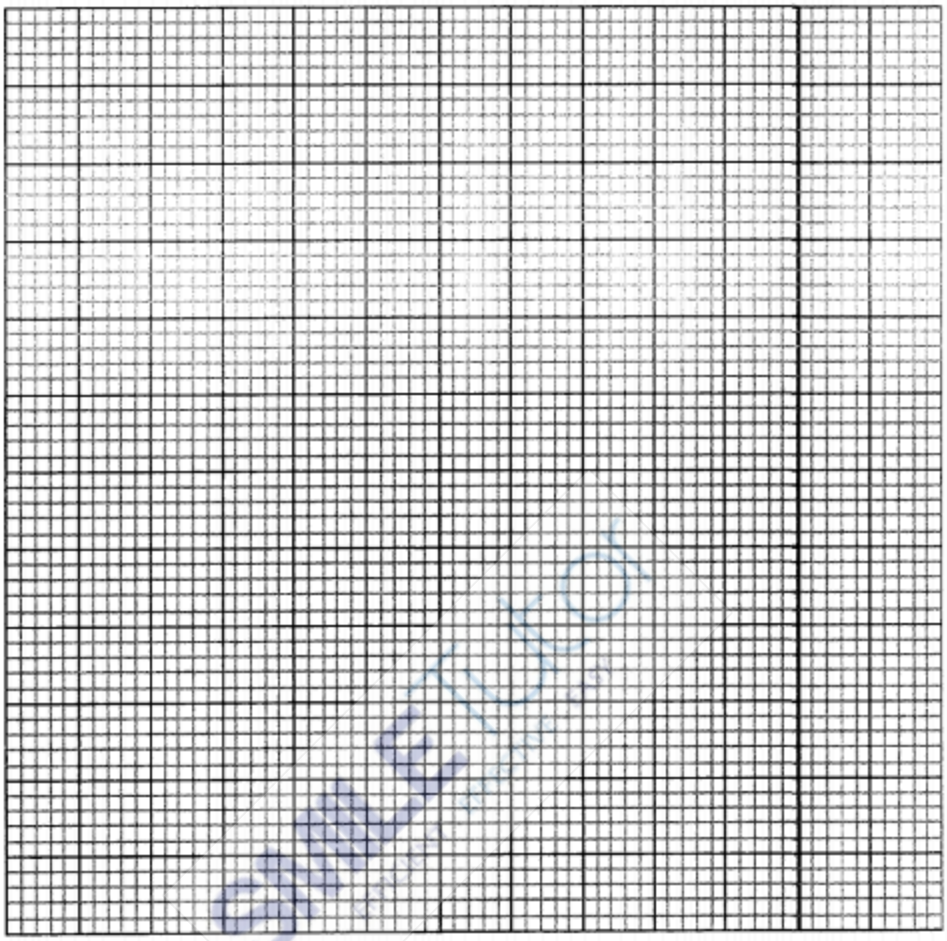
(b) The rate of photosynthesis in six tropical crop plants was measured when the plants were growing outside under normal conditions (rate **X**).
The measurements were repeated when the plants were grown under controlled optimum conditions in a glasshouse (rate **Y**).
The results are shown in the Table.

Table

crop plant	rate of photosynthesis (**X**) / µmol per m^2 per second	rate of photosynthesis (**Y**) / µmol per m^2 per second	difference in rate of photosynthesis (**Y-X**) / µmol per m^2 per second
cassava	13.7	23.1	9.4
eucalyptus	18.4	26.0	7.6
maize		26.0	2.6
soya bean	18.3		6.8
sugar cane	24.0	26.8	2.8
sunflower	24.3	31.7	7.4

(i) Calculate the missing values in the table and complete the table. [1]

(ii) Draw a bar chart of the difference (**Y-X**) in the rate of photosynthesis of each plant.



[3]

(iii) The measurements of the rate of photosynthesis (**X**) of the plants when grown outside are means of 10 readings.

Suggest a reason why mean measurements were used.

.....

..... [1]

(iv) Suggest two factors that were changed when the plants were grown in controlled optimum conditions.

.....

..... [2]

(c) The rate of photosynthesis can be measured by:

- calculating the rate per unit area of leaf

  or

- calculating the rate per unit mass of the leaf

Suggest why these measurements may give different results.

.....

..... [1]

[Total: 10]

8 Both artificial selection and genetic engineering leads to genetic variation.

(a) Describe the difference between artificial selection and genetic engineering.

.....

.....

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..... [2]

(b) Medical biotechnology can be used to produce chicken eggs that contain human proteins. These proteins can be used in medicines.

Discuss **two** social and **two** ethical implications of using chickens to produce human proteins.

social implications .....

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ethical implications .....

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..... [4]

(c) Describe one example of artificial selection in the production of an economically important plant and animal.

(i) plant

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.....

(ii) animal

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..... [4]

[Total: 10]

9 Either

(a) Explain the basic principles of homeostasis.

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..... [2]

(b) Describe the role of the skin in homeostasis when a person is in freezing conditions.

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..... [4]

(c) With reference to the basic principles of homeostasis, compare regulation of blood glucose concentration and regulation of water potential of blood.

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..... [4]

[Total: 10]

9 Or

(a) Some cells secrete enzymes.

Describe how different parts of such a cell work together to synthesize and secrete the enzymes.

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..... [4]

(b) Compare the effect of temperature and pH on enzymes.

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..... [4]

(c) Explain why the lock and key hypothesis does not accurately represent how enzymes work.

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..... [2]

[Total: 10]

The End

ANSWER SHEET

Paper 1

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
C	D	A	A	B	A	B	C	B	D

Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
C	B	C	B	B	B	D	C	B	D

Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30
C	D	B	D	B	D	A	D	A	C

Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40
A	B	A	C	C	B	C	D	A	B

Paper 2

Section A

1ai ii (1)

aii v (1)

b

biological molecule	test reagent(s)	observation if present
glucose	Benedict's solution (0.5)	Red precipitate (0.5)
Protein	Biuret solution (0.5) or sodium hydroxide and copper (II) sulfate solution (0.5)	purple solution (0.5)
Fat	ethanol and water (0.5)	white emulsion (0.5)

2a gene : unit of inheritance (0.5) that determines a particular characteristic / trait of an organism (0.5) OR a segment of DNA that is made up of a specific sequence of nucleotides (0.5) which codes for a specific polypeptide (0.5) that determines a specific characteristic .

allele: alternative forms of a gene (0.5) that occupies the same relative positions on a pair of homologous chromosomes (0.5)

b

Parents	Male	X	Female
Phenotype	Normal		Normal (0.5)
Genotype	Dd		Dd (0.5) *
Gametes	D d		D d
F1 genotype	DD Dd		Dd dd (0.5) *

F1 phenotype Normal normal normal cystic fibrosis (0.5)

Phenotypic ratio: 3 normal : 1 cystic fibrosis (0.5)

Chance of child inheriting cystic fibrosis: 25% or ¼ (0.5)

*can be awarded for Punnett Square too

Penalise 0.5m if no headings at all

ci A: oesophagus B: gall bladder

C: duodenum D: pancreas

cii Less bile (0.5) and pancreatic juice / enzymes (0.5) are secreted into the duodenum (0.5). with less bile, there is less emulsification/break up of fats (0.5) resulting in a smaller surface area to volume ratio for digestion (0.5). With less enzymes, there is less digestion of food (any named nutrient) (0.5) into smaller molecules resulting in less nutrients absorbed (0.5) and assimilated /used for growth / energy (0.5). Hence the person will have poor nutrition.

3a Beta-blockers caused the mean heart rate to decrease (0.5) from 85 to 62 beats per minute / by 23 beats per minute (0.5) in 4 months (0.5). The mean heart rate then remains relatively constant (0.5) between 59 to 62 beats per minute (0.5). Max 2 m

b decrease trend starts at 36 months (0.5)

decreases from 85 to 72 beats per minute (0.5) within 4 months (0.5) + remains relatively constant till 60 months (0.5)

c As the mean heart rate has decreased, less blood will be pumped into the blood vessels (0.5), causing the blood pressure to decrease (0.5).

d The drugs relax the muscles (0.5) found in the wall (0.5) of blood vessels causing the blood vessels to dilate (0.5) which results in pressure of blood flowing through the vessels to decrease (0.5)

4a label sperm/egg as 'gamete' (1) R:label as 'sperm' or 'egg'

Label immediate structure formed after fertilisation (1)

b During prophase 1, homologous chromosomes pair up (0.5). They then arrange themselves in two lines in the centre of the cell during metaphase 1 (0.5). During anaphase I, homologous chromosomes separate to opposite poles (0.5), causing the daughter cells to be haploid gametes (0.5)

c structure P gets implanted in the uterine lining (0.5). A placenta (0.5) then develops which allows for oxygen/nutrients (0.5) and antibodies (0.5) to diffuse from the mother's blood to the fetus blood (0.5). It also allows for carbon dioxide/waste products (0.5) to diffuse from fetus blood to mother's blood (0.5). The fetus also develops an amniotic membrane/sac (sac) to protect the fetus (0.5). These help the fetus to be able to develop and survive.

d Since child A and B are identical twins / came from the same sperm and egg (0.5), they inherited the same genetic information from their parents (0.5) Thus, they have the same blood type. However, weight is of continuous variation (0.5) which can be affected by environmental factors / combined effects of several genes (0.5). Thus, their weight is different when born.

5a Non-cyclical means that the energy is not returned to its source (1) which is the sun (0.5). As energy is transferred from one trophic level to another, 90% is lost (0.5) as heat during respiration (0.5) and chemical energy in waste products / uneaten body parts (0.5).

b Any of the following two (1m each):

- light from the sun gets reflected off the leaves
- rate of photosynthesis was not high enough due to low/high temp
- rate of photosynthesis was not high enough due to low carbon dioxide concentration
- some light energy does not fall on the leaves to be absorbed

c Since 90% of the energy is lost as it gets transferred from one trophic level to another (0.5), the crops/wheat grain has more energy than the lamb (0.5) as the crops are at a lower trophic level/ crops is a producer while lamb is a consumer (0.5). 1 hectare of land can produce 12000 loaves bread which is 10 times more than 1200 portions of meat (1). Thus, more bread can feed more more people and provide them with more/sufficient energy (0.5).

6ai glucose -> lactic acid + small amount of energy

aii As the distance of race increases from 200 m to 1500 m, the percentage of energy provided by anaerobic respiration decreases (0.5) from 72% to 14% / by 58% (0.5). This is because, as the distance increases, the increase in energy demand is more gradual (0.5) and the athlete can breathe more to take in more oxygen (0.5). Thus, more aerobic respiration (0.5) can occur in the muscle cells (0.5) to release more energy (0.5). Hence, less anaerobic respiration is needed to meet the energy demand (0.5).

bi (13-6)/6 X 100% = 117 % (nearest whole number) (1)

*0.5m for working, 0.5m for final answer to the nearest whole no/

bii More respiration (0.5) occurs to release more energy needed to run with a heavier bag (0.5). More heat energy released causes the blood temperature to increase (0.5) above normal (0.5). Thus, more sweat is produced to lose more heat/decrease blood temperature (0.5) as water evaporates (0.5) during sweating.

7a Chloroplasts contain chlorophyll (0.5) which traps/absorbs light energy (0.5) and converts it to chemical energy (0.5) which is stored in the glucose produced (0.5) during photosynthesis.

bi maize – 23.4 (0.5)

soya bean – 25.1 (0.5)

bii labelled axis with units (1)

6 bars of equal width (1)

Correct height for all bars (1) (0.5 m for 1 bar wrong bar, 0m for more than 1 wrong bar)

biii Mean measurements were used to increase the reliability of the results (1)

iv light intensity / carbon dioxide concentration / temperature (any 2 factors, 1 mark each)

c The leaves may be of different thickness. Hence, leaves of the same area can have different mass due to different thickness. / There is a lack of proportionality between mass and area. (1)

8a Artificial selection is the deliberate/selective breeding of organisms with desirable characteristics/traits (1) but genetic engineering is a technique/method used to transfer genes from one organism to another (1).

8b Social implications

- May lead to class distinctions. Only individuals with sufficient financial means can afford the medicine/gene technologies
- Long term impact of the proteins used as medicines may be unknown

Ethical implications

- Vegetarians / vegans who need the medicine may find it unacceptable to consume it as its production involved the use of chickens.
- Some people feel that it is morally wrong to exploit animals for medical research especially when the animals are designed to suffer.

8ci Variety of sugarcane plant with high sugar content (1) is crossed/bred with another variety that is resistant to diseases (1) to produce offsprings that have both of these traits.

8cii Jersey cows which produce a lot of milk (1) were mated with Brahman bull which thrive well in warm climates (1) to produce offsprings that have both of these traits.

*accept other possible answers

9 either

9a The basic principles of homeostasis includes a stimulus resulting from a change in the internal environment (0.5) which triggers/stimulates a corrective mechanism (0.5) to restore normal conditions (0.5) by negative feedback (0.5).

b In freezing conditions, the skin has thermoreceptors (0.5) to detect the decrease in skin temperature (0.5) and produce nerve impulses (0.5). The skin also has arterioles (0.5) which constrict (0.5) to reduce blood flow to the capillaries at the skin surface (0.5) so that less heat is lost (0.5) through the skin by conduction, convection and radiation (0.5).

c similarities:

- both involve negative feedback (1)

- both involve hormones to carry out the corrective mechanisms (1)

Differences (1m for each difference):

Regulation of blood glucose concentration	Regulation of water potential of blood
stimulus is detected by the pancreas	stimulus is detected by the hypothalamus
organ involved in the corrective mechanism is the liver / muscles	organ involved in the corrective mechanism is the kidney

9 Or

a The nucleus contains the genetic material/gene/DNA (0.5) that codes for the enzymes (0.5). The ribosomes attached to the rough endoplasmic reticulum (RER) (0.5) synthesizes the proteins / enzymes (0.5) coded by the gene. The RER then transports the enzymes to the Golgi body (0.5) via vesicles. The Golgi body stores/modifies the enzymes (0.5) and packages them into vesicles (0.5) which fuses with the cell membrane (0.5) to be secreted out of the cell.

b similarities:

- enzymes work best at the optimum temp and pH (1)

- above optimum pH and temperature, enzymes are denatured (0.5) whereby their active site is altered (0.5)

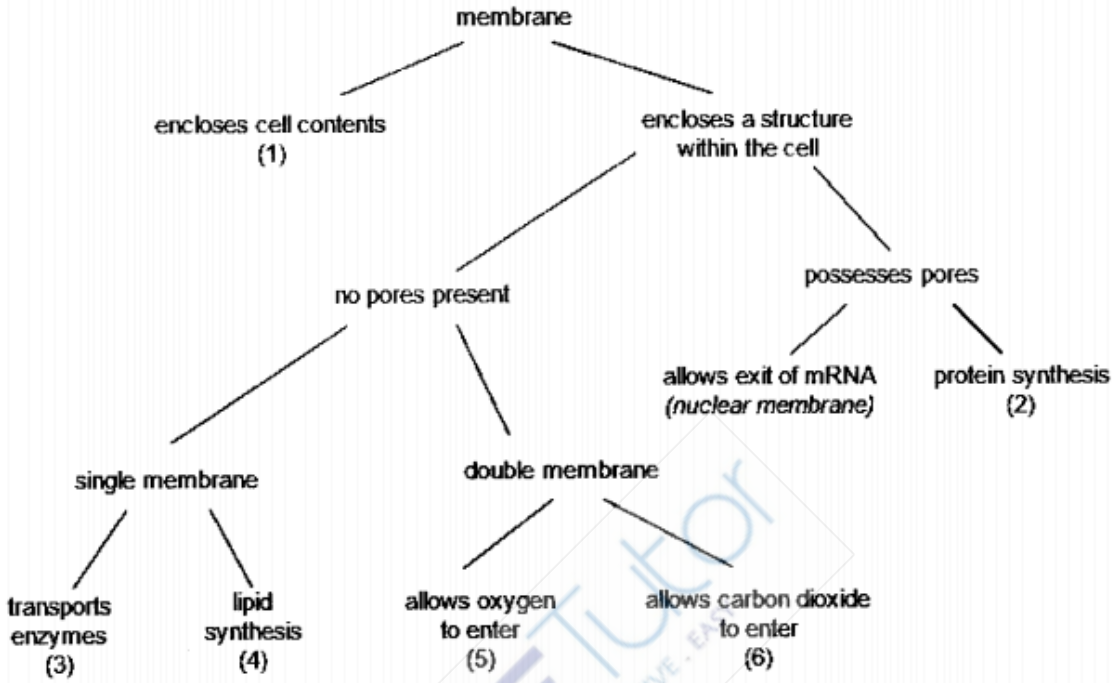
differences: (1m for each difference)

effect of temperature	effect of pH
temperature affects the kinetic energy of the enzymes	pH does not affect the kinetic energy of the enzymes
Below the optimum temperature, enzymes are inactive / have little kinetic energy	Below the optimum pH, enzymes are denatured

c The lock is the enzyme and the key is the substrate (0.5). The enzyme remains unchanged at the end of the reaction (0.5) while the substrates are broken down/synthesized (0.5). However, the lock changes shape after being unlocked / the key is the one that remains the same after being used (0.5).

BENDEMEER SECONDARY SCHOOL SA2 PAPER

1 Membranes within and at the surface of cells have different roles. The diagram shows the identification of the various organelles by describing the membrane structure and function.



Which row is correct?

	(1)	(2)	(3)	(4)	(5)	(6)
A	chloroplast	vesicle	smooth ER	rough ER	cell membrane	mitochondrion
B	cell membrane	rough ER	vesicle	smooth ER	chloroplast	mitochondrion
C	cell membrane	rough ER	vesicle	smooth ER	mitochondrion	chloroplast
D	cell membrane	smooth ER	mitochondrion	rough ER	vesicle	chloroplast

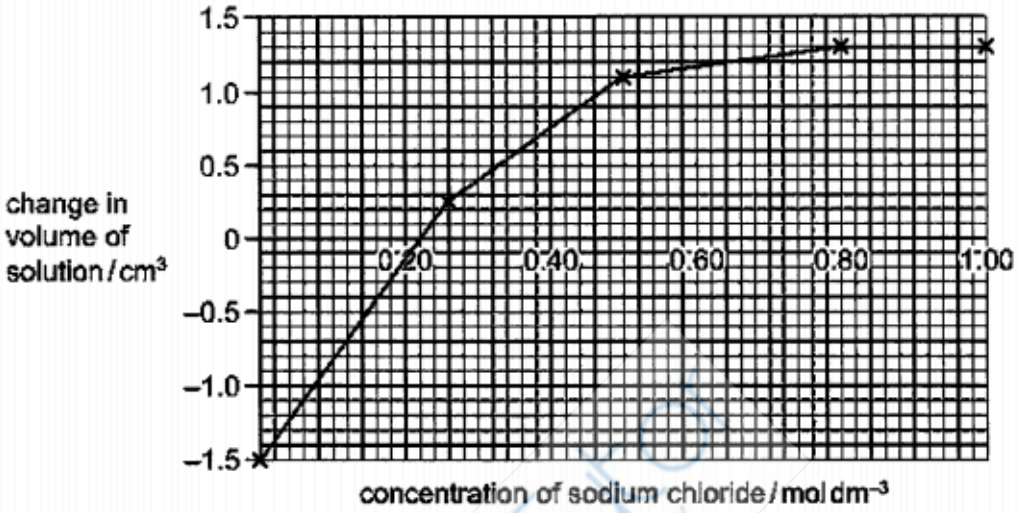
2 Which option shows how xylem is structurally adapted for its function?

I lacks protoplasm
II lacks cross walls between adjacent cells
III contains cell walls strengthen with lignin
IV contains cell walls strengthen with cellulose

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

3 Equal volumes of five different concentrations of sodium chloride solution were placed into five similar containers. An identical piece of plant tissue was placed in each container and left for 48 hours.

The plant tissues were removed after 48 hours and the change in volume of solution was accurately measured for each container. The results are shown below.

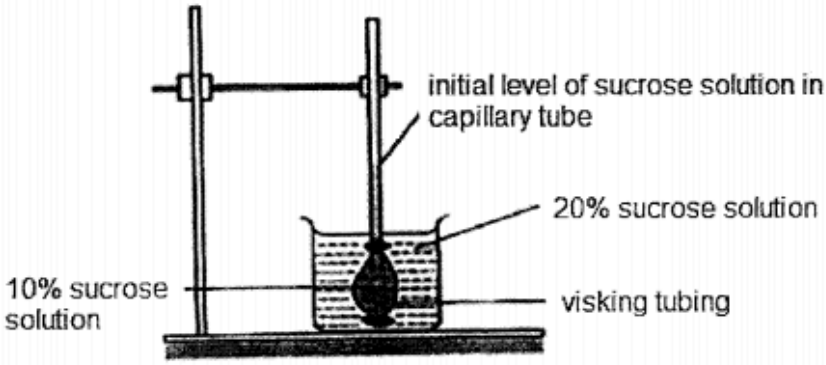


Which statement(s) explain/s the results from 0.80 to 1.00 mol dm^{-3} sodium chloride?

1 There was no movement of water molecules out of the plant tissues.
2 The plant tissues had a water potential of zero.
3 The plant tissues were fully plasmolysed.

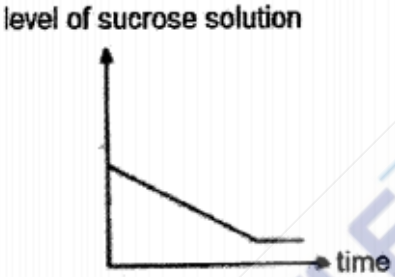
A 1 only
B 1 and 2
C 2 and 3
D 3 only

4 The diagram shows the initial level of 10% sucrose solution in a capillary tube before an experiment.

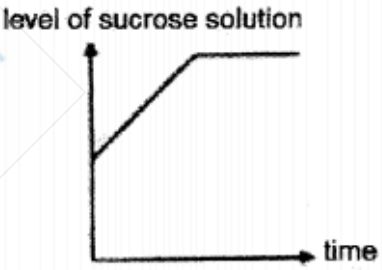


Which graph shows the changes in the level of sucrose solution in the capillary tube changes during the experiment?

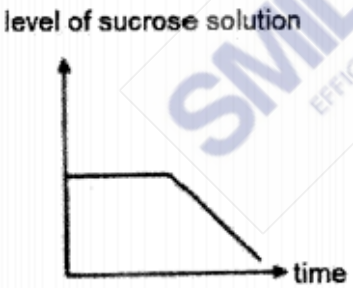
A



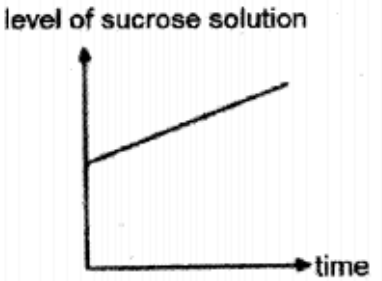
B



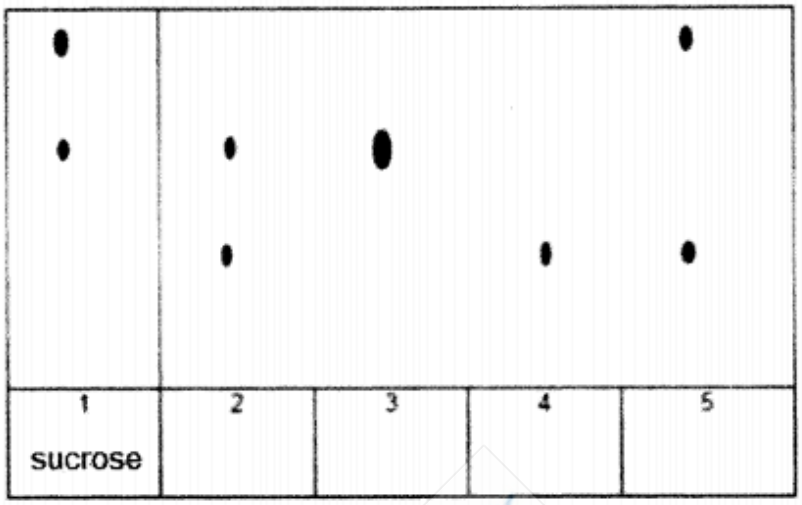
C



D



5 Five disaccharides were each hydrolysed with dilute acid, and the final products were separated by chromatography. The final chromatogram is shown in the diagram.



If 1 represents the products obtained from the hydrolysis of sucrose, which option indicates the results obtained from the hydrolysis of lactose and maltose respectively?

	lactose	maltose
A	2	3
B	2	4
C	3	2
D	3	5

6 The following statements describe the characteristics of water.

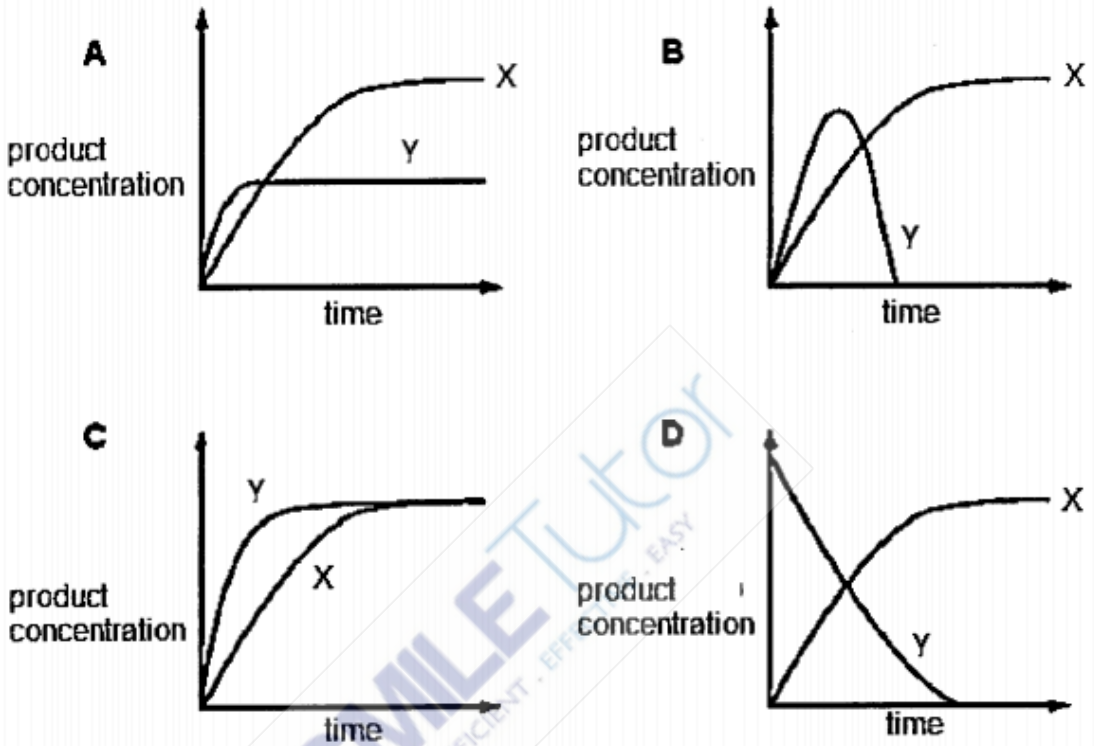
1 water cools a surface from which it evaporates
2 water is used as a solvent for many chemicals
3 water is involved in many metabolic reactions

Which statement(s) make water suitable to use in a blood transport system?

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

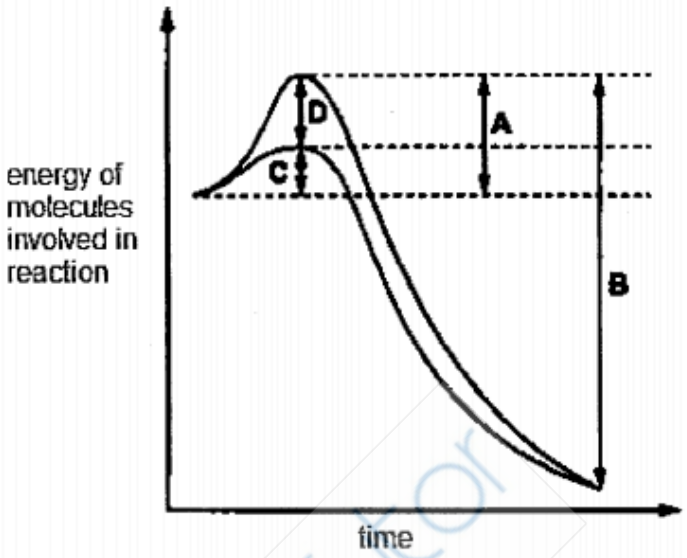
7 Two enzyme-controlled experiments were carried out one after another. Experiment X was carried out at a constant temperature of 37°C. In experiment Y, the temperature was initially 37°C. It was gradually raised to 80°C. No products were removed throughout both experiments.

Which graph shows the results?

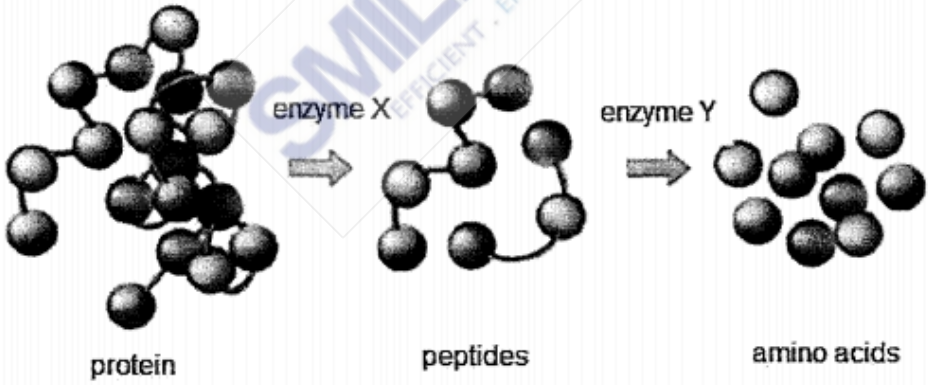


8 The two curves in the diagram represent energy levels as a chemical reaction progresses, with and without the presence of the enzyme specific to this reaction.

Which arrow represents the total activation energy of the reaction without the enzyme?



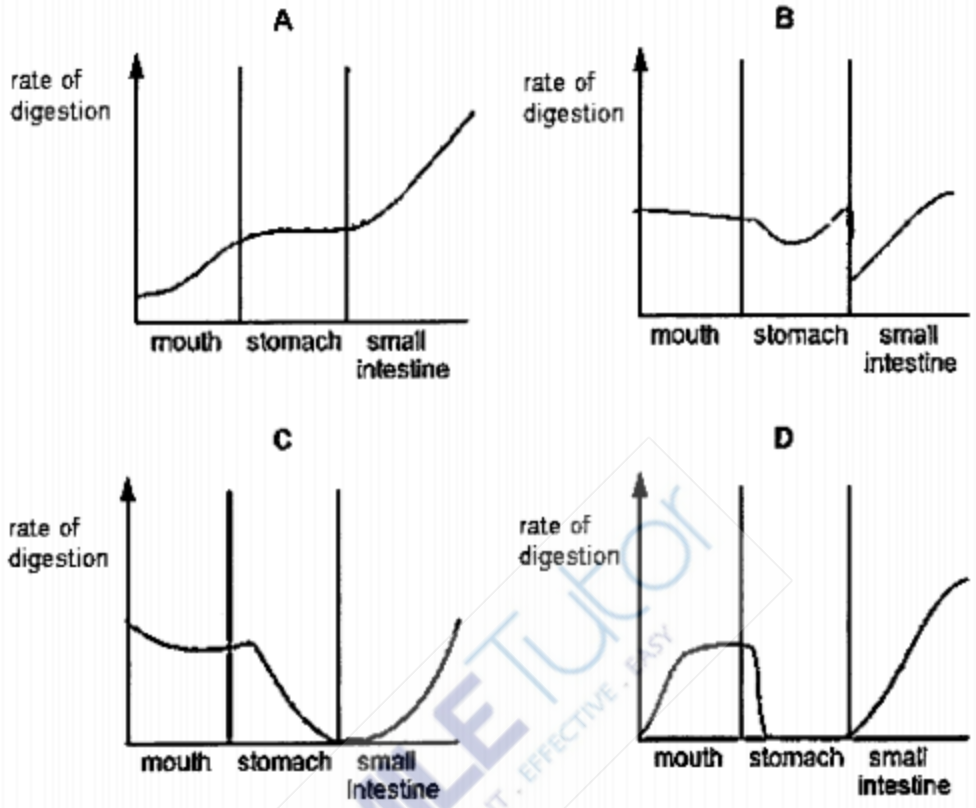
9 The diagram shows the digestion of protein.



What is enzyme Y and where is it released from?

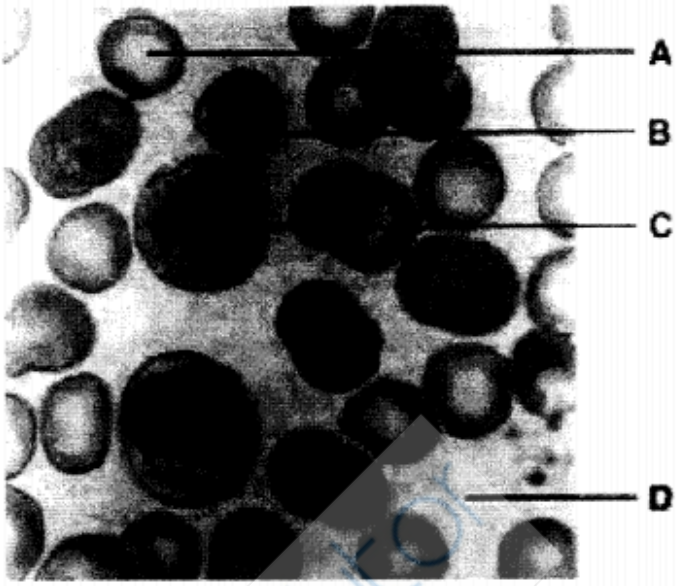
	enzyme Y	released from
A	lipase	intestinal wall
B	pepsin	stomach wall
C	peptidase	intestinal wall
D	trypsin	pancreas

10 What graph below shows the rate of digestion of starch in the three parts of the alimentary canal?

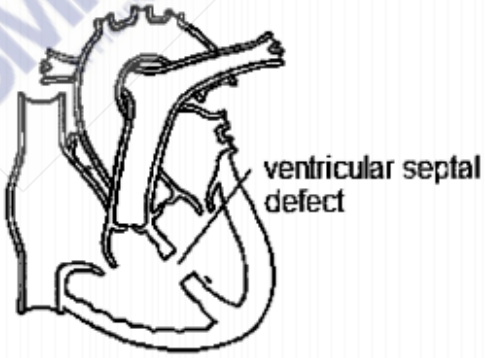


11 The diagram shows a photograph of blood smear seen under a light microscope.

Which part shows the structure that carry out phagocytosis?



12 The diagram shows a congenital defect (ventricular septal defect) in which the median septum of the heart fails to form fully, resulting in 'a hole in the heart'.

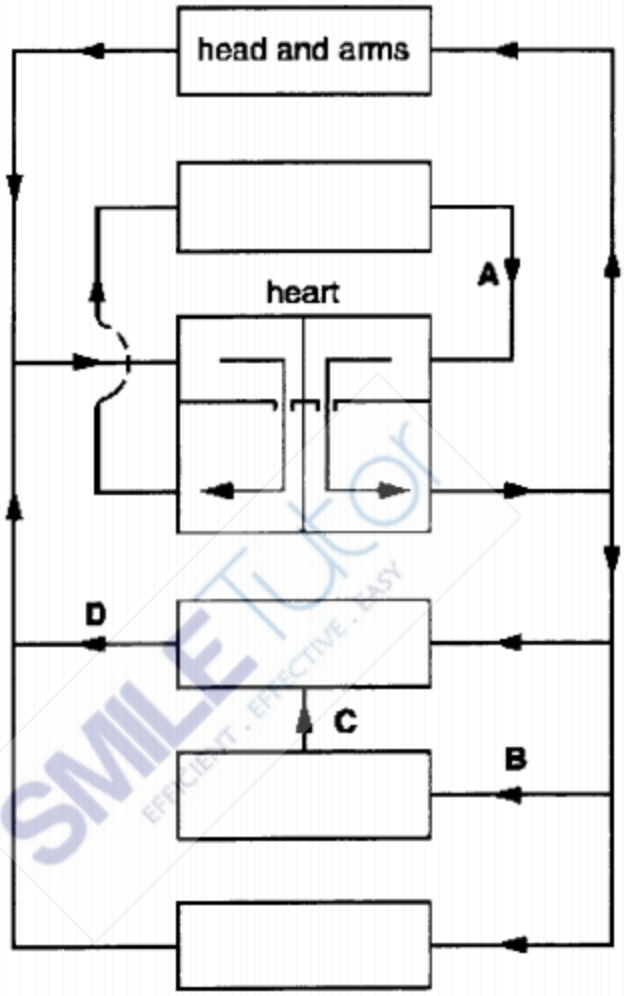


Which of the following would not be a likely consequence of this disease?

A a reduction in the pressure of blood leaving the aorta
B a reduction in the percentage of oxygen brought to body cells
C mixing of oxygenated and deoxygenated blood
D backflow of blood into the atria

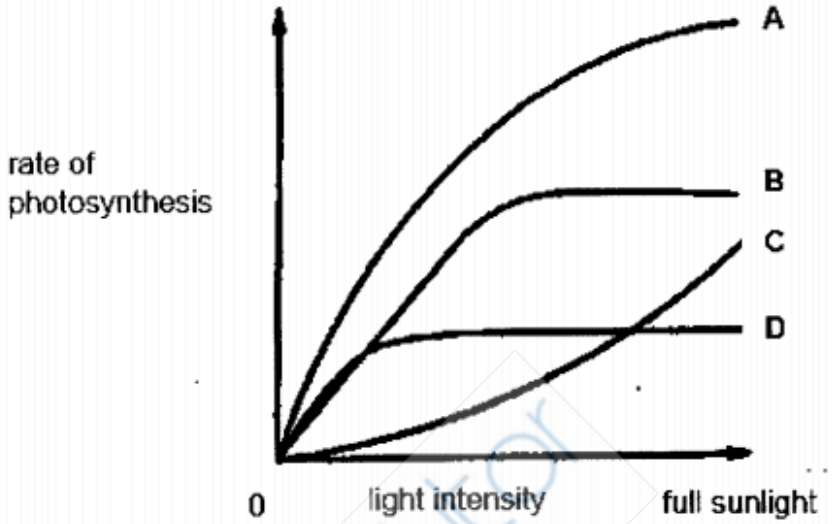
13 The diagram shows the human circulatory system.

In which vessel, **A**, **B**, **C** or **D** will there be the highest amount of amino acids after a meal high in protein?



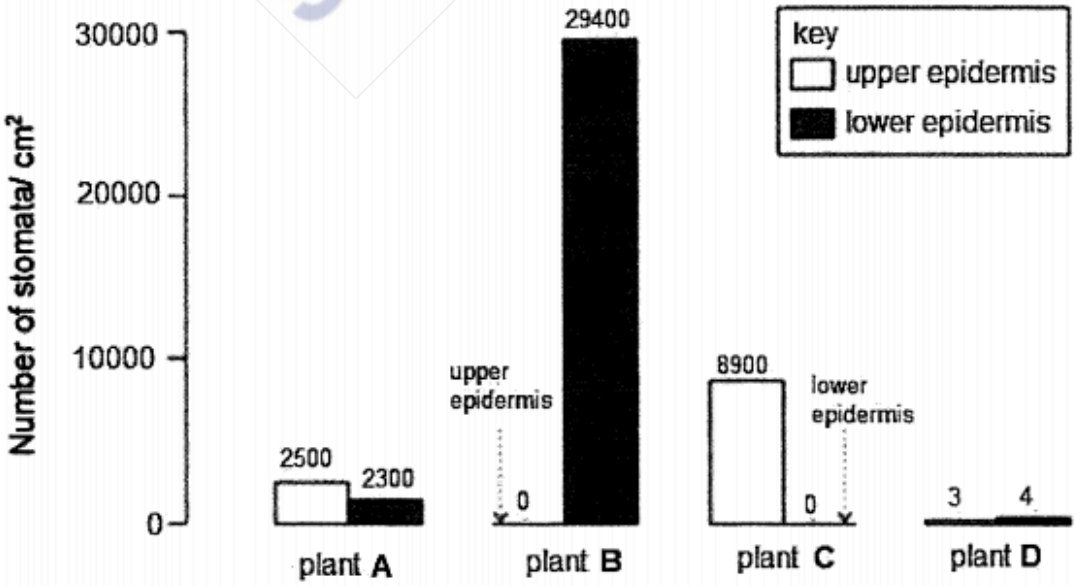
14 Plants of the rainforest floor are adapted to grow in conditions of permanently low light intensity.

Which graph shows the effect of light intensity on the rate of photosynthesis for these plants?



15 The graph shows the distribution of stomata on the upper and lower epidermis of the leaves of four plants.

Which of these plants can be found floating on the surface of an aquatic environment?

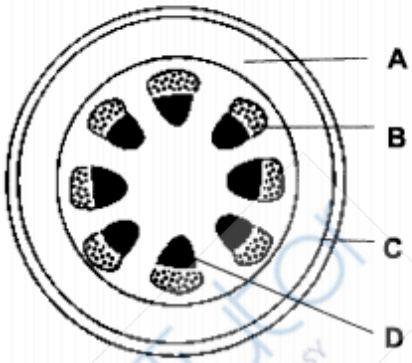


16 Which way could increase the rate of water uptake by a shoot?

A covering the shoot with a black plastic bag
B covering the shoot with a clear plastic bag
C removing the leaves from the shoot
D shining bright light onto the shoot

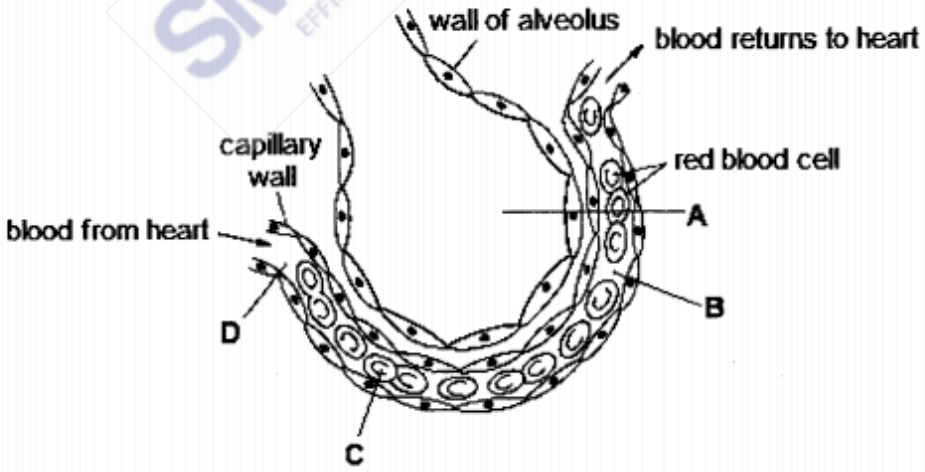
17 The diagram shows a section of a young stem.

Which cells do not respire?



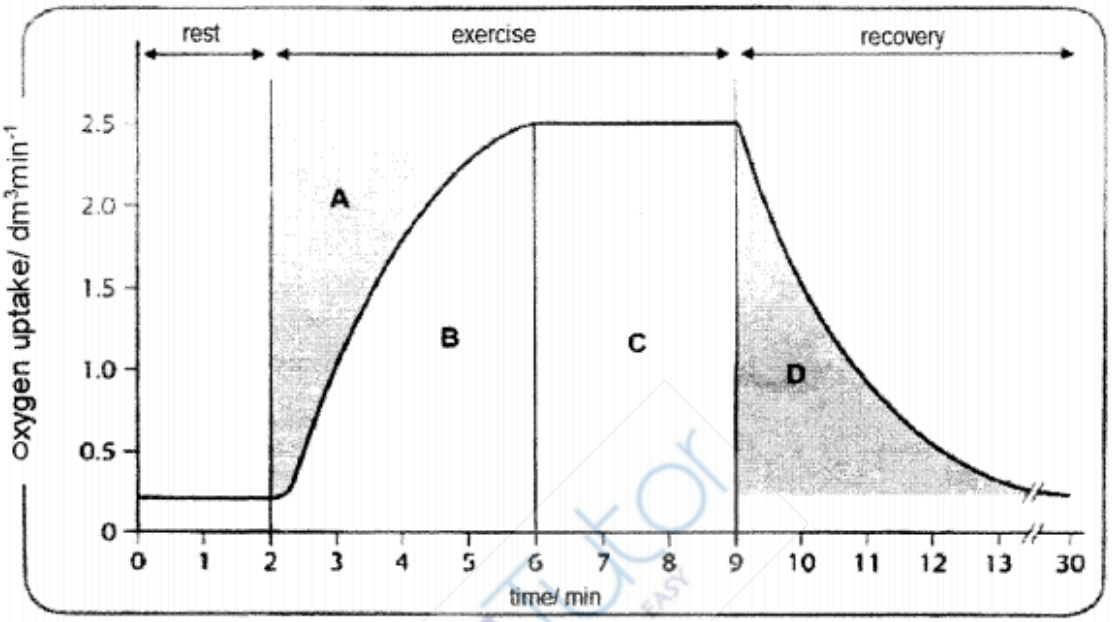
18 The diagram shows a section through an alveolus and an associated blood capillary.

In which part is the concentration of carbon dioxide the highest?

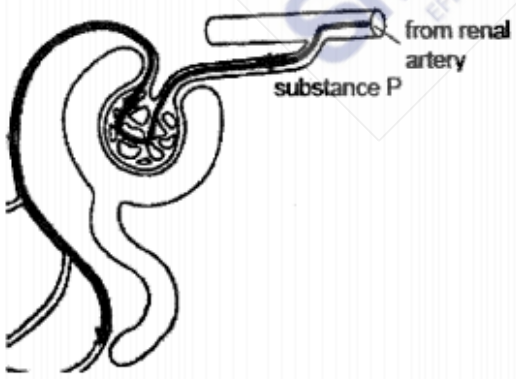


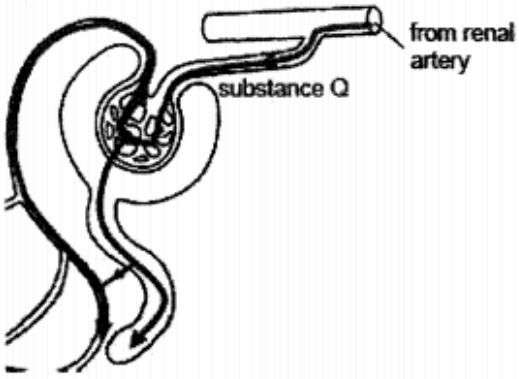
19 The diagram shows the oxygen uptake of a man before, during and after strenuous exercise.

Which region represents the repayment of oxygen debt?



20 The diagram shows the movement of substances P and Q through a normal, healthy human nephron.

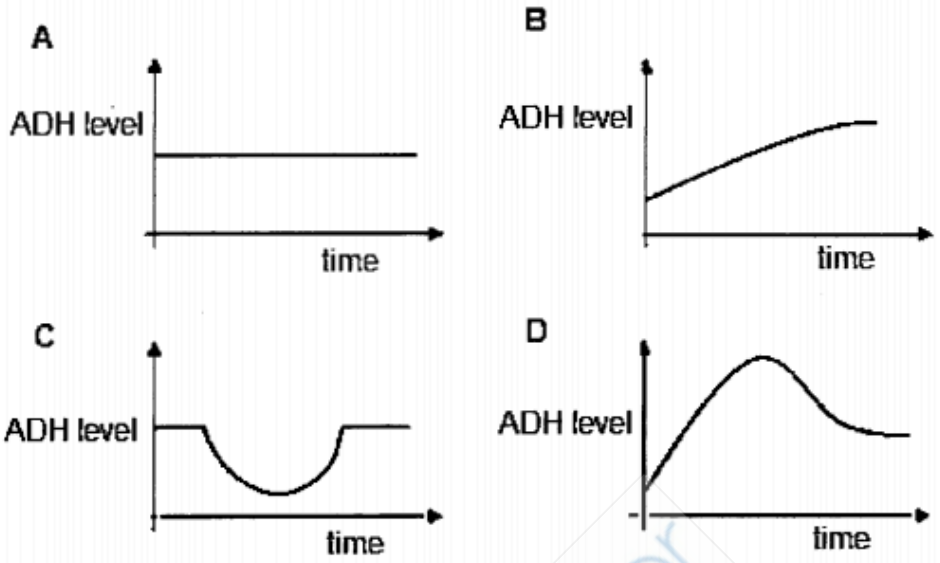




What could substances P and Q be?

	substance P	substance Q
A	glucose	mineral salts
B	mineral salts	plasma protein
C	plasma protein	water
D	water	glucose

21 Which graph best represents the levels of anti-diuretic hormone in the blood of a person who has just drunk a large cup of water?

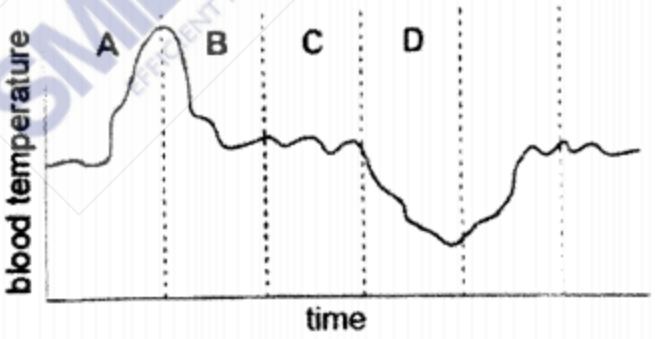


22 Which of the following is not an example of a homeostatic mechanism?

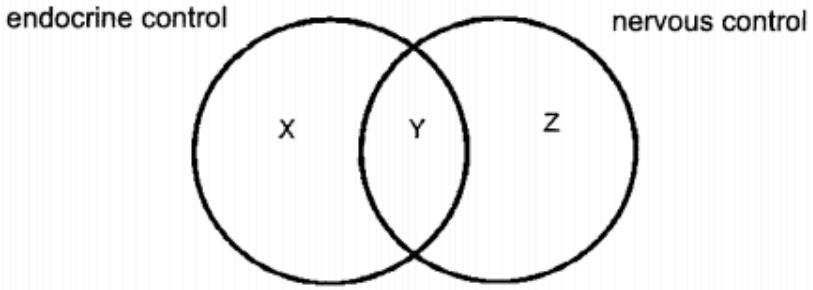
A osmoregulation
B production of sweat
C secretion of glucagon
D selective reabsorption in nephron

23 The diagram shows a section through the skin.

During which period of time will the muscles in structure X contract?



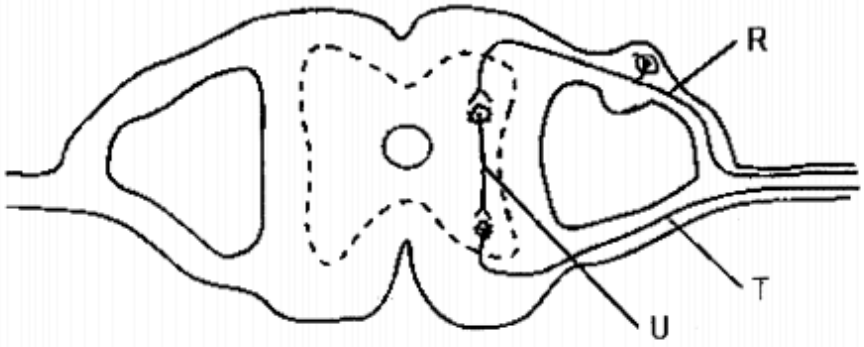
24 The comparison between an endocrine control and a nervous control can be illustrated using the following Venn diagram.



Which one of the following can fit into regions X, Y and Z?

	X	Y	Z
A	always involuntary	can be chemically transmitted	may be involuntary or voluntary
B	can be chemically transmitted	always involuntary	may be involuntary or voluntary
C	may be involuntary or voluntary	can be chemically transmitted	always involuntary
D	may be involuntary or voluntary	always involuntary	can be chemically transmitted

25 The diagram below shows a transverse section of the spinal cord with spinal nerves.



Nerve impulses in neurones can travel in the following directions.

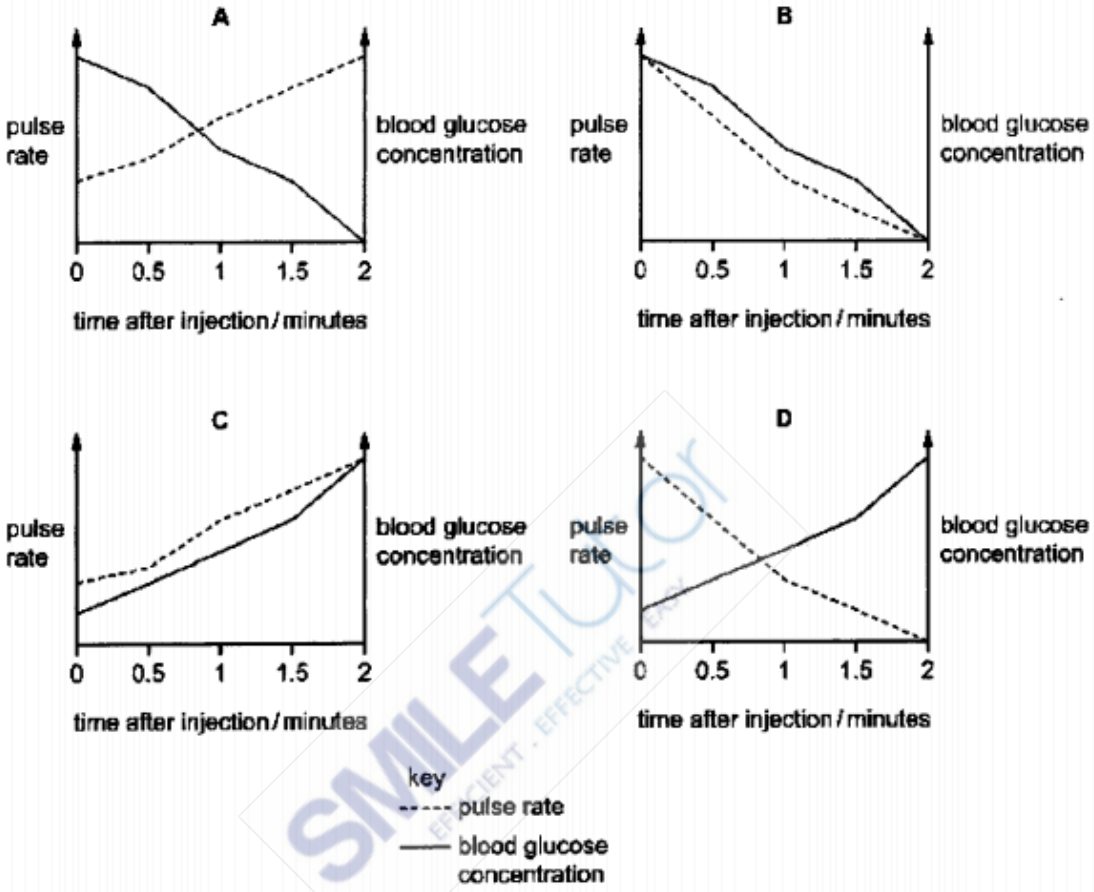
1 away from the central nervous system
2 towards the central nervous system
3 within the central nervous system

In which direction do impulses in neurones R, T and U travel?

	R	T	U
A	1	2	3
B	1	3	2
C	2	3	1
D	2	1	3

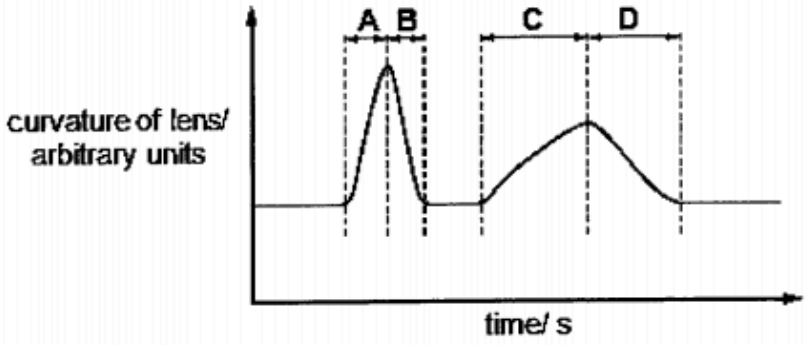
26 Jessica is injected with adrenaline.

Which graph shows the expected changes to pulse rate and blood glucose concentration?

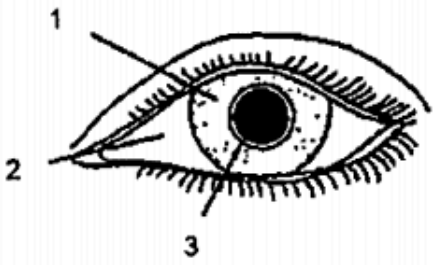


27 The diagram shows the curvature of the lens in a person's eye. The shape of the lens changes as the person watches two motorbikes move past at different speeds.

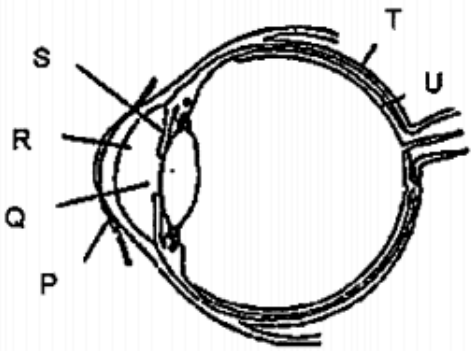
During which period was a motorbike moving towards the person at a higher speed?



28 The diagrams show the front view and longitudinal section of the human eye.



front view



longitudinal section

What structures shown in the front view are same as the longitudinal section?

	1	2	3
A	S	T	Q
B	P	Q	S
C	S	R	U
D	Q	R	T

29 An experiment was set up using four groups of insect pollinated flowers in a field. In each group, different parts of the flower were removed as shown in the table and insects were allowed to visit the flowers freely.

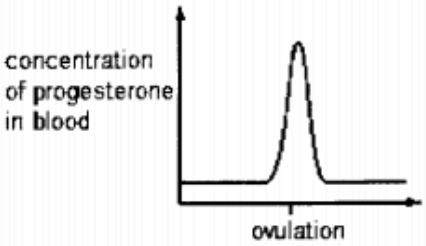
Which of the following groups of flowers will not produce seeds?

	petals	stigma	anthers
A	removed	intact	removed
B	intact	removed	intact
C	intact	intact	removed
D	removed	intact	intact

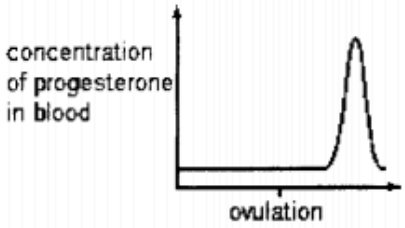
30 The graphs below show the concentration of progesterone in the blood of a female during a 28-day menstrual cycle.

Which graph shows the changes in concentration of progesterone if implantation occurs?

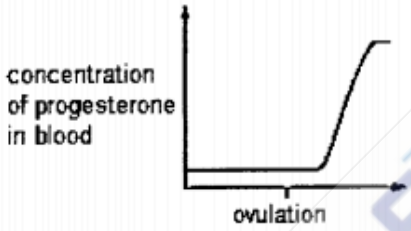
A



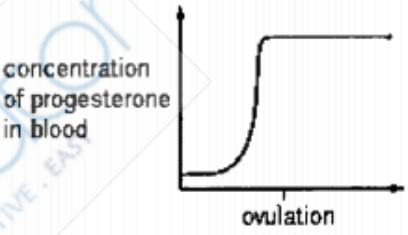
B



C



D

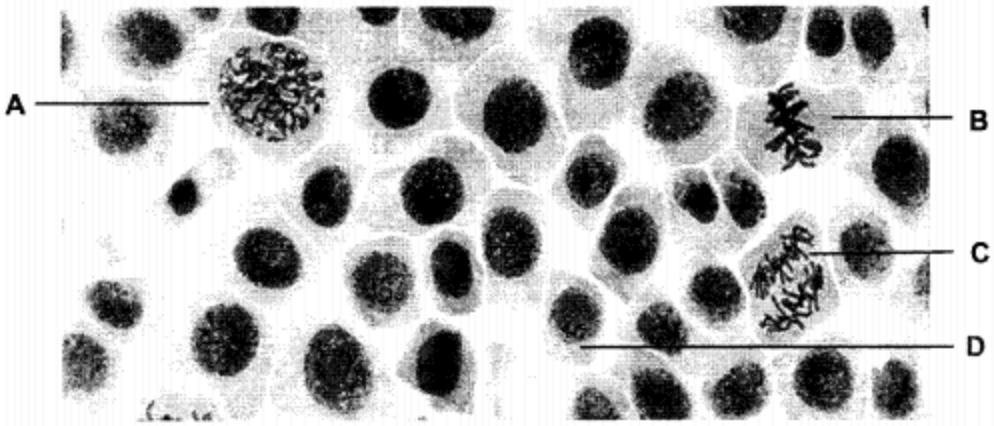


31 A couple who had been unsuccessful in having a baby wished to take advantage of in-vitro fertilisation, using the woman's own egg and her husband's sperm.

Which infertility problem could be most easily overcome in this way?

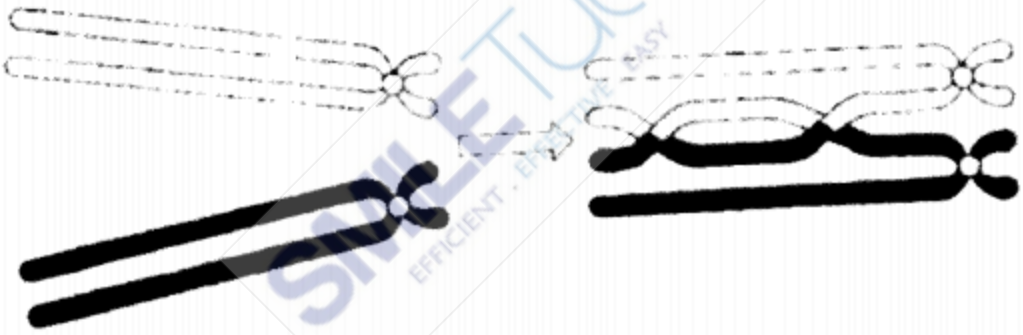
A blocked oviducts from severe infection
B failure of the follicle to mature
C pelvis is too small to allow normal development of the fetus
D unstable uterine wall which greatly reduces the probability of implantation

32 The photomicrograph shows cells obtained from the root tip of an onion.



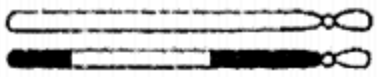
Which cell represents a cell during metaphase of mitosis?

33 The diagram below shows two chromosomes during the early stages of meiosis.

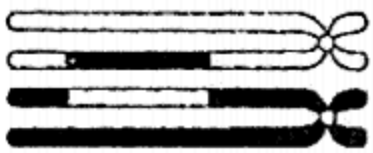


Which of the following diagrams represents the final products of the second meiotic division?

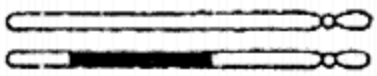
A



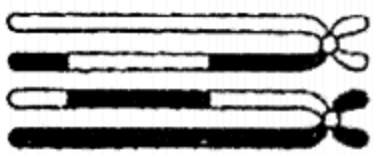
B



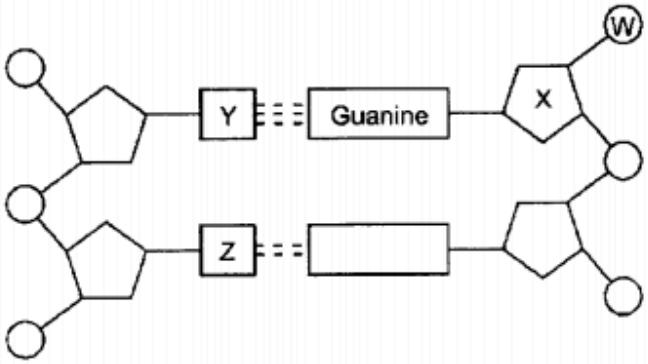
C



D



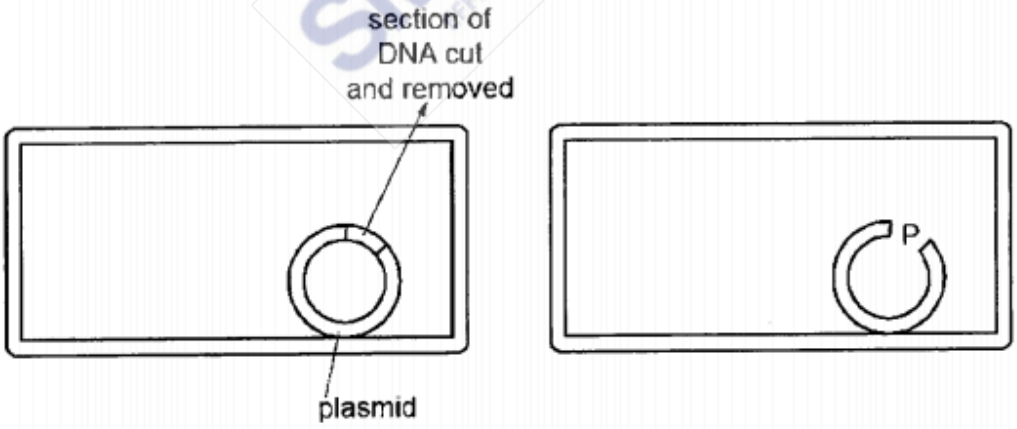
34 The diagram shows part of a DNA molecule.



Which letters indicate cytosine, deoxyribose sugar, phosphate and thymine?

	cytosine	deoxyribose	phosphate	thymine
A	W	X	Y	Z
B	Y	X	W	Z
C	Y	Z	X	W
D	Z	W	X	Y

35 The diagram shows a bacterium whose plasmid is being used during genetic engineering to produce human insulin.



What is inserted at P so that the bacterium can produce human insulin, and which enzyme is used to catalyse the insertion?

A a section of human DNA, using DNA ligase
B a section of human DNA, using restriction enzymes
C a section of human mRNA, using DNA ligase
D a section of human mRNA, using restriction enzymes

36 When a breed of cattle with red coats is crossed with the same breed with white coats, the offspring all have coats with a mixture of red and white hairs, a condition called roan.

What would the theoretical ratio of the offspring be, if a roan cow was crossed with a red coated bull?

A all red coated
B all roan
C 1 red coated : 1 roan
D 3 red coated : 1 roan

37 Two pure bred lines of different plant varieties, which differed greatly in bean seed mass, were crossed. The mass of bean seeds produced by the two parental varieties and their offspring were measured to the nearest gram. The number of bean seeds in each mass category was counted.

mass of bean/ mg		51-150	151-250	251-350	351-450	451-550	551-650	651-750
number of beans	parental	5	375	177			352	10
	offspring			13	544	974	48	

Which statement best explains these experimental data?

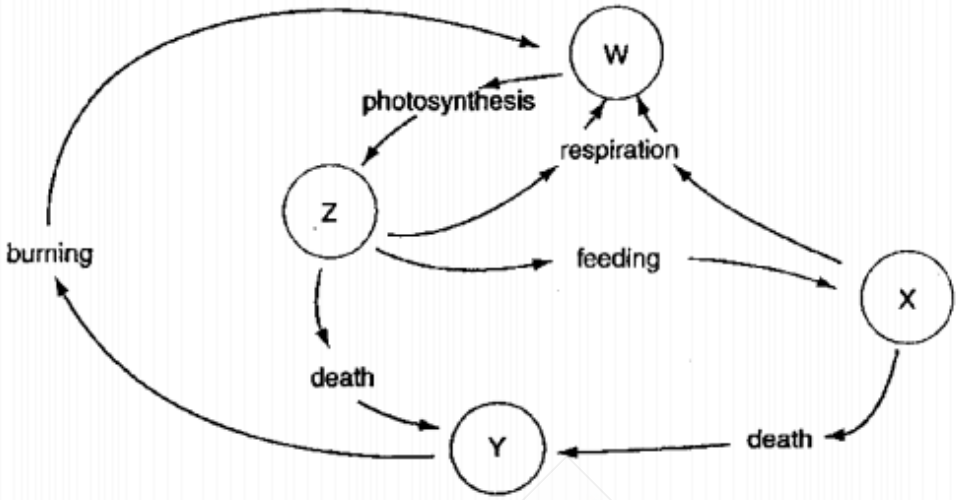
A The characteristic of bean mass shows continuous variation, which is brought about by the additive effects of multiple alleles.
B The mass of bean in plants is affected by various environmental factors, which caused the variation in bean mass observed in the offspring generation.
C The greater variation in bean mass observed in the offspring generation as compared to the parental generation may be due to random fusion of gametes.
D The mass of beans for the parental generation shows discontinuous variation while the offspring generation shows continuous variation.

38 Which environmental factors act as forces of natural selection?

1 competition
2 disease
3 food supply
4 predation

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

39 The diagram shows some stages in the carbon cycle. W, X, Y and Z are carbon compounds.



What could X be?

A coal and oil
B carbon dioxide in the air
C carbon compounds in plants
D carbon compounds in animals

40 A scientist tested the level of pesticides in the following food chain.

plankton → clams → flounder → white-bellied sea eagle

Which option shows the likely results? (ppm = parts per million)

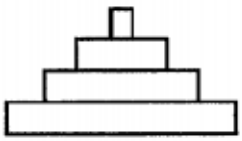
	plankton/ ppm	clam/ ppm	flounder/ ppm	white-bellied sea eagle/ ppm
A	0.03	0.23	2.05	18.45
B	0.03	0.06	0.09	1.00
C	0.03	0.03	0.56	6.30
D	0.03	0.005	0.00024	0.00001

41 The diagram shows a food chain.

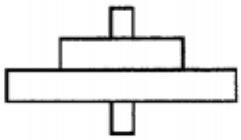
tree → herbivorous insects → carnivorous insects → bird

Which pyramid of numbers represents the food chain?

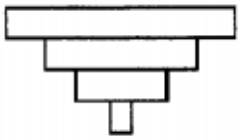
A



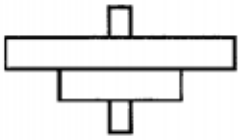
B



C



D



Section A (50 marks)
Answer **all** questions.
Write your answers in the spaces provided.

1 A student cuts a section of a stem and made an outline drawing of the distribution of tissues as shown in Fig. 1.1.

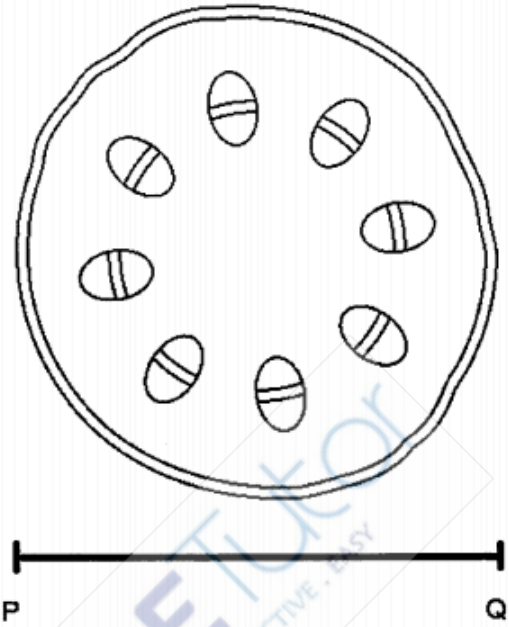


Fig. 1.1

(a) (i) Identify and label the position of xylem tissue on Fig. 1.1. [1]

(ii) The actual distance of P-Q is 0.08 mm.
Calculate the magnification of Fig. 1.1. Show your working clearly.

magnification = x ..... [1]

(iii) Explain why xylem is a tissue.

.....

..... [1]

(b) Describe how water from the soil is transported to the xylem in the root.

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..... [3]

[Total: 6]

2 Fig. 2.1 shows the total cross-sectional area of the blood vessels in the systemic circulation. It also shows the changes that occur in blood pressure and the speed (velocity) of blood in the different blood vessels.

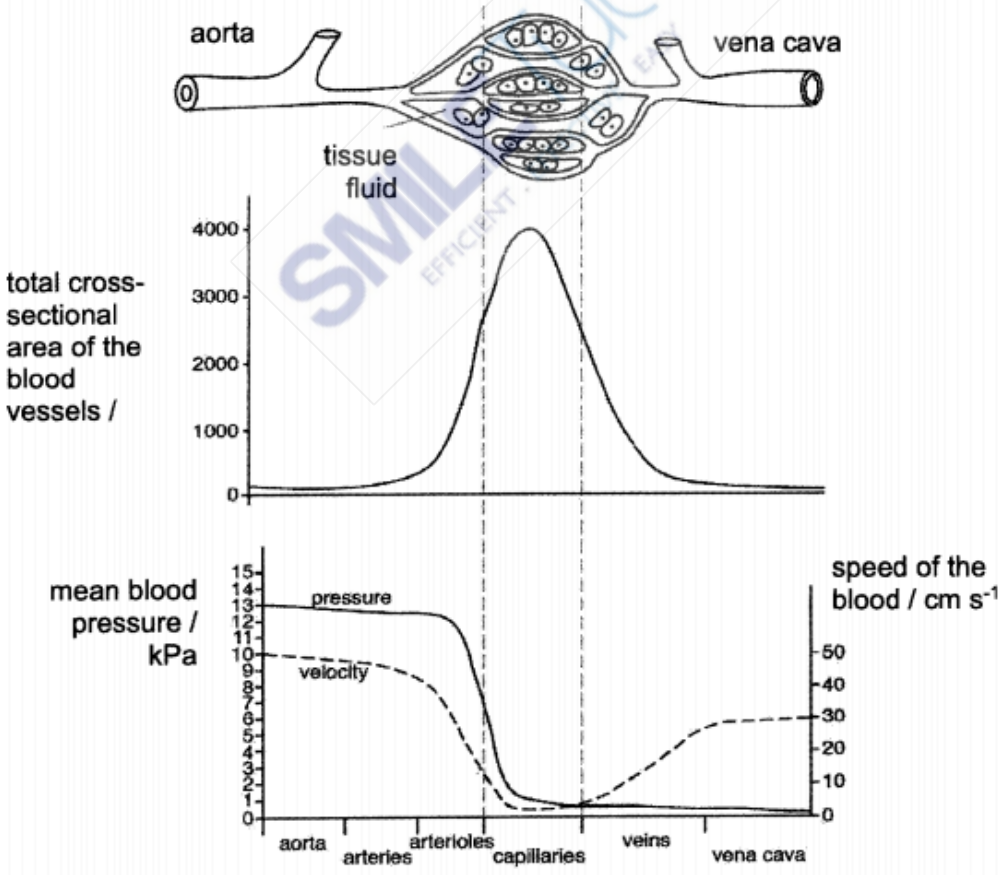

Fig. 2.1

(a) (i) State the maximum speed of the blood in the aorta.

..... [1]

(ii) Describe how mean blood pressure and speed of blood change with cross-sectional area of blood vessels, as shown in Fig. 2.1.

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..... [2]

(iii) Besides blood pressure and speed of blood, state two other ways in which the blood in aorta is different from the blood in vena cava.

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..... [2]

(b) Humans have a double circulation.

Explain two advantages of humans having a double circulation.

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..... [2]

[Total: 7]

3 **(a)** The concentration of lactic acid in the blood of two athletes was investigated. One athlete, P, had been training and the other, Q, was returning to training after an injury.

Blood samples were taken from both athletes during a training session. The results are shown in Fig. 3.1.

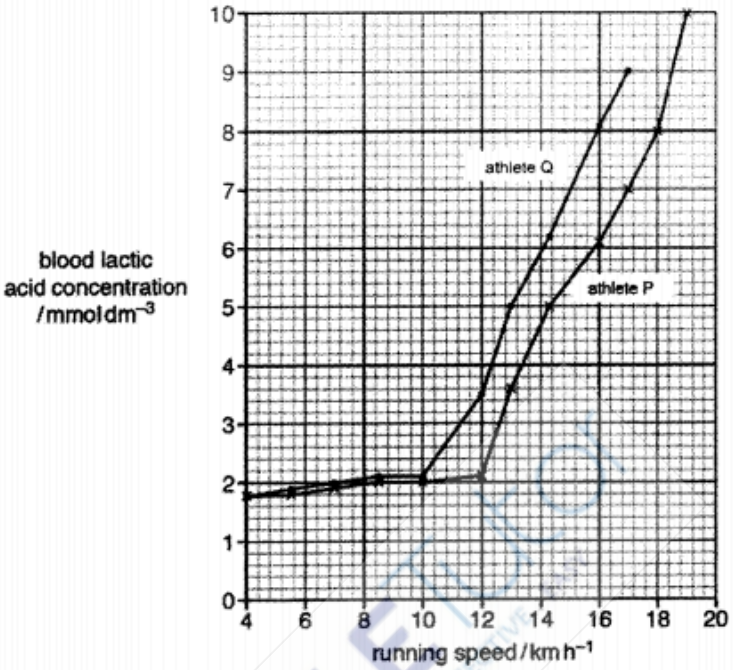

Fig. 3.1

(i) The lactic acid threshold is the running speed where the lactic acid concentration begins to increase sharply.

State the lactic acid threshold for athletes P and Q.

P: ..... km/h

Q: ..... km/h [1]

(ii) Suggest one reason for the difference in lactic acid threshold of athletes P and Q.

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..... [1]

(iii) Describe and explain the changes in blood lactic acid concentration of athlete P shown in Fig. 3.1.

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..... [4]

(b) Fig. 3.2 shows a photomicrograph of the epithelial lining in the human respiratory system.

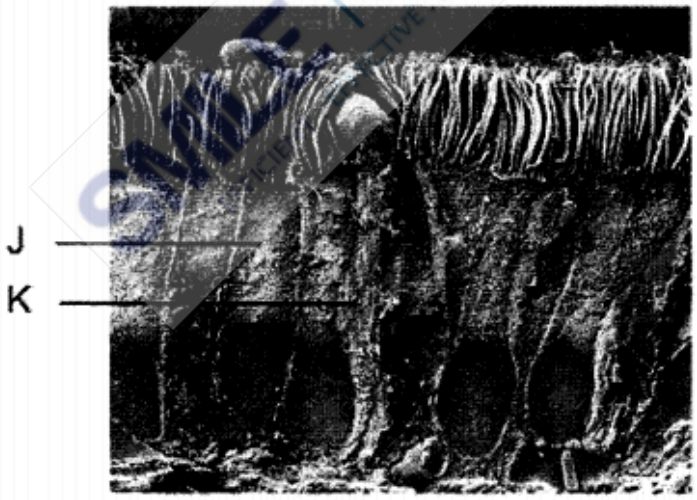

Fig. 3.2

Explain how cells J and K play a role in protecting the respiratory system.

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..... [2]

(c) When comparing to non-smokers, the ability of smoker to deliver oxygen to their body tissues are reduced. Two causes of this reduction include:

- a decrease in the volume of air per breath moving towards the alveoli
- a decrease in the ability of red blood cells to carry oxygen.

(i) Suggest one reason why smoking tobacco, even after only a short time, may cause a decrease in the volume of air per breath moving towards the alveoli.

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..... [1]

(ii) Explain why smoking tobacco causes a decrease in the ability of red blood cells to carry oxygen.

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..... [2]

[Total: 11]

4 The graph in Fig. 4.1 shows the sharpness of the image formed on various parts of the retina of a normal person, located at various degrees from a certain point X. The higher the value, the sharper the image formed on the retina.

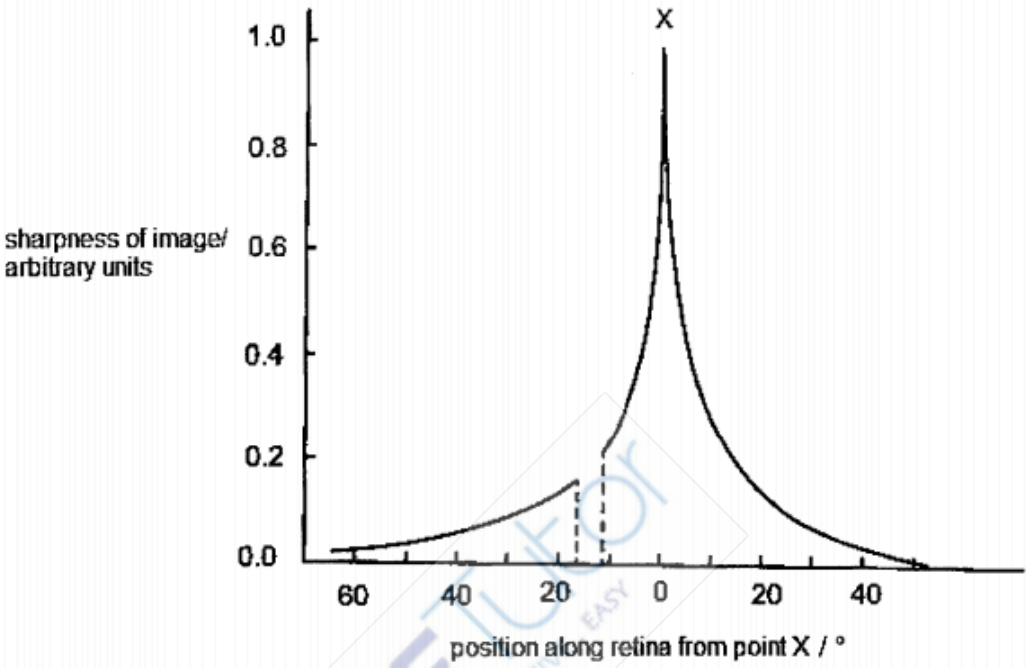

Fig. 4.1

(a) (i) With reference to the structure of the eye, suggest why there is a break in the graph when the position along retina is between 10° and 20° from point X.

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..... [2]

(ii) Suggest why the sharpness of image is only high at point X, rather than it being uniform throughout the retina.

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..... [1]

(b) Describe how the parts of the eye produce a focused image of a distant object.

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..... [3]

[Total: 6]

5 Fig. 5.1 shows two seeds, one from each of the two pea plants of the same species. Seeds from this species of plant have either a smooth surface or a wrinkled surface.

Fig. 5.1

(a) The type of surface of a seed is controlled by a single gene. The allele of the gene that gives the seed a smooth surface (R) is dominant to the allele that gives the seed a wrinkled surface (r).

(i) Distinguish clearly between the terms *gene* and *allele*.

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..... [2]

(ii) Explain the terms *dominant* and *recessive*.

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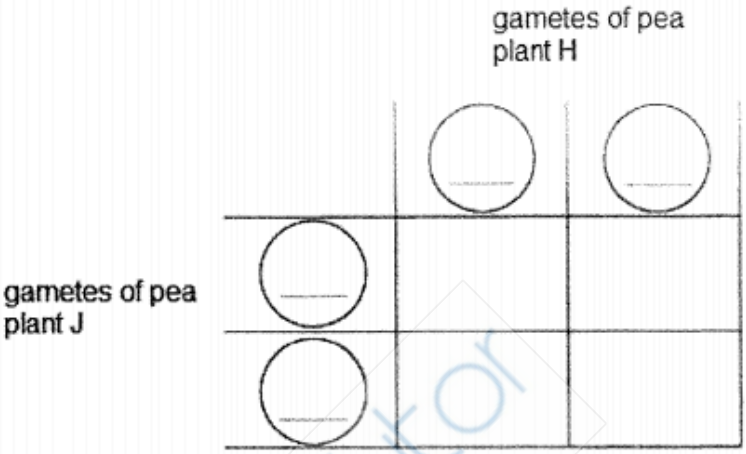
..... [2]

(b) One pea plant, H, has a homozygous genotype that develops seeds with a wrinkled surface. Another pea plant, J, has an unknown genotype. When these two plants were cross-pollinated, approximately half of the new plants produced had peas with a wrinkled surface.

Complete the genetic diagram below for this cross and state the genotype of pea plant J.



genotype of pea plant J: ..... [2]

[Total: 6]

6 A group of students collected 30 butterflies from a garden. They recorded the colour of the wings and measured the length of wings of each butterfly. The measurements and observations are organised in Table 6.1 and 6.2.

Table 6.1

length of wings/ mm	21-25	26-30	31-35	36-40	41-45
number of butterflies	4	10	12	8	6

Table 6.2

colour of wings	blue	yellow
number of butterflies	13	17

(a) (i) State what type of variation is exhibited by the colour of wings. Explain your answer.

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..... [2]

(ii) State a genetic explanation for the difference in the type of variation between length of wings and colour of wings.

..... [1]

(b) The forest is the natural habitat for species D. A small group of individuals of species D live in a forest. Fig. 6.1 shows what can happen, over the same period of time, if some members of species D migrate from the forest to a desert region.

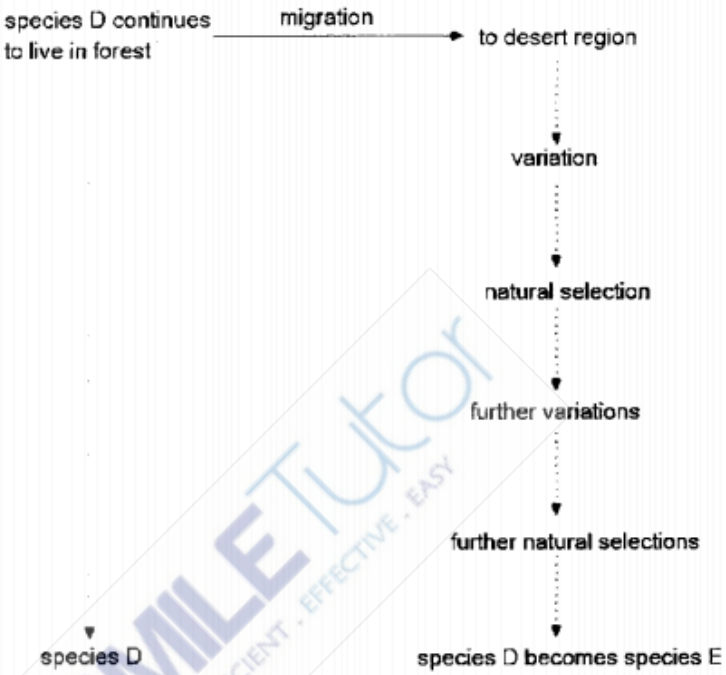

Fig. 6.1

Describe and explain how the processes of variation and natural selection lead to formation of the new species E.

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..... [3]

[Total: 6]

7 A scientist studies communities in different parts of a desert and estimated the biomass of the organisms in each area. He divided the organisms into three groups according to their roles in the food web as shown in Table 7.1.

Table 7.1

groups of organisms in the food web	biomass/ g per m^2
producers	480
herbivores	340
carnivores	40

Some of these results are shown as a pyramid of biomass in Fig. 7.1.

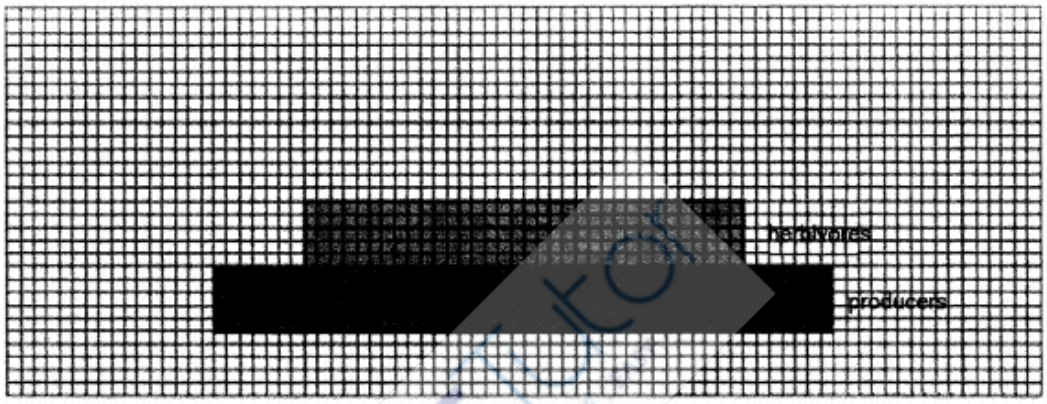

Fig. 7.1

(a) Use the information in Table 7.1 to complete the pyramid of biomass in Fig. 7.1. [1]

(b) Explain why there are rarely more than four or five trophic levels in ecosystems.

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..... [2]

(c) State a disadvantage of using pyramid of numbers to study the community.

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..... [1]

[Total: 4]

8 A healthy kidney controls the excretion of urea and other waste products of metabolism from the blood. When kidneys failed, there are two possible treatments: dialysis or a kidney transplant.

Fig. 8.1 shows how blood and dialysis fluid move through a dialysis machine.

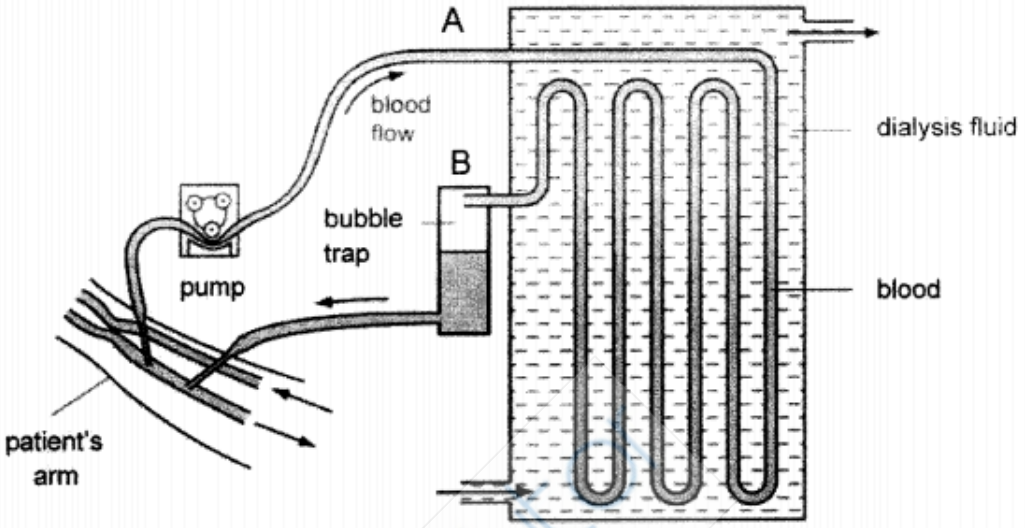

Fig. 8.1

(a) Describe and explain the changes that occur to the blood as it flows through the dialysis machine from A to B.

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..... [2]

(b) (i) Discuss an advantage of kidney transplants over dialysis.

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..... [1]

(ii) Explain why there is a need to ensure the donor organ for transplant is compatible with the recipient.

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..... [1]

[Total: 4]

Section B (30 marks)

Answer **three** questions.

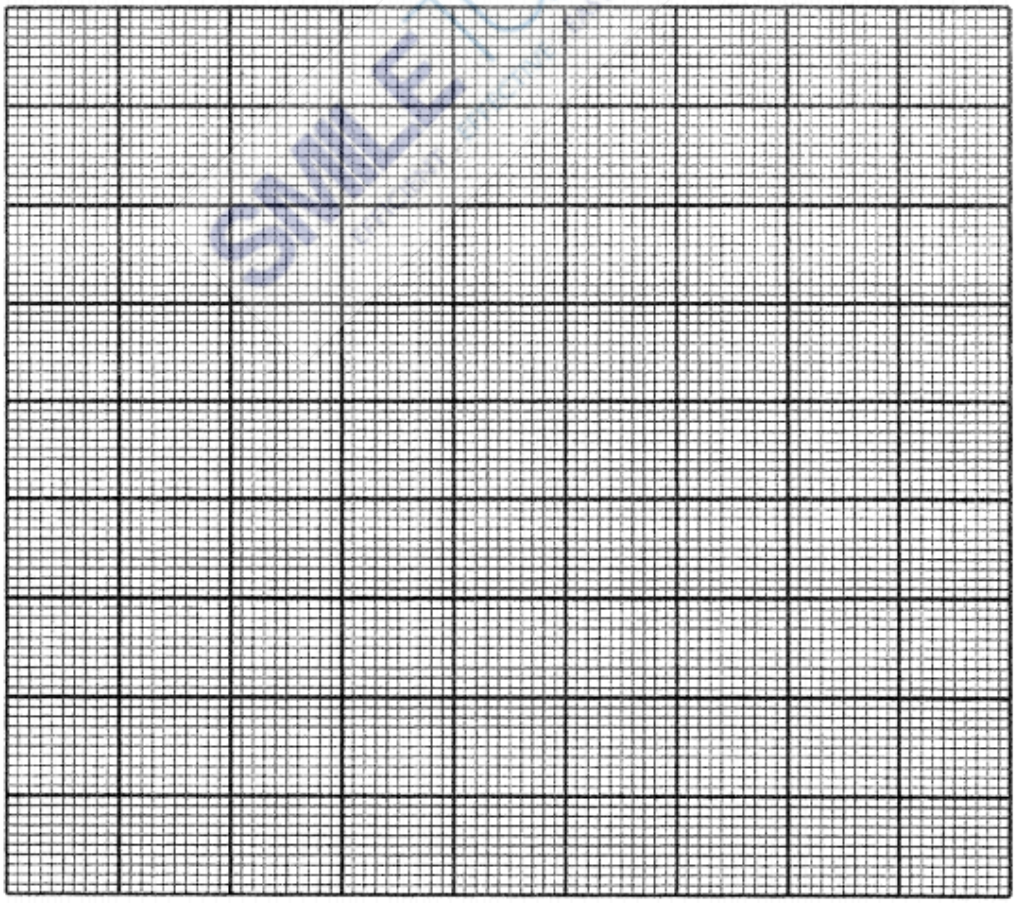
Question **11** is in the form of an **Either/Or** question. Only **one** part should be answered.

9 Table 9.1 shows the results obtained in an investigation to compare the rate of transpiration with the rate of water absorption of a plant taken at four-hour intervals on a summer day.

Table 9.1

time / h	rate of water absorption / g/h	rate of transpiration / g/h	light intensity / %
0400	1.50	0.25	0
0800	1.50	2.00	70
1200	3.50	5.00	100
1600	5.50	7.25	100
2000	3.25	2.50	10
2400	2.00	0.75	0

(a) Using the data in Table 9.1, plot a graph to show how the rate of water absorption and the rate of transpiration changes with time. Join the points using suitable line(s).



[4]

(b) Based on the results, what is the time of the maximum water absorption and maximum transpiration? Explain your answer.

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(c) With reference to Table 9.1, suggest whether the plant can live indefinitely under the conditions of the experiment.

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(d) Describe and explain how the rate of transpiration and water absorption will be affected if a polyethene bag is used to cover the leafy parts of the plant.

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..... [3]

[Total: 12]

10 Chemical X is a waste material from the manufacturing of fabric dyes.

In the past 30 years, factories dumped large quantities of chemical X into the river of a town. Studies measured the concentrations of chemical X in the tissues of organisms in a food chain with four trophic levels in the river, as shown in Table 10.1.

Table 10.1

concentrations of chemical X in arbitrary units	food chain in river
11000 – 16400	large-sized fishes
	↑
5 – 37	small-sized fishes
	↑
1.56	zooplankton
	↑
0.85	phytoplankton

(a) Define the term "trophic level".

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..... [1]

(b) Explain why large-sized fishes contain much higher concentrations of chemical X compared to the rest of the organisms in the food chain.

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..... [3]

(c) A surge in the amount of chemical X released into the river can cause large amounts of fishes to die.
Explain why these mass deaths result in depletion of dissolved oxygen in the river.

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..... [3]

(d) Chemical X is toxic to many organisms because they bind to a common protein molecule in living cells. A population of medium-sized fish lives in the river of the town. 80% of this population is resistant to the effects of chemical X.

Suggest why.

.....

..... [1]
[Total: 8]

EITHER

11 **(a)** In conditions of prolonged exposure to extreme cold temperatures (e.g. below 0^0C), frostbite occurs and the person may feel complete loss of sensation in the fingers and toes. Explain how this happens.

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..... [4]

(b) The after effect of frostbite can cause pain to the patient. Aspirin is a strong drug often used to relieve aches and pains. For the drug to act on its target organs, it must be absorbed by the small intestine into the bloodstream.
Describe and explain how the structure of villi contributes to the absorption of Aspirin.

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OR

11 (a) Describe the changes during a menstrual cycle and explain the role of the hormones in the process.

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..... [6]

(b) Fig. 11.1 shows the human life cycle. The components of the diagram are not drawn to the same scale.
Fig. 11.1 shows cells L, M and N, and two types of cell divisions, K and O.

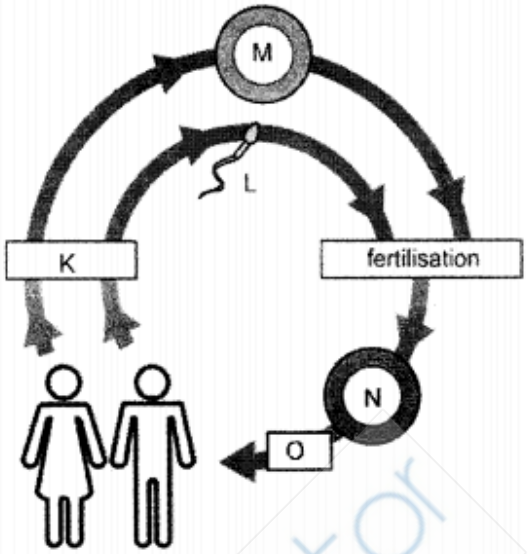

Fig. 11.1

Identify and compare the types of cell division K and O.

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..... [4]

End of paper

ANSWER SHEET

Paper 1

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

Paper 2

No	Answers	Marks
1ai	xylem tissue correctly identified and labelled	1
aii	Magnification = 67/0.08 = x837.5	1
aiii	composed of (a group of) xylem cells with similar structures + working together to perform a specific function;	1
b	• active transport of ions into root hair cell lowers water potential of cell sap/ or ref to concentrated cell sap of root hair cell; • water potential gradient between two solutions described, osmosis; • movement of water molecules from cell to cell (down water potential gradient) to xylem;	1 1 1
2ai	50 cm s^{-1}	1
aii	blood pressure decreases as cross-sectional area increases (in capillaries) ; blood pressure decreases slightly / remains roughly constant / as cross-sectional area decreases (in the veins) ; speed of blood decreases as cross-sectional area increases (in capillaries) ; speed of blood increases as cross-sectional area decreases (in veins / vena cava) ; Quota data	1 1 1 1 (max 2 – must be one on speed and one on pressure)
aiii	aorta higher concentration of oxygen than vena cava ; aorta lower concentration of carbon dioxide than vena cava. aorta lower temperature than vena cava; aorta lower concentration of lactic acid than vena cava,	Any 2 1m each
b	allows only deoxygenated blood to be transported to the lungs allows only oxygenated blood + transported to the rest of the body lower pressure blood + transported to the lungs higher pressure blood + transported to the rest of the body reference to increased efficiency of oxygen transport to body cells reference to increased efficiency of exchange of gases / carbon dioxide / oxygen in the lungs ;	1 1 1 1 (max 2)
3ai	P: 12km/h Q: 10km/h	½ each
aii	trained athlete / P has a higher level of (aerobic) fitness than Q; OR difference in, gender / age / height / mass / lung capacity / lung mass	1
aiii	describe: • when running speed increases from 4 – 12 km h^{-1}, lactic acid concentration increases gradually from 1.8 – 2.1 mmol dm^{-3}; explain: • ref. to low rate of anaerobic of respiration / energy is released by aerobic respiration as oxygen is still available; describe: • when running speed increases from 12 – 19 km h^{-1}, lactic acid concentration increases sharply from 2.1 – 10 mmol dm^{-3}; explain: (max 1) • oxygen demand increases, cells switch to anaerobic respiration to release energy;	1 1 1 1

	• anaerobic respiration produces lactic acid;	
b	cell J has cilia to help sweep the trapped particles up the bronchi and trachea; cell K secretes mucus to trap dust and bacteria;	1 1
ci	• ref. to airways / trachea / bronchi carry less air because the diameter of lumen decreases; smooth muscle contraction in bronchi cause narrowing of airway • inflammation; • thicker layer of mucus; • smoke present in inhaled air (so lower proportion of air);	1 1 1 1 (max 1)
ii	• carbon monoxide (present in smoke) binds to haemoglobin / ref. to carboxyhaemoglobin formed; • ref. to irreversible/ permanent binding; • presence of carbon monoxide lowers affinity of haemoglobin for oxygen; • comparatively less haemoglobin per red blood cell to bind oxygen;	1 1 1 1 (max 2)
4ai	The break in the graph corresponds to the location of the blind spot / region where optic nerve leaves the eye. The blind spot lacks photoreceptors, thus it cannot detect light and provide vision.	1 1
aii	When light enters the eye, it is only focused on one spot of the retina (the fovea) instead of the entire retina.	1
b	When the eye focuses on a distant object, the ciliary muscles relax and pull on the suspensory ligaments. The suspensory ligaments become taut and pull on the lens. The lens become thinner and less convex, increasing its focal length and focussing light rays from the distant object on the retina.	1 1 1
5ai	Allele is the alternate form of the same gene Gene is a unit of inheritance/ small segment of DNA/ sequence of nucleotides that codes for a single polypeptide of a trait (while allele express itself into a particular characteristic.)	1 1
aii	The dominant allele will be expressed in both homozygous or heterozygous condition while the recessive allele will only be expressed in homozygous condition	1 1
b	Pea plant J is Rr	1 – parent genotype 1-offspring genotype
6ai	Discontinuous variation The colour of the wings of butterflies can be grouped into 2 distinct groups without intermediate phenotype.	1 1
aii	Length of wings is controlled by multiple genes while the colour of the wings is controlled by one gene.	1
b	By chance, mutations result in variations in species D some varieties are better adapted to desert conditions than others; The better adapted varieties live longer, reproduce and pass their beneficial genes to their offspring; the less adapted varieties die off	1 1

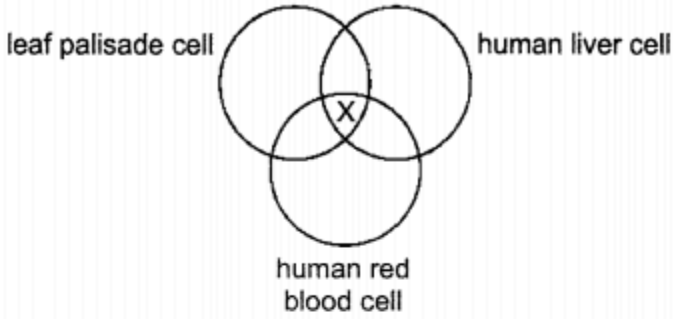
	Many rounds of mutations and natural selections result in accumulation of many beneficial genes cumulative effect over many generations lead to a change in appearance in species D, thus forming new species E.	1
7a	Show 4 squares + Label carnivore	1
b	Only 10 % of energy is transferred across trophic levels 90% is lost as heat during respiration/uneaten parts/faeces and excretory products, therefore insufficient energy available to support more than 5 trophic levels	1 1
c	Pyramid of numbers does not account for the size of the organism	1
8a	urea concentration decreases as the blood entering the dialysis machine contains a higher concentration of urea than the dialysis fluid/ dialysis fluid does not contain any urea; urea molecule diffuses out of the blood into the dialysis fluid down a concentration gradient; salt concentration decreases/ water content +could be increases / decreases/ glucose concentration could be increases / decreases / stays the same	1 1
bi	no need to go to clinic / hospital regularly ; increased freedom / better quality of life; a disadvantage of dialysis: pain / tiring / discomfort / time-consuming / can have wider diet; reference to cost or economic benefit to health service / individual ;	Max 1
bii	Recipients white blood cells will not produce antibodies to attack/ or engulf and ingest the transplanted organ	1
9a	- labelled axes with correct units with suitable scale - accurate plotting of points for both graphs (1m for each graph) - lines drawn/ join the points for both graphs	4
b	1600 At 1600, light intensity is 100%, stomata are widely open, causing maximum water transpiration. Rate of water absorption also increases to the maximum to replace the amount of water loss. At the same time at high light intensity, the rate of water absorption increases as the photosynthetic rate of plant increases.	1 1 1 1
c	No. Rate of transpiration is higher than rate of absorption between 6.48am to 7.48pm / for a long period of time / for most hours in the day, causing plant to wilt.	1
d	Decrease rate of transpiration and water absorption Increase humidity as water vapour are trapped in the polyethene bag, reduce the water vapour concentration gradient between the air spaces and the surrounding	1 1 1
10a	It is the feeding position of an organism in a food chain.	1
b	• animals at higher trophic levels consume more animals below them in the food chain due to inefficient flow of energy in food chain/ to obtain enough energy to survive	1

	• chemical X cannot be excreted/ removed / broken down/non-biodegradable • bioaccumulation (relating to individual organism and including the keyword and include description: build up / increase in concentration in the tissues) /bioamplification (including the keyword and relating to effects of increasing concentration along the food chain)	1 1
c	• dead fishes result in large amount of organic matter available • decomposition by bacteria • Increase in bacteria population + increase rate of aerobic respiration + decreases concentration of dissolved oxygen	1 1 1
d	Mutation resulted in a different protein molecule produced	1
11a(E)	Temperature drops, arterioles constricting; less blood flow to blood capillaries in skin; reduce blood flow to the skin to prevent heat loss; oxygen supply to skin reduced, ice crystals in spaces around the cells; cause cell death and destruction of cells in fingers and toes;	1 1 1 1 1 (max 4)
b	The presence of villi, a finger-like projections on the (inner) surface of the small intestine increases the surface area to volume ratio for a faster rate of absorption This surface area to volume ratio is further increased with the presence of microvilli on the epithelium of the villus, resulting in a faster rate of absorption. The wall of the villus is one-cell thick, reducing the diffusion distance allowing for a faster rate of diffusion of Aspirin into the bloodstream. Many blood capillaries are present in a villus to help carry away absorbed aspirin to maintain a steep concentration gradient for a faster rate of diffusion.	1 1 1 1 1 1 1 1 (max 6)
11a (O)	[duration] each menstrual cycle lasts about 28 days, involving 4 major phases, menstruation, repair of uterine lining, ovulation, preparation of lining for implantation [menstruation phase] during menstruation, which is between day 1 to 5, the uterine lining breaks down and discharged from the body. This is due to the low level of progesterone and oestrogen. (As the uterine lining is discharged, follicles are maturing in the ovary, resulting in the formation of mature follicle) [repair phase] the follicles produce oestrogen and the levels of oestrogen in the blood increases to repair the uterine lining [ovulation phase] high levels of oestrogen stimulates ovulation at about day 14, (in which an ovum is released into the oviduct.) [preparation of lining - ovary] the remains of mature follicles form corpus luteum which produces progesterone and some oestrogen to thicken the uterine lining [preparation of lining] Without fertilisation, corpus luteum disintegrates, levels of progesterone and oestrogen decreases and the uterine lining gets broken down, the cycle repeats.	1 1 1 1 1 1 1
b	K – meiosis and O - mitosis Meiosis | Mitosis	1

	chromosome + number halved / 46 to 23 / diploid to haploid (reduction division)	chromosome + number maintained / 46 to 46/ diploid to diploid	1m each, max 3
	genetically different, 4 daughter cells	genetically identical, 2 daughter cells	
	Involves crossing over	No crossing over	
	takes place in testes / ovaries / gonads – for reproduction	takes place in all parts of the body except the gonads – for growth	
	2 nuclear divisions	1 nuclear dvision	

RIVERSIDE SECONDARY SCHOOL SA2 PAPER

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



Which cell structure is X?

A cell wall

B chloroplast

C cytoplasm

D nucleus

2 Some processes occurring in organisms are listed.

1 absorption of glucose by villi
2 reabsorption of glucose by the kidney
3 translocation of sugars in the phloem
4 movement of oxygen into leaves of a plant
5 transpiration from the leaves of a plant
6 uptake of minerals by root hairs

Which processes may involve respiration?

A 1, 2, 3 and 6

B 1, 3, 4 and 5

C 2, 3, 4 and 6

D 2, 4, 5 and 6

3 The table shows the colours obtained after testing three different foods for carbohydrates, fats and proteins.

test	food X	food Y	food Z
Benedict's	brick-red	blue	blue
biuret	blue	violet	blue
ethanol emulsion	clear	clear	white
iodine	black	brown	brown

Which nutrients are present in foods X, Y and Z?

	food X	food Y	food Z
A	carbohydrates	proteins	fats
B	fats	proteins	carbohydrates
C	carbohydrates	fats	proteins
D	proteins	carbohydrates	fats

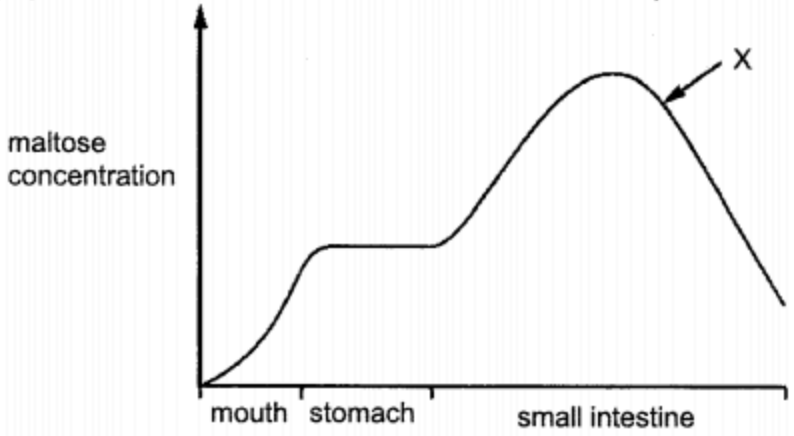
4 Seven test-tubes were set up at different pH values. They each contained the same concentration of substrate and enzyme. The table shows the time taken for the reaction to be completed in each test-tube.

pH	1	3	5	7	9	11	13
time to be completed / s	96	64	42	20	5	35	66

At which pH does the enzyme work best?

A pH 1 **B** pH 7 **C** pH 9 **D** pH 13

5 The graph shows the concentration of maltose in different parts of the alimentary canal.



What causes the change in concentration at X?

A absorption of maltose

B action of amylase

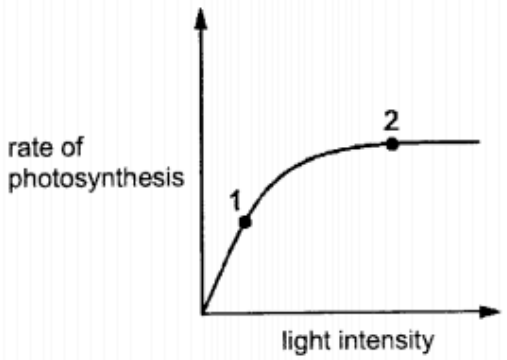
C action of maltase

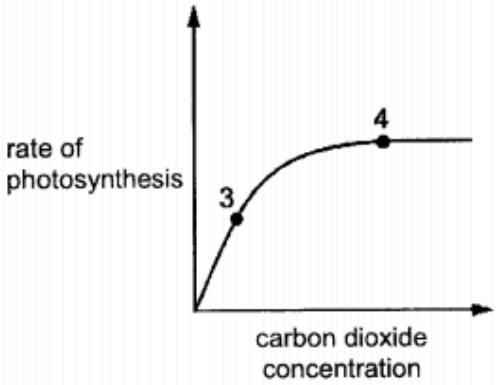
D assimilation of maltose

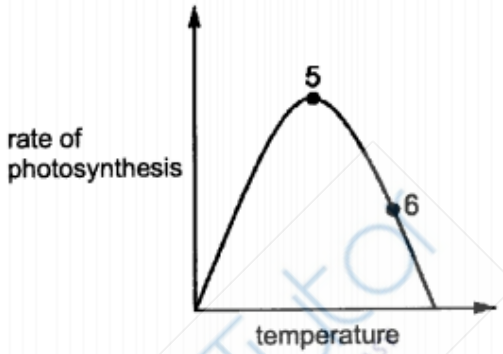
6 Which row correctly shows the number of molecules, for each substance used and produced, during photosynthesis?

	substances used	number of molecules	substances produced	number of molecules
A	CO_2 H_2O	1 1	$C_6H_{12}O_6$ O_2	6 1
B	CO_2 H_2O	6 6	$C_6H_{12}O_6$ O_2	1 6
C	$C_6H_{12}O_6$ O_2	1 1	CO_2 H_2O	6 6
D	$C_6H_{12}O_6$ O_2	6 6	CO_2 H_2O	6 1

7 The graphs show factors affecting the rate of photosynthesis.



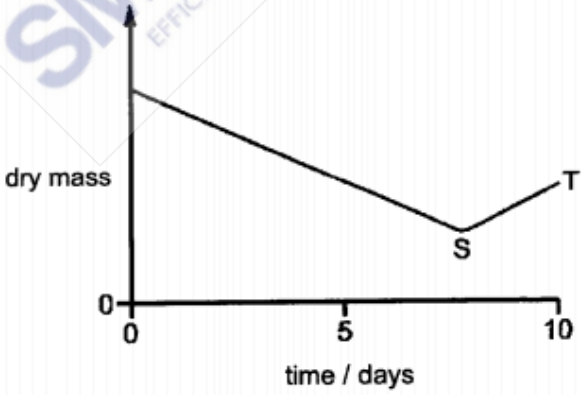




At which points on the graphs could the rate of photosynthesis be limited by light intensity?

A 1, 3 and 6 **B** 1, 4 and 5 **C** 2, 3 and 5 **D** 2, 4 and 6

8 The graph shows changes in the dry mass of a seed as it grows.



What causes the change shown between points S and T?

A osmosis

B photosynthesis

C respiration

D transpiration

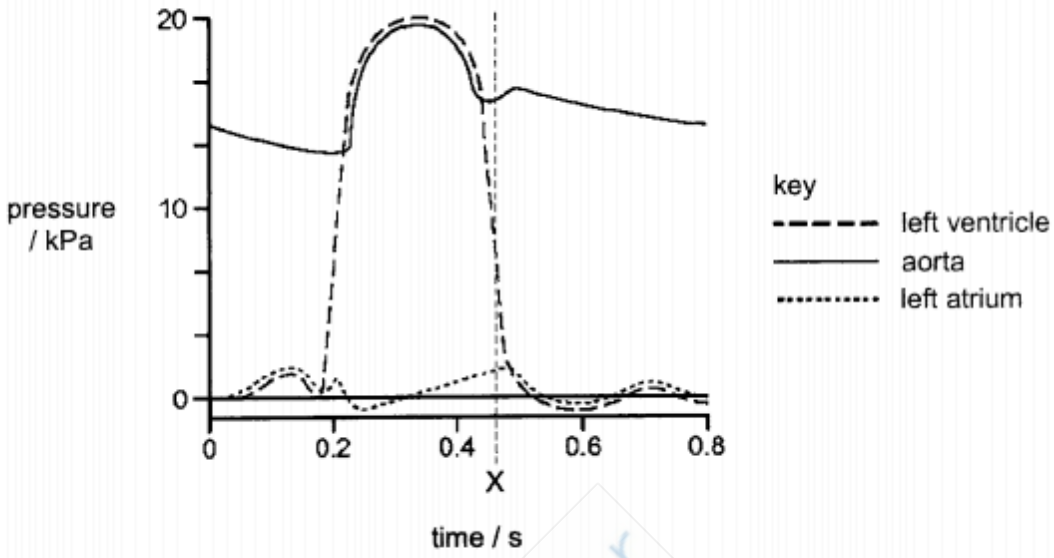
9 What is a difference between the contents of plasma and the contents of tissue fluid?

	plasma	tissue fluid
A	dissolved glucose	no dissolved glucose
B	less dissolved glucose	more dissolved glucose
C	more protein molecules	no protein molecules
D	white blood cells	no white blood cells

10 Which row describes the functions of the blood components?

	plasma	platelets	white blood cells
A	antibody formation	clotting	transport of nutrients
B	clotting	transport of nutrients	antibody formation
C	clotting	antibody formation	transport of nutrients
D	transport of nutrients	clotting	antibody formation

11 The diagram shows the pressures in the left side of the heart during one heartbeat.



Which valves are open and which are closed at the time marked X?

	bicuspid	semi-lunar
A	closed	closed
B	closed	open
C	open	closed
D	open	open

12 What is the pathway taken by water as it travels through a plant?

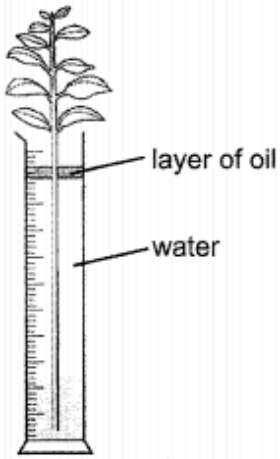
A mesophyll cells → xylem → root cortex cells → root hair cells

B root cortex cells → root hair cells → mesophyll cells → xylem

C root hair cells → root cortex cells → xylem → mesophyll cells

D xylem cells → mesophyll → root cortex cells → root hair cells

13 Four leafy plant stems were placed into measuring cylinders with 100 cm^3 of water. A layer of oil prevented the water in the measuring cylinder from evaporating.



The plant stems were exposed to different air humidities and temperatures for 48 hours as shown in the table.

plant stem	humidity	temperature / °C	final volume of water / cm^3
1	low	5	75
2	low	25	.....
3	high	5	95
4	high	25	65

The final volume of water in the measuring cylinders is shown for plant stems 1, 3 and 4.

What would be a likely final volume for plant stem 2?

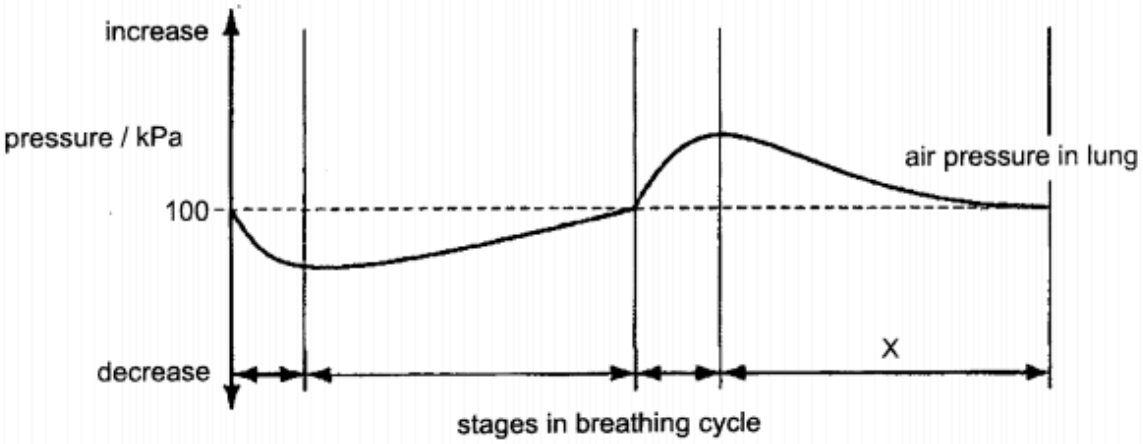
A less than 65 cm^3

B between 65 cm^3 and 75 cm^3

C between 75 cm^3 and 95 cm^3

D greater than 95 cm^3

14 The graph shows changes in air pressure within the lungs during one breathing cycle.



Which row describes the state of the breathing system during time X?

	diaphragm contracting	external intercoastal muscles contracting	internal intercoastal muscles contracting	lung volume increases
A	✓	✓	✗	✓
B	✓	✗	✗	✗
C	✗	✗	✓	✗
D	✗	✗	✓	✓

key
✓ = yes
✗ = no

15 Some structures found in the body are listed below.

1 alveolus
2 bronchus
3 small intestine
4 oviduct

Which structures are lined with cilia?

A 1 and 2

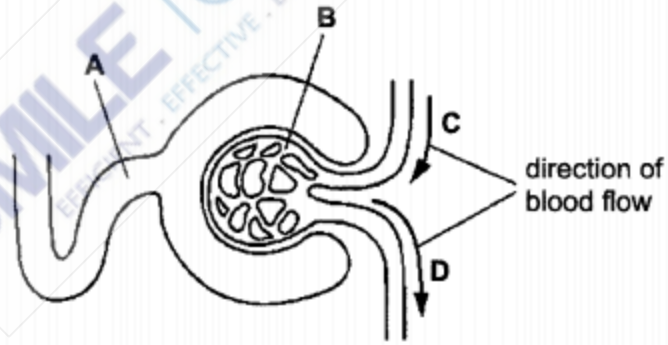
B 1 and 4

C 2 and 3

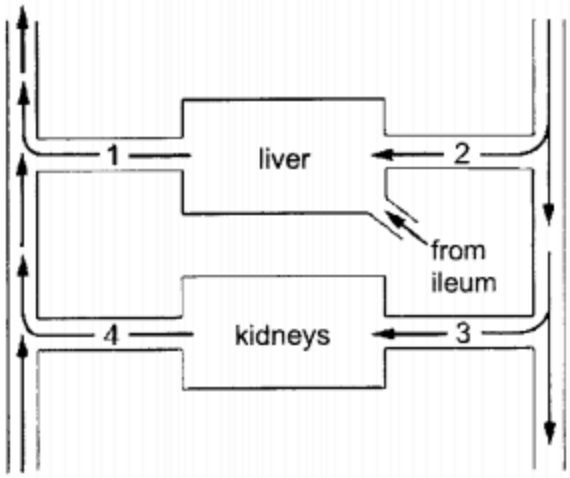
D 2 and 4

16 The diagram shows the first part of a kidney nephron and its blood supply.

Which part contains the highest concentration of protein?



17 The diagram represents the blood supply to the liver and to the kidneys.



Which blood vessels contain blood with the highest and lowest concentrations of urea?

	highest	lowest
A	1	2
B	1	4
C	3	2
D	3	4

18 Which mechanism for maintaining body temperature involves the action of muscles?

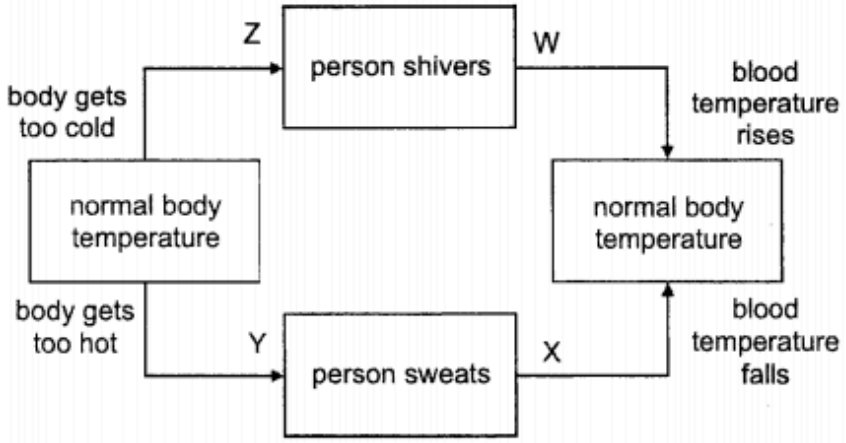
A detection of temperature

B insulation with fatty tissues

C sweating

D vasodilation of arterioles

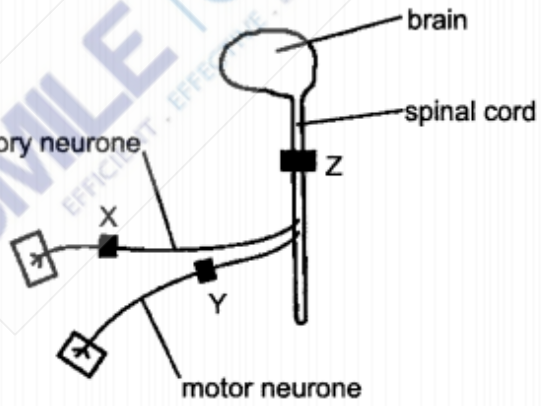
19 The diagram shows an example of homeostasis in a person.



Which letters represent negative feedback changes?

A W and X **B** W and Y **C** X and Z **D** Y and Z

20 The diagram shows three possible positions, X, Y and Z, where nerve impulses are blocked by a drug.



A person has a block at Y.

Which row describes what happens to the person?

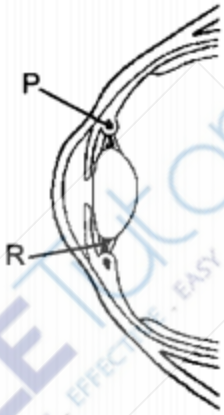
	moves the leg	feels a pinprick
A	✓	✗
B	✗	✓
C	✓	✓
D	✗	✗

key
✓ = yes
✗ = no

21 Which row best describes a reflex action?

	response	effector
A	rapid	brain
B	slow	muscle
C	rapid	gland
D	slow	spinal cord

22 The diagram shows a section through the eye.

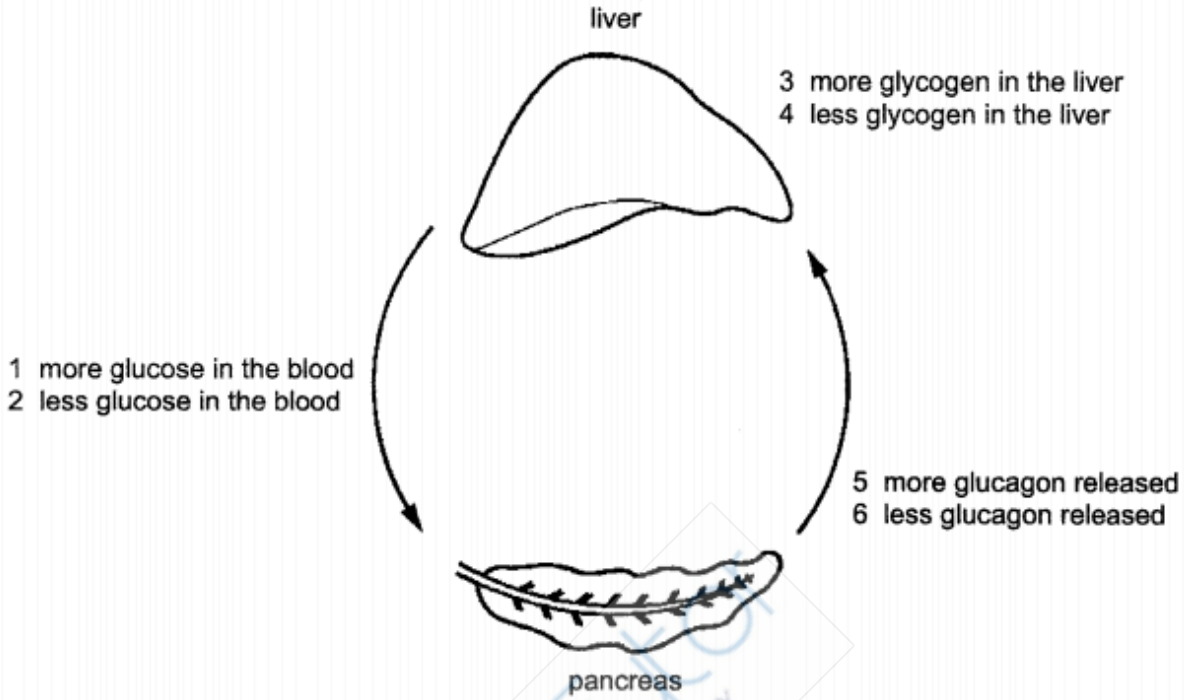


A person was looking at a plane in the sky, and looked down at his mobile phone.

What is the name and state of the structures P and R?

	P		R	
	name	state	name	state
A	ciliary muscles	contracted	suspensory ligaments	loose
B	ciliary muscles	relax	suspensory ligaments	tight
C	suspensory ligaments	contracted	ciliary muscles	tight
D	suspensory ligaments	relax	ciliary muscles	loose

23 The diagram shows part of the mechanism that controls blood sugar concentration.



A person does one hour of exercise.

Starting with the pancreas, what is the sequence of events in which glucagon is involved?

A 5 → 3 → 2 **B** 5 → 4 → 1 **C** 6 → 3 → 1 **D** 6 → 4 → 2

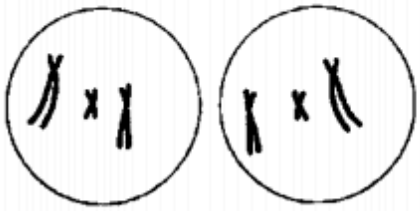
24 Which row matches each hormone to its function?

	reduces blood glucose concentration	repairs uterus lining	increases water potential of blood	dilates pupil
A	adrenaline	oestrogen	insulin	antidiuretic hormone
B	adrenaline	antidiuretic hormone	oestrogen	insulin
C	insulin	adrenaline	antidiuretic hormone	oestrogen
D	insulin	oestrogen	antidiuretic hormone	adrenaline

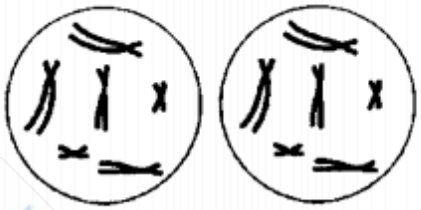
25 The diagram shows the chromosomes in a cell nucleus.

Which diagram shows the product of one division of the cell nucleus by mitosis?

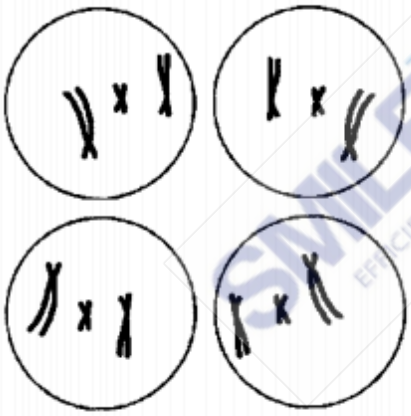
A



B

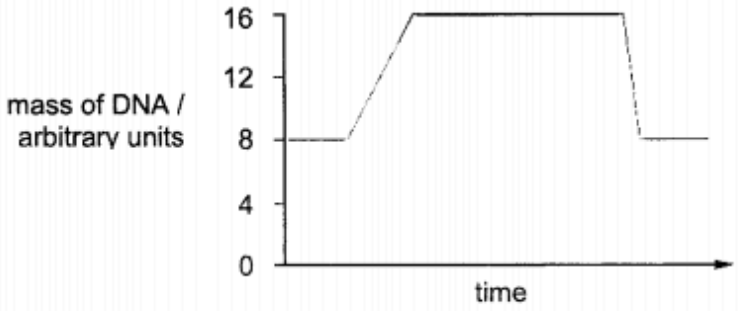


C



D

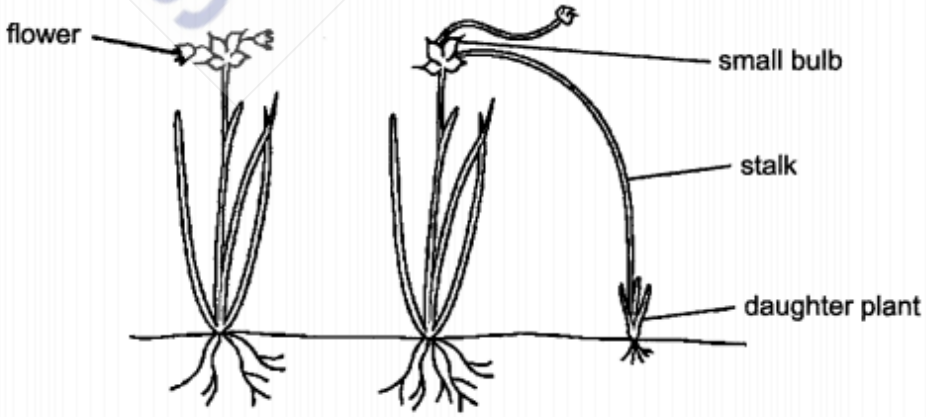
26 The diagram shows the mass of DNA in cells which are dividing.



Which row describes this type of cell division?

	type of cell division	type of reproduction using this cell division	this type of cell division gives rise to
A	meiosis	asexual	genetically identical offspring
B	meiosis	sexual	genetically dissimilar offspring
C	mitosis	asexual	genetically identical offspring
D	mitosis	sexual	genetically dissimilar offspring

27 The diagram shows two onion plants.



Using the information in the diagram, which statement about these onion plants is correct?

A Daughter plants are produced from the small bulb by meiosis.

B Daughter plants produced from the flower are genetically identical to the parent plant.

C The plants can reproduce sexually and asexually.

D Two parent plants are required for reproduction.

28 The following investigation was carried out using flower buds growing on three plants of the same species:

Plant 1 – The anthers were carefully removed and the buds left open to the air.

Plant 2 – The anthers were left untouched and a paper bag was tied tightly around each bud.

Plant 3 – The anthers were carefully removed and a paper bag was tied tightly around each bud.

Although all flowers later opened normally, only those on plant 1 produced seeds.

Which statement shows a conclusion that can be made from the results?

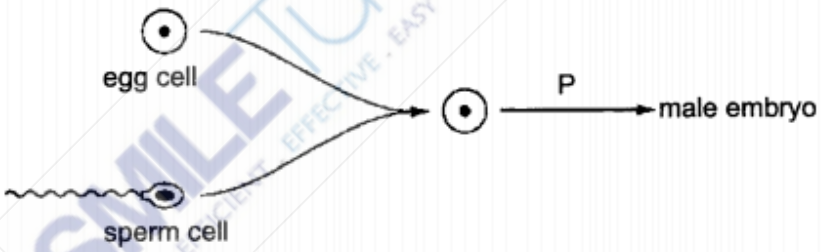
A Only cross-pollination can take place.

B Only wind-pollination can take place.

C Only insect-pollination can take place.

D Both self- and cross-pollination can take place.

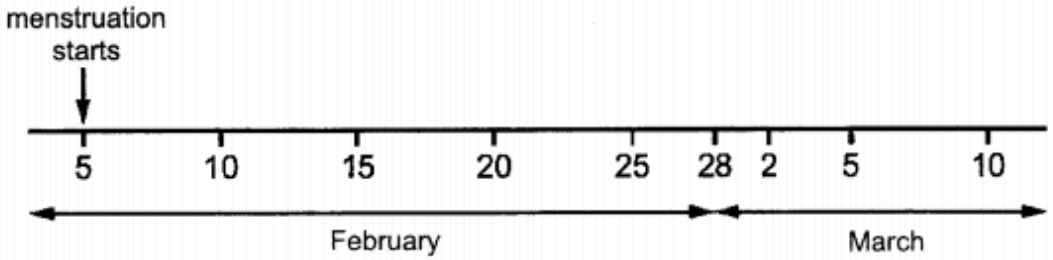
29 The diagram shows the production of a male embryo.



Which row shows the sex chromosomes in the cells and the type of cell division at P?

	sex chromosomes found in			type of cell division at P
	egg cell	sperm cell	male embryo	
A	X	X	XX	mitosis
B	X	Y	XY	mitosis
C	X	X	XX	meiosis
D	Y	X	XY	meiosis

30 The diagram shows a calendar for 33 days in February and March.



A girl, who has a regular menstrual cycle of 28 days, begins menstruation on 5 February.

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

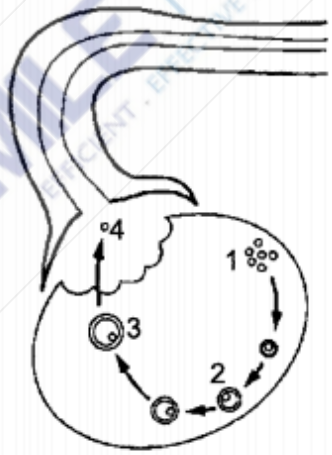
A 5 – 12 February

B 13 – 19 February

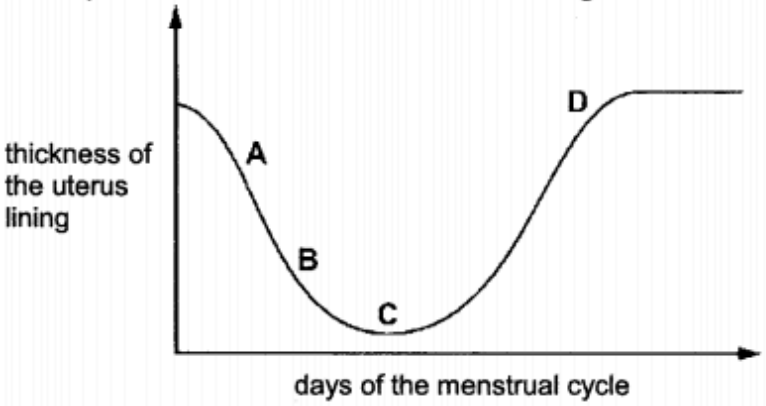
C 20 – 26 February

D 27 February – 5 March

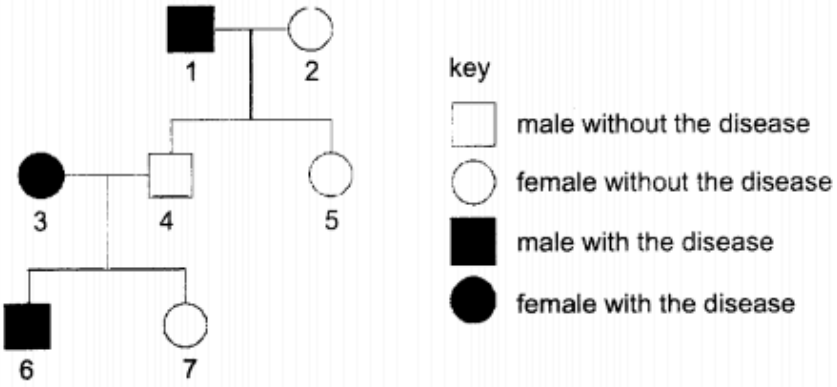
31 The diagram shows changes in the ovary.



Which point represents the thickness of the uterus lining when the ovary is at stage 4?



32 The diagram shows a family in which some members suffer from a disease caused by a recessive allele.



Which two members of the family must be heterozygous for the gene?

A 5 and 7 **B** 3 and 6 **C** 2 and 5 **D** 1 and 4

33 The diagram shows two human chromosomes from a muscle cell.

Which row best describes P?

	term	description
A	complementary	two chromosomes that have complementary base pairing
B	complementary	two chromosomes that have the same sequence of genes
C	homologous	two chromosomes that form a pair at the start of meiosis
D	homologous	two chromosomes that have identical alleles

34 One gene has two codominant alleles, A^E and A^F, and one recessive allele, A^G.

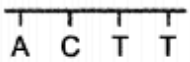
How many different genotypes and phenotypes are possible?

	genotypes	phenotypes
A	3	3
B	4	6
C	6	4
D	6	6

35 Which statements about natural selection are correct?

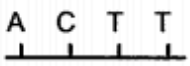
	natural selection can lead to better adapted species surviving	natural selection can lead to extinction of a species	natural selection can lead to gene mutations occurring
A	true	true	true
B	true	true	false
C	true	false	true
D	false	true	true

36 The diagram shows a short section of a single strand of DNA.

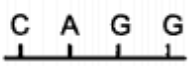


Which strand of DNA will combine with this strand to form part of a double helix?

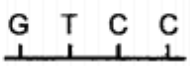
A



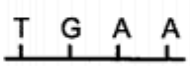
B



C



D



37 Which statements about the use of bacteria to produce human insulin are correct?

1 Enzymes are used to cut out the human insulin gene.
2 The human insulin gene is transferred to bacterial DNA.
3 The bacterial DNA is transferred into human cells.

	statement		
	1	2	3
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✓

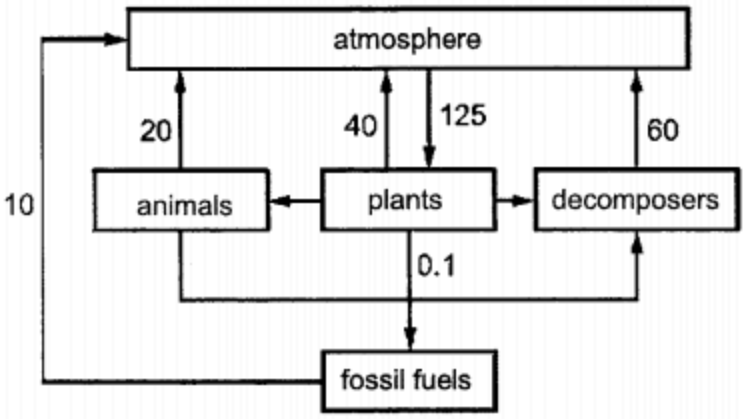
key
✓ = correct
✗ = incorrect

38 In a pyramid of biomass, the mass of producers is 800 g / m^2.

What are the likely masses of the carnivores and the herbivores?

	carnivores / g / m^2	herbivores / g / m^2
A	4	4
B	4	40
C	40	4
D	400	40

39 The diagram shows the movement of carbon in the carbon cycle, in gigatonnes per year.



How many gigatonnes of carbon are moved by respiration each year?

A 120 **B** 125 **C** 130 **D** 255

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

What is directly responsible for the increase in decomposers?

A a decrease in dissolved oxygen concentration

B an increase in nitrate concentration

C an increase in the population of algae

D an increase in the death of producers

Section A

Answer **all** questions.

Write your answers in the spaces provided.

1 Fig. 1.1 shows the human lungs and associated structures.

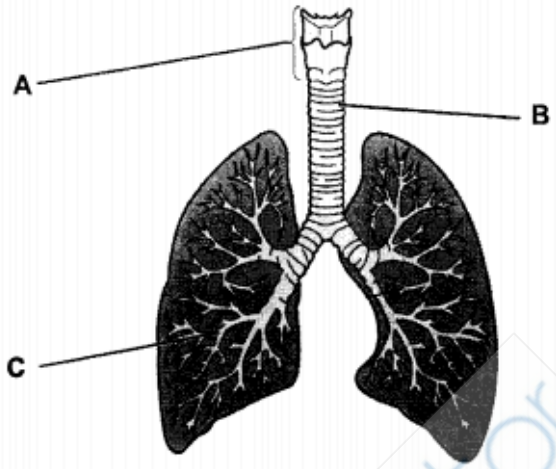


Fig. 1.1

(a) Identify structures **A**, **B** and **C** in Fig. 1.1.

A .....

B .....

C .....

[3]

(b) Lungs are important organs in humans.

Explain why humans need lungs.

.....

.....

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..... [3]

[Total: 6]

2 A person visits an eye doctor to have an eye test. Fig. 2.1 shows a diagram of an eye, which is on the wall of the doctor's room.

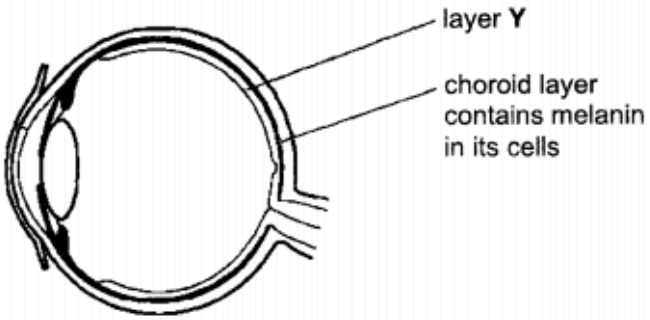

Fig. 2.1

(a) As part of the eye test, the doctor shines a bright light into the eye and takes a picture. Fig. 2.2 shows layer **Y** and the choroid layer behind it.

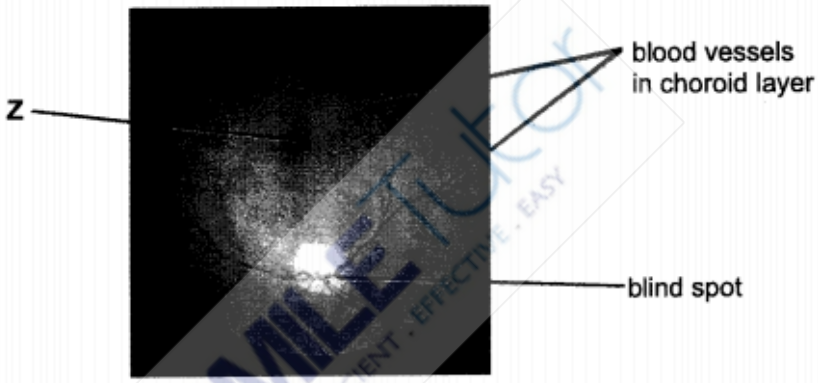

Fig. 2.2

(i) State the name of **Z**.

.....

[1]

(ii) Layer **Y** does not contain blood vessels.

Explain how the blood vessels in the choroid layer are important for layer **Y**.

.....

.....

..... [2]

(b) When the bright light is shone into the eye, there is a pupil reflex which causes the pupil to become smaller.

Explain how **named** parts of the eye and the nervous system are involved in this pupil reflex.

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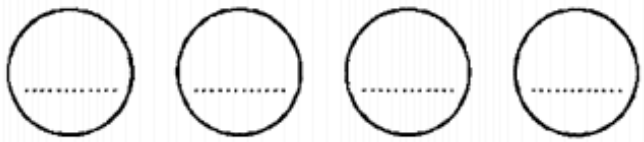
..... [4]

(c) Some people inherit a condition which prevents the production of the dark pigment melanin in their choroid and skin cells. Only people with two recessive alleles have this condition.

(i) Two parents are both heterozygous for the condition. Use **A** for the dominant allele and **a** for the recessive allele to complete the genetic diagram.

	father	x	mother
genotypes of parents	.....	x	.....

gametes



genotypes of offspring ....

phenotypes of offspring ....

[4]

(ii) The parents have two children who are unaffected by the condition. The mother is pregnant with her non-identical twins.

State the probability of **both** the twins having the condition.

..... [1]

[Total: 12]

3 A man is cooking in a hot kitchen and sweating.

(a) (i) Explain the term homeostasis with reference to sweating.

.....

.....

.....

..... [2]

(ii) Explain how blood vessels in the man's skin are also involved in homeostasis when he is in the hot kitchen.

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..... [3]

(b) Sweat contains very small quantities of the waste product urea.

Name the organ where urea is made in the body.

..... [1]

(c) Table 3.1 shows the concentrations of some chemicals found in the sweat, urine and blood plasma of a healthy human.

Table 3.1

chemical	concentration of chemical / mmol per dm^3		
	sweat	urine	blood plasma
urea	22	393	6
sodium	66	110	141
chloride	59	103	99

(i) Compare the chemical composition of urine and blood plasma.

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..... [2]

(ii) A patient has kidney disease and is about to start dialysis treatment.

With reference to Table 3.1, suggest and explain the concentration of urea in the sweat of the patient compared to that of a person who does **not** have kidney disease.

.....

.....

.....

..... [2]

[Total: 10]

4 A species of caterpillar, the holly looper, feeds on the leaves of the holly tree.

Holly tree produces red berries that are eaten by a species of bird, the song thrush.

Song thrushes also eat caterpillars and are eaten by hawks.

(a) Use the information above to complete the food web in Fig. 4.1 by naming **one species** in each box **and** draw **arrows** between the boxes to show the direction and amount of energy flow between organisms. The width of your arrows represents the amount of energy.

[2]

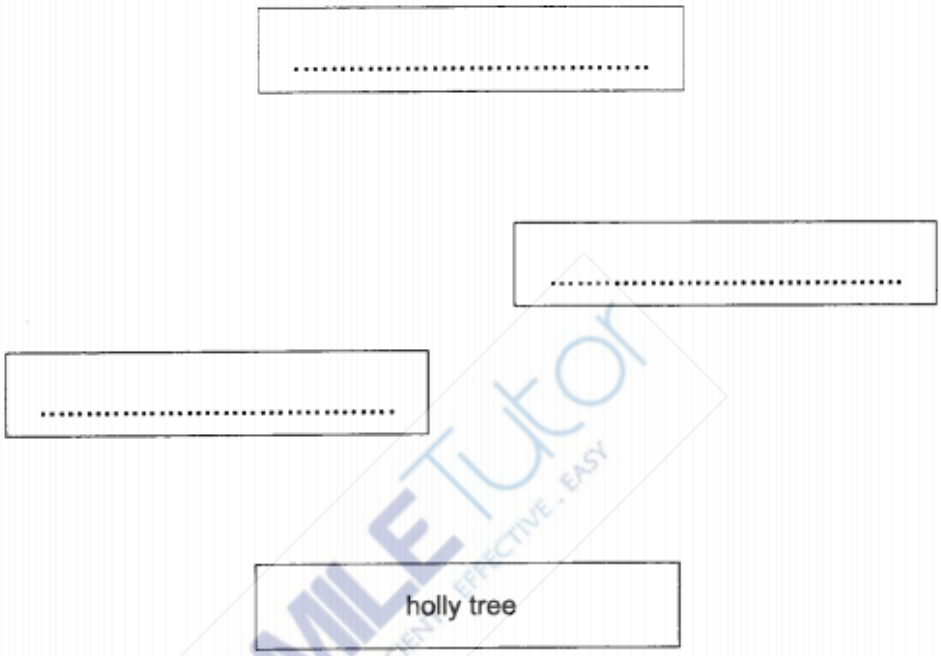

Fig. 4.1

(b) Holly trees are tall flowering plants. Bats also feed on the nectar from holly flowers and pollinate them so they can produce small, light seeds. Insects feed on its leaves and when the leaves fall to the ground, they will come into contact with soil bacteria and fungi.

(i) Suggest and explain ways in which being tall may be helpful for the survival of the holly trees.

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..... [3]

(ii) Explain why the bacteria and fungi found in the soil are important in this ecosystem.

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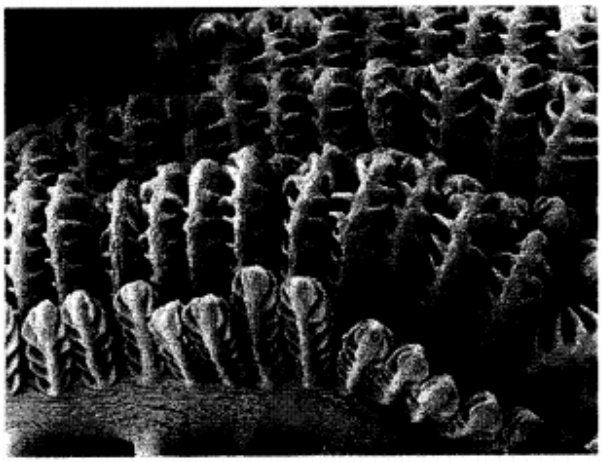
..... [3]

[Total: 8]

5 **(a)** Fig. 5.1 is a micrograph of part of some fish gills.



magnification x110

Fig. 5.1

Fish gills are adapted for gas exchange by diffusion.

(i) Define the term diffusion.

.....

.....

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..... [2]

(ii) Suggest **one** adaptation, **visible** in Fig. 5.1, that shows that fish gills are efficient structures for gas exchange by diffusion.

.....

..... [1]

(b) Some pollutants decrease the concentration of dissolved oxygen in rivers. This can result in the death of fish.

(i) State **one** type of pollutant that can result in a decrease in the concentration of dissolved oxygen in rivers.

..... [1]

Researchers investigated the effect of the concentration of dissolved oxygen in water on gas diffusion distance in tissues. The thickness of fish gills was used to determine the gas diffusion distance.

The researchers changed the concentration of dissolved oxygen by bubbling different concentrations of oxygen into water. The temperature of the water was kept constant at 15 °C.

Their results are shown in Fig. 5.2.

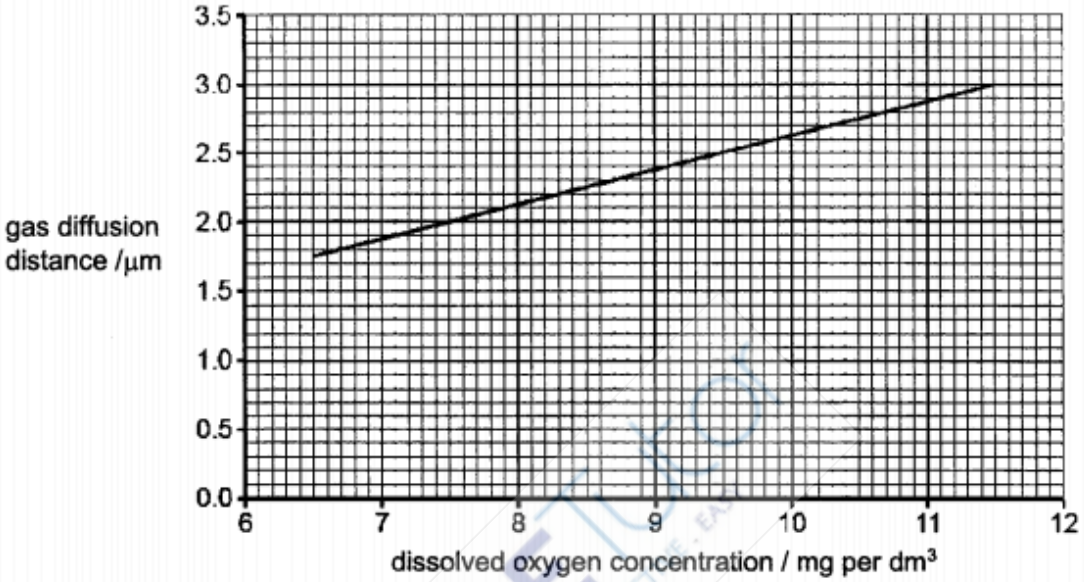

Fig. 5.2

Fig. 5.3 shows the relationship between the concentration of dissolved oxygen and water temperature.

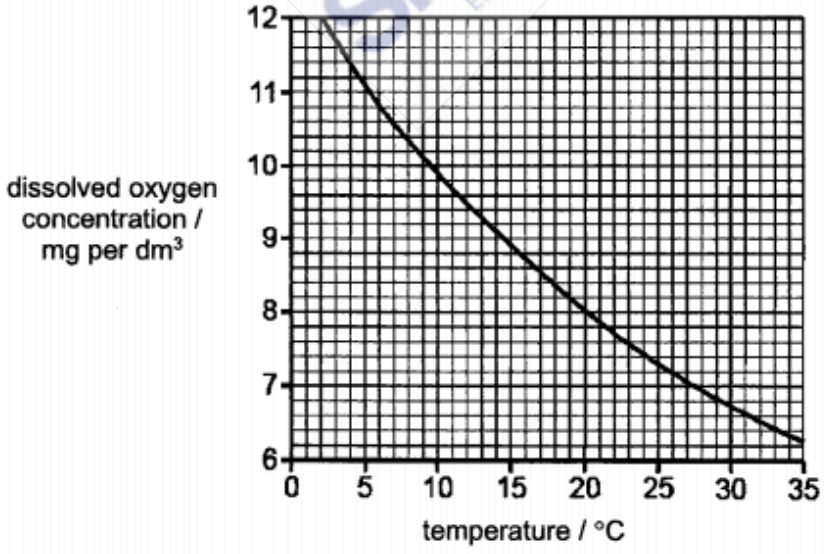

Fig. 5.3

(ii) State the concentration of dissolved oxygen from Fig. 5.3 at

15°C ..... mg per dm³ and 25°C ..... mg per dm³. [1]

(iii) Using the concentration of dissolved oxygen from Fig. 5.2 and 5.3, describe the effect on gas diffusion distance of increasing the temperature of the water from 15 °C to 25 °C.

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..... [2]

[Total: 7]

6 Some washing powders contain enzymes.

Fig. 6.1 shows a box of biological washing powder containing enzymes.

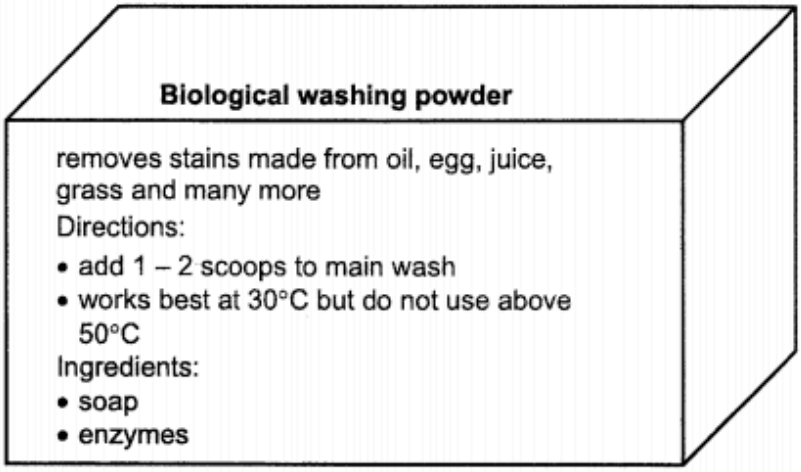

Fig. 6.1

(a) Eggs contain protein.

Describe how the biological washing powder removes egg stains.

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..... [3]

(b) Explain why the manufacturer states that the washing powder works best at 30 °C and should **not** be used above 50 °C.

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..... [4]

[Total: 7]

Section B

Answer **three** questions.

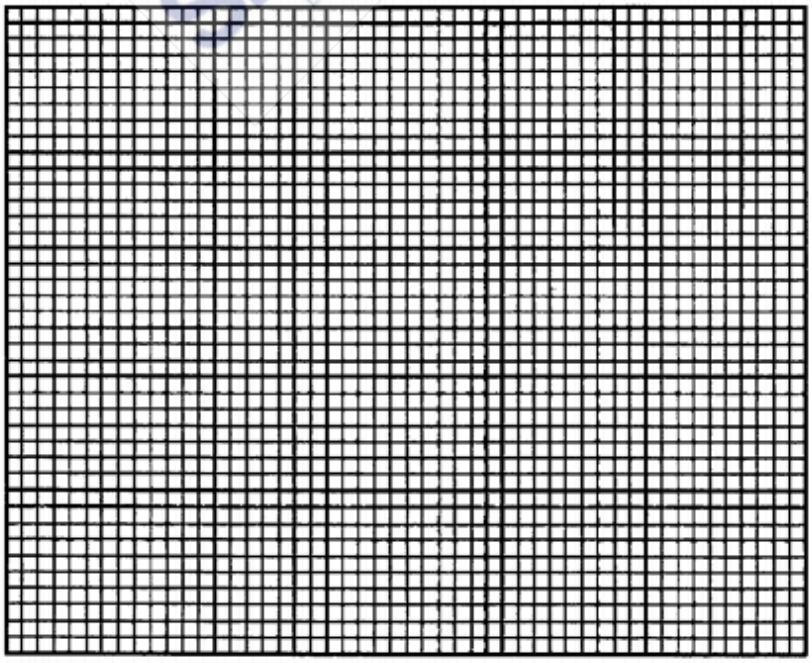
Question **9** is in the form of an **Either/Or** question. Only one part should be answered.

7 A student investigated the effect of exercise on her rate of breathing. She started exercising at two minutes and stopped exercising at eight minutes. Table 7.1 shows the data collected.

Table 7.1

time / minutes	rate of breathing / breaths per minute
0	12
2	13
4	24
6	35
8	35
10	19

(a) (i) Plot a line graph of the data in Table 7.1 on the grid.



(ii) Using your graph, state the rate of breathing at five minutes. Show your working on the graph.

..... [1]

(b) Explain the effect of exercise on the function of the student's heart, to transport blood out to the muscles.

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..... [5]

[Total:10]

8 A potometer is used to measure water uptake by a plant. Fig. 8.1 shows the stem and flower of a plant in a potometer. As water is taken up, the bubble moves in the direction shown.

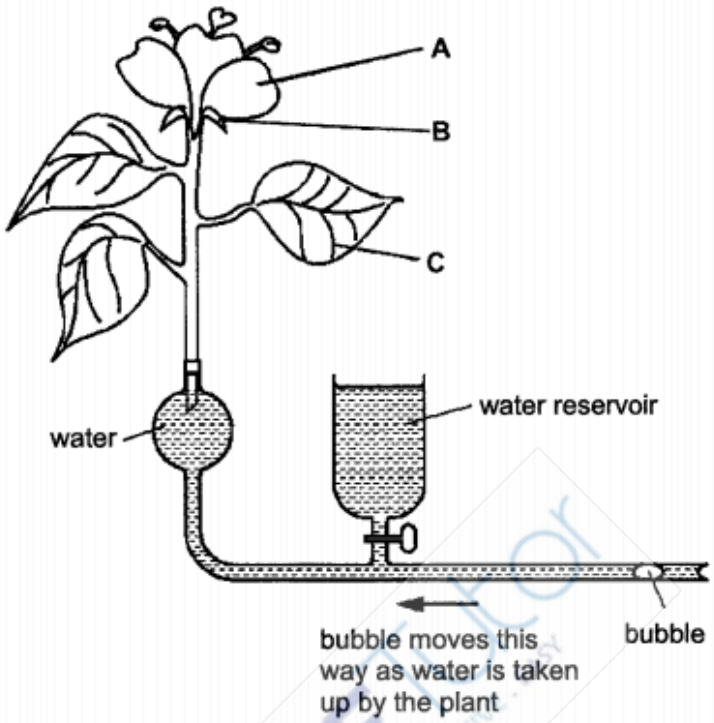

Fig. 8.1

(a) In the table below, name structures **A**, **B** and **C**, and describe their functions.

structure	name	function
A		
B		
C		

[4]

(b) Describe the pathway taken by water as it moves from the potometer, through the plant stem and into the surrounding air.

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..... [4]

(c) The experiment was repeated in an area of lower light intensity.

Explain what would happen to the rate at which the bubble moved.

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..... [2]

[Total:10]

Either

9 Glycogen is a storage carbohydrate in animals.

Fig. 9.1 shows the concentration of glycogen in the fetus of a domestic cat during pregnancy and immediately after birth.

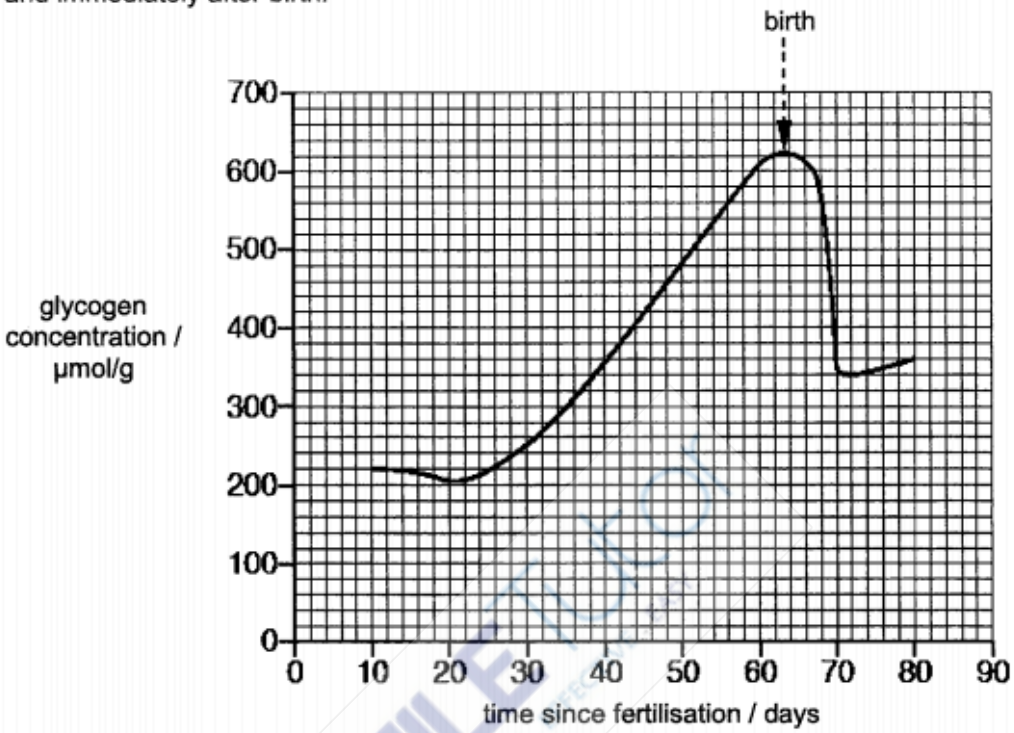

Fig. 9.1

Hormones stimulate changes in the concentration of glycogen in the fetus.

(a) Define the term hormone.

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..... [3]

(b) Calculate the percentage change in the glycogen concentration in the fetus between day 10 and birth in Fig. 9.1.

Give your answer to the nearest whole number. Show your working.

.....% [2]

(c) Use data from Fig. 9.1 to describe the changes in glycogen concentration from day **20** to **80** **and** explain how hormones in the fetus cause these changes.

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.....[5]

[Total:10]

Or

9 **(a)** The Indian muntjac deer, *Muntiacus muntjak*, is recorded as the mammal with the lowest number of chromosomes.

Fig. 9.2 is an image of the chromosomes in the nucleus of a diploid cell of a male muntjac deer.

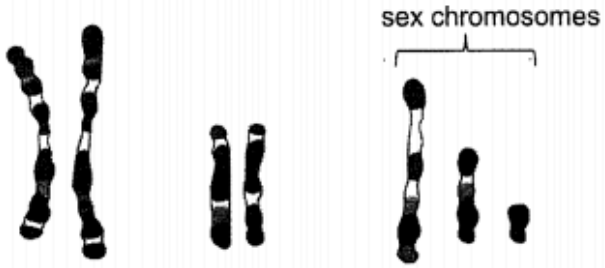

Fig. 9.2

(i) State the diploid number of chromosomes for the male muntjac deer.

..... [1]

(ii) Compare the similarity and difference between the sex chromosomes of the male muntjac deer shown in Fig. 9.2 and male human sex chromosomes.

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..... [2]

(b) Large quantities of plastic waste are polluting the oceans. Plastic products contain chemicals and a number of them have been associated with serious health problems such as infertility and cancers.

A survey published in March 2018 showed the increase in plastic waste in the Pacific Ocean. One area of the Pacific Ocean is known as the Great Pacific Garbage Patch (GPGP).

Data was collected from areas inside and outside the GPGP between 1965 and 2015 to estimate the quantity of plastic waste.

The results are shown in Fig. 9.3.

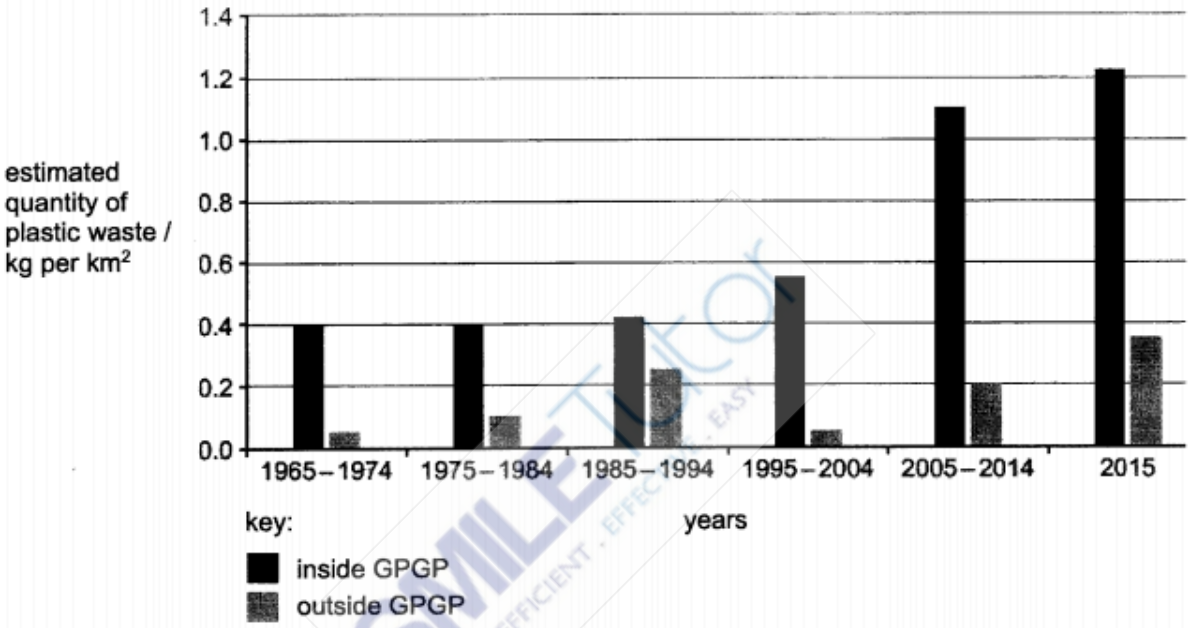

Fig. 9.3

(i) Describe the results of the survey shown in Fig. 9.3.

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..... **[4]**

(ii) The green turtle, *Chelonia mydas*, is a species of marine animal that is harmed by plastic waste.

Outline the effects of non-biodegradable plastic waste to plants and marine animals, such as green turtles.

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..... [3]

[Total:10]

ANSWER SHEET

Paper 1

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

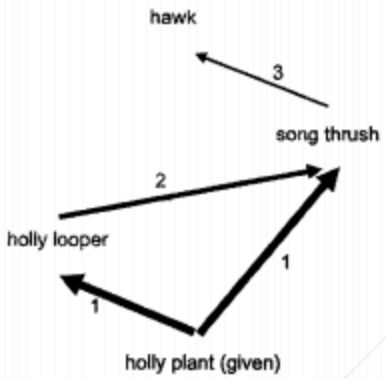
Paper 2

Question		Answers	Marks
1	a	A larynx ; reject voice box B trachea ; reject windpipe C bronchiole ; Reject wrong spelling	1 1 1
	b	needs a large surface area / moist surface / blood capillaries close to air for gas exchange ; oxygen diffuse from the alveoli into the blood capillaries / carbon dioxide diffuse out from blood capillaries into alveoli ; *[idea of oxygen into blood or carbon dioxide out into alveoli]* oxygen is needed for respiration / carbon dioxide is produced from respiration ; energy released from respiration used for a named activity e.g. muscles contraction for movement or active transport to absorb glucose / amino acids;	3
2	ai	yellow spot / fovea ;	1

Question		Answers	Marks
	aii	blood capillaries (in choroid) transport glucose and oxygen (to Y) ;	1
		for aerobic respiration to release energy ;	1
		OR	
		blood capillaries (in choroid) transport amino acids	
		for repair of Y / tissue ;	
		OR	
		blood capillaries (in choroid) remove carbon dioxide away ;	
		by diffusion ;	
		OR	
		blood capillaries (in choroid) carry white blood cells ;	
		to fight infection ;	
	b	extra light (intensity) stimulates the photoreceptors / retina and nerve impulse is produced in the receptor ;	1
		nerve impulse is transmitted along the sensory neurone / optic nerve +	1
		to the relay neurone in the brain ; ignore CNS	
		(nerve impulse) is transmitted by the motor neurone to the *iris ; ignore effector	1
		radial muscles in the *iris relax and circular muscles in the *iris contract ;	1
		*iris mention at least once	

Question		Answers	Marks
	ci	parental genotypes Aa + Aa ;	1
		gametes A a A a ;	1
		offspring genotypes AA, Aa, Aa and aa ;	1
		correctly linked phenotypes: AA & Aa = produce melanin, aa does not produce melanin ;	1
	cii	¼ × ¼ =	
		1/16 or 0.0625 ;	1
3	ai	water in the sweat evaporates to remove latent heat of vaporisation ;	1
		and cools / decreases / returns temperature to norm / set-point, through negative feedback ;	1
		OR	OR
		water in the sweat evaporates to remove latent heat of vaporisation ;	1
		to maintain a constant internal environment / temperature, through negative feedback ;	1
		award 1m for (homeostasis is) the maintenance of a constant internal environment / temperature ;	
	aii	vasodilation of arterioles / arterioles dilate ; reject blood vessels / capillaries	1
		more blood flows to the blood capillaries near skin surface / more blood flows to the sweat gland ;	1
		increase loss of heat / thermal energy by radiation (conduction and convection) / more sweat is produced ;	1
		3rd marking point must match the 2nd marking point	
	b	liver ;	1

Question		Answers	Marks
	ci	blood plasma has less urea than urine by 387 mmol per dm^3 / 65.5x ; blood plasma has more sodium than urine by 31 mmol per dm^3 ; blood plasma has less chloride than urine by 4 mmol per dm^3 ;	2
	cii	higher than 22 mmol per dm^3 urea in patient (than healthy person) ; less urea is filtered from kidneys / into kidney tubules, from blood plasma ;	1 1
4	a	all 3: holly looper, song thrush and hawk correctly written in the boxes ; all arrows and thickness of width correct, decreasing thickness going up the food web ; 1 > 2 > 3	1 1



Question		Answers	Marks
	bi	(tall tree) receive more / maximum light energy for photosynthesis / to make glucose ; ignore food exposed to wind for seed dispersal ; easier for bats to find flowers for pollination ;	1 1 1
	bii	(bacteria and fungi) are decomposers ; break down dead organisms / dead leaves / organic matters into smaller and simpler substances ; recycled / returned carbon (compounds) / nutrients to the soil ; carbon / named nutrient (e.g. nitrate) can be used by plants / producers for correct use such as photosynthesis / growth ; correct use: carbon / nitrate for photosynthesis	3
5	ai	net movement of particles / molecules ; from a region of their higher concentration to a region of their lower concentration / down a concentration gradient ;	1 1
	aii	(the gills have) large surface area to volume ratio ; OR (the gills are) thin ;	1
	bi	phosphate / nitrate (ions) / (untreated) sewage / fertilisers ;	1
	bii	*15 °C* : 8.9 ± 0.1 (mg per dm^3) **and** *25 °C* : 7.3 ± 0.1 (mg per dm^3) ;	1
	biii	As the temperature of the water increases from 15 °C to 25 °C, the gas diffusion distance decreases ; by 0.4 µm / from 2.35 ± 0.05 µm to 1.95 ± 0.05 µm [correct unit written at least once]	1 1

Question		Answers	Marks
6	a	protease / pepsin / trypsin digests (protein) to polypeptides ; reject break down	1
		protease / peptidase / erepsin digests (polypeptides) to amino acids ;	1
		converting insoluble molecules to soluble molecules / ref to amino acids are soluble / dissolve in water;	1
	b	30 °C is the optimum temperature and the enzymes are the most active at 30 °C ;	1
		active site (in enzyme) has a complementary shape to the substrate / active site (in enzyme) has a unique / specific (three dimensional) shape to fit the substrate ;	1
		above 50 °C, enzymes are denatured / lost its (three dimensional) shape and active site ;	1
		substrate cannot bind to the active site to form an enzyme-substrate complex / for chemical reaction / for digestion to take place ;	1

Question		Answers	Marks
7	ai	axes fully labelled with units horizontal axis : time / minutes + vertical axis: breathing rate / breaths per minute + appropriate scale for both axes + origin labelled 0 + line occupies more than half the grid ;	1
		all 6 points plotted correctly and clearly ;;	2
		best fit line ;	1
	aii	31 breaths per min + working shown on graph ; read from student's graph refer to graph attached	1
	b	Effect: heart rate increases / heart contracts faster ;	5
		Explanation:	
		muscles in the wall of the left ventricle ;	
		contracts faster / stronger ;	
		increases the blood pressure (in the left ventricle) ;	
		force the semi-lunar valve in the aorta open (and bicuspid valve closed) ;	
		force blood out of the aorta (to the muscles) ; reject pump	

Question		Answers	Marks
8	a	**A** petal + large to attract insects / large for insect to land ;	1
		B sepal + protect flower in the bud stage ;	1
		C vein (most accurate) / vascular tissue / xylem and phloem + transport water and mineral salts to the leaf ;	1
		transport sugar / sucrose (and amino acids) to other parts of the plant ; reject food	1
	b	water is transported up the xylem vessels to the leaves / flower(s) ;	1
		water molecules move into mesophyll *cells and the surface of the *cells by osmosis ;	1
		*mention at least once	
		water evaporates (from the surface of cells) to form water vapour ; reject water vapour evaporates	1
		(water vapour) diffuse into the (intercellular) air spaces and out of the leaves through the stomata ;	1
	c	(the rate at which) the bubble moves decreases / bubble moves slower ;	1
		lower rate of photosynthesis and less water is used ;	1
		OR	
		stomata are closed / smaller stomatal pores and slower diffusion of water vapour out / slower (rate of) transpiration ;	

Question		Answers	Marks
9E	a	chemical substance produced by an endocrine gland ;	1
		carried by the blood and alters the activity of specific target organs ;	1
		destroy by the liver after it has carried out its effect ;	1
	b	(620 – 220) ÷ 220 × 100 ;	1
		= + / increase by 182 (%) ;	1
	c	describe changes:	At least 2 changes, max 3m for all 3 changes with data
		glycogen concentration increases from 200 µmol per g on day 20 to 620 µmol per g on day 62 – 64 OR by 420 µmol per g from day 20 to day 62 - 64 ;	
		(glycogen concentration) decreases steeply (from 620) after birth / after day 62-64 to 340 µmol per g on day 70 OR by 280 µmol per g after birth / after day 62-64 to day 70 ;	
		(glycogen concentration) starts to increase slowly, (from 340) on day 70 to 360 µmol per g on day 80 OR by 20 µmol per g ;	
		Must state units, µmol/g and day, at least once.	
		explanation:	At least 2 explanation, max 3m
		an increase in blood glucose concentration causes pancreas to release insulin ;	
		insulin stimulates the liver cells to convert excess glucose to glycogen (store in liver and muscles) ;	
		a decrease in blood glucose concentration causes pancreas to release glucagon ;	
		glucagon stimulates the liver cells to convert glycogen to glucose ;	
		Reject insulin / glucagon convert excess glucose to glycogen / converts glycogen to glucose	Max 5

Question		Answers	Marks
9O	ai	seven / 7 ;	1
	aii	*similarity* Y chromosome is shorter than X chromosome / X chromosome is longer than Y chromosome ; *difference* The deer has three sex chromosomes but human has two ; One Y chromosome is longer than the other but human has only one shorter Y chromosome ;	1 Either 1 difference, 1
	bi	quantity of plastic waste is always higher **inside** GPGP than outside it ; quantity inside GPGP is constant (from 1965) to, any year 1975 to 1994 ; quantity increases in GPGP, steeply (overall from 1965 to 2015) ; smaller (overall) increase **outside** the GPGP ; quantity of plastic waste outside the GPGP, increases from 1965 to 1994 then decreases to 2004 and increases again to 2015 ;	4

Question		Answers	Marks
	bii	*direct effects* (non-biodegradable plastic) does not break down and reduces the ability (of marine animals) to breathe / reduces the ability to move ; (plastic / toxin) consumed by marine animals / turtles, die of starvation or malnutrition ; *indirect effects* blocks (sun)light, so algae / plants / producers, cannot photosynthesise ; (so) less food / energy, enters, food chains / food webs ; plastic / toxin accumulates along the food chain and kills the animal / turtle OR bioaccumulation / highest concentration of toxin / plastic in animal / turtle and kills them ; Reject chemicals, need to use toxin [applies to bioaccumulation marking point]	3