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**FUCHUN SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2022
SECONDARY FOUR EXPRESS**

CANDIDATE NAME

CLASS

CENTRE NUMBER

S				
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INDEX NUMBER

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BIOLOGY

6093/01

Paper 1 Multiple Choice

Wednesday, 31 Aug 2022

1 hour

Additional materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, index number and class on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

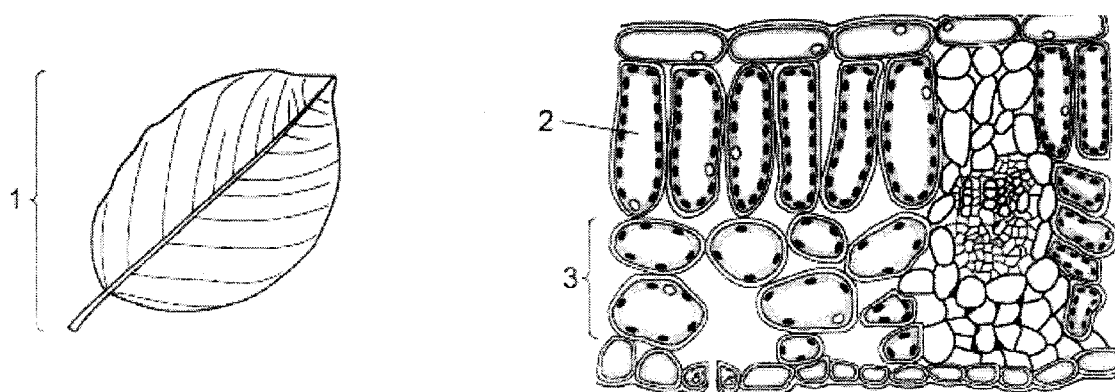
The use of an approved scientific calculator is expected, where appropriate.

Setter: Philemon Foo

This document consists of 21 printed pages and 1 blank page.

2

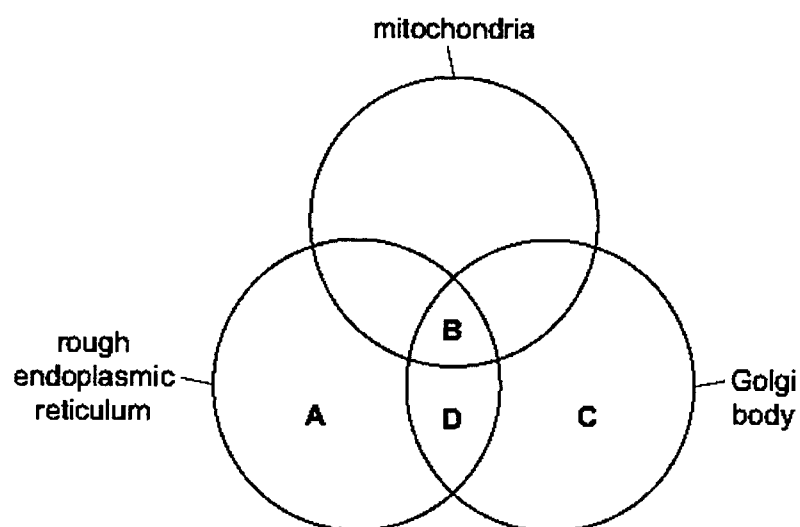
- 1 The diagrams show a leaf and its internal structure.



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

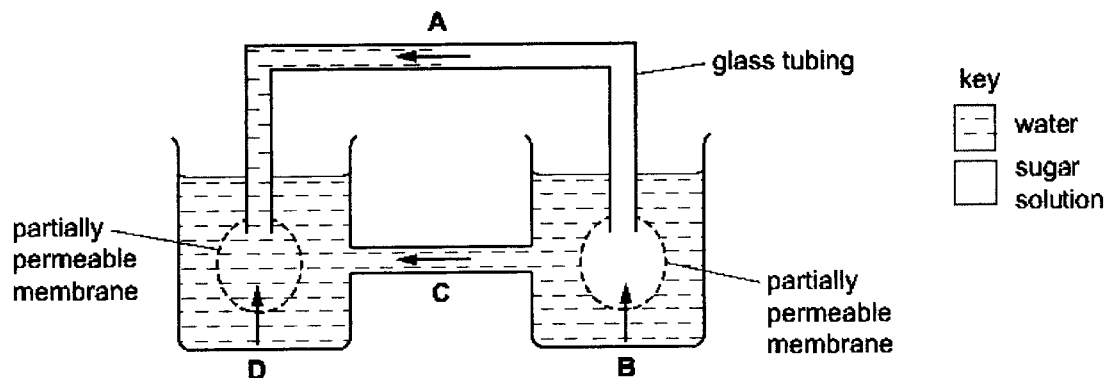
- 2 Which cell structures are required for the formation of proteins in a cell that are to be secreted out?



3

- 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?

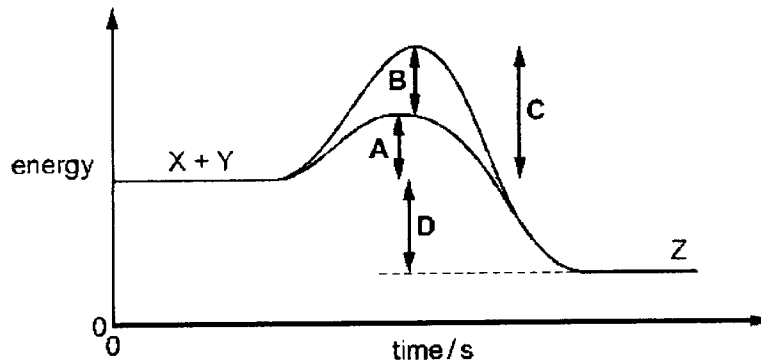
	evaporation from the spongy mesophyll cells	glucose transported in blood plasma	loss of sweat from the skin surface
A	✓	✓	✓
B	✓	✓	x
C	✓	x	x
D	x	✓	x

key

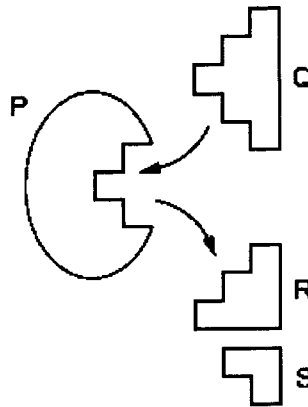
✓ : depends

x : 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.

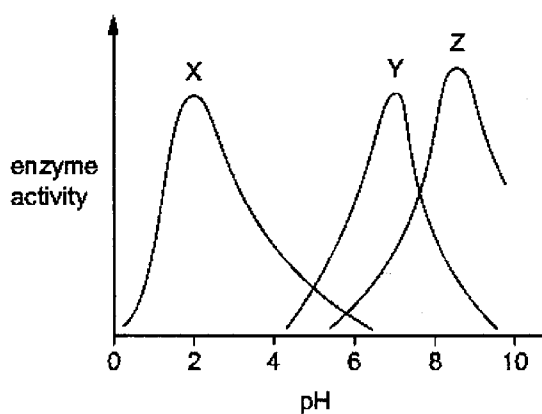


Which form an enzyme-substrate complex?

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

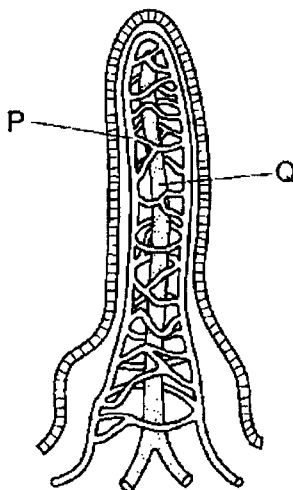
6

- 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.

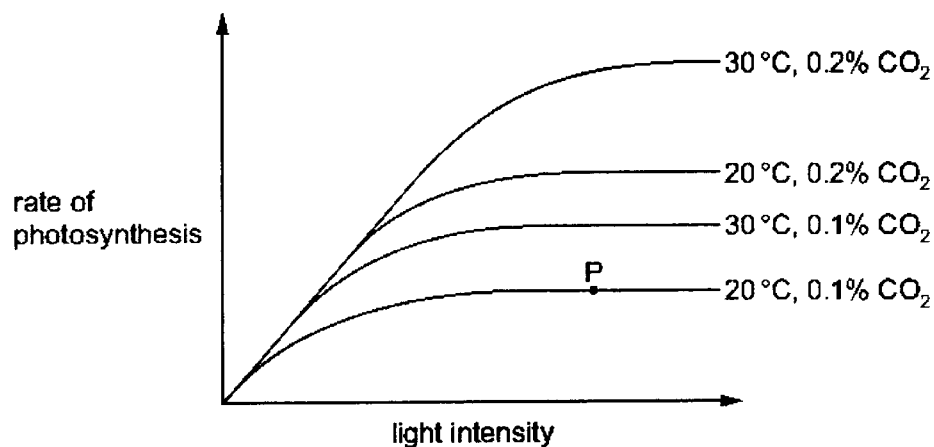


Which row identifies the products absorbed by P and Q?

	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?

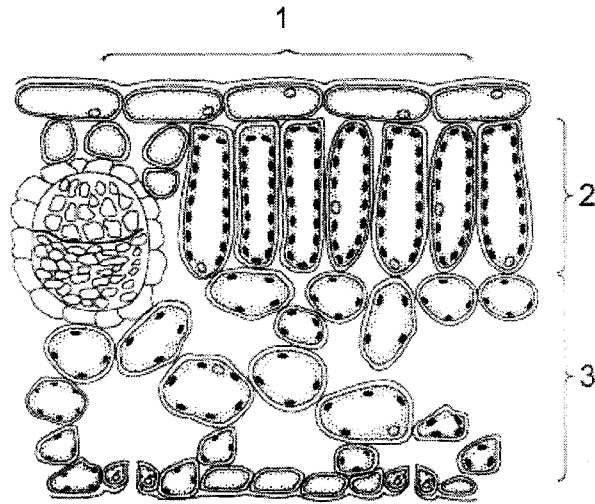
	light intensity	carbon dioxide concentration	temperature
A	✓	✓	×
B	✓	×	×
C	×	✓	✓
D	×	×	✓

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.

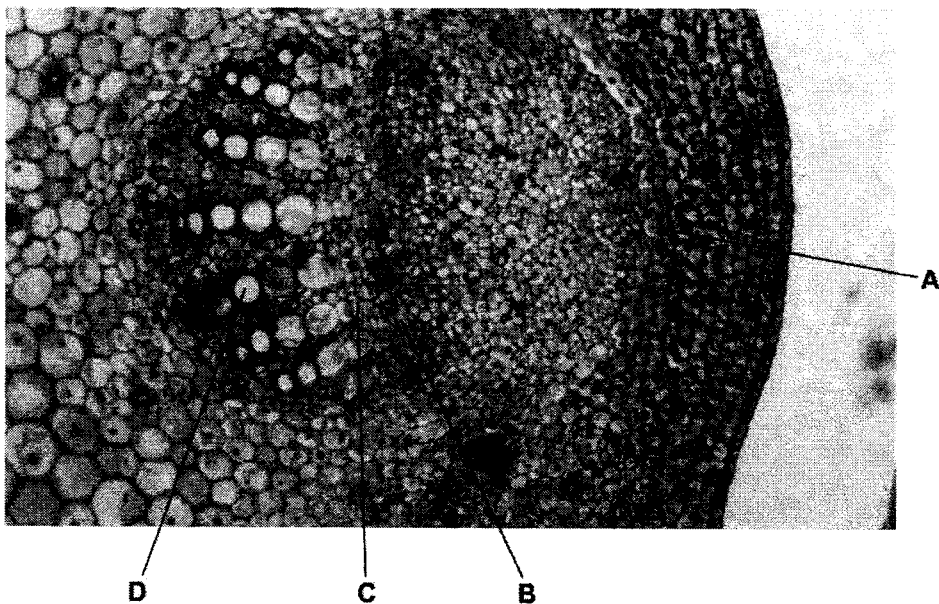


What are the names of regions 1, 2 and 3?

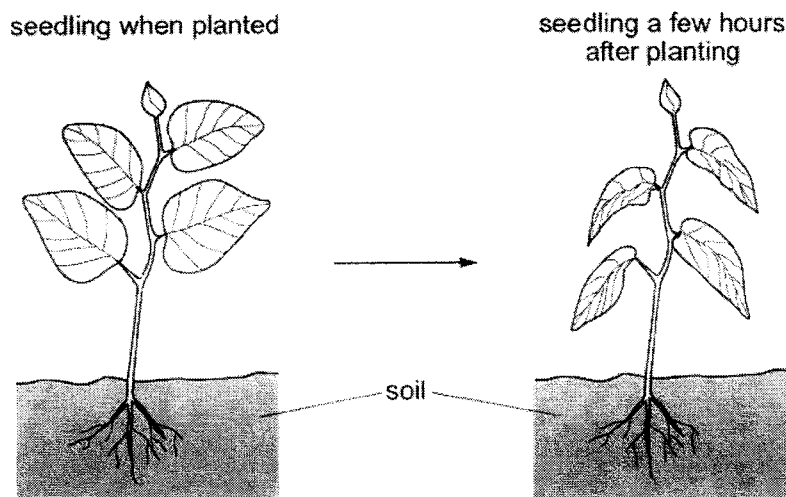
	region		
	1	2	3
A	palisade mesophyll	epidermis	spongy mesophyll
B	spongy mesophyll	palisade mesophyll	epidermis
C	epidermis	palisade mesophyll	spongy mesophyll
D	epidermis	spongy mesophyll	palisade mesophyll

- 13 The diagram shows a transverse section of a stem.

Which area is the phloem?

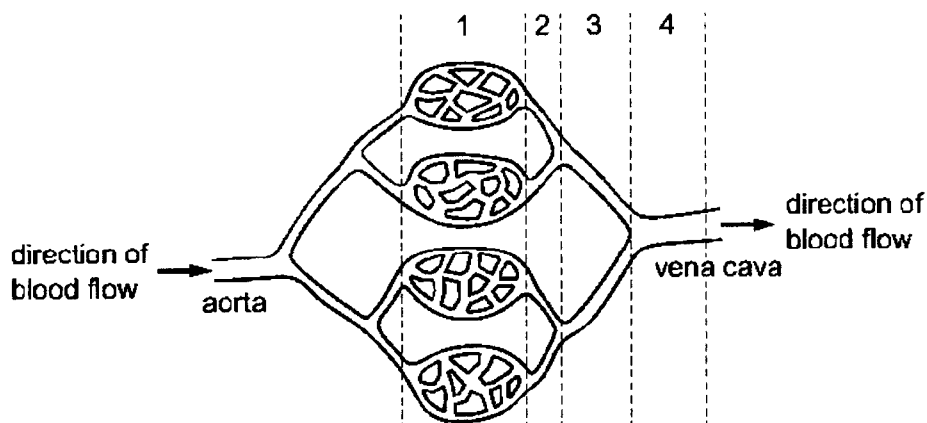


- 14 The diagram shows a newly planted seedling and the same seedling a few hours after being planted.



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

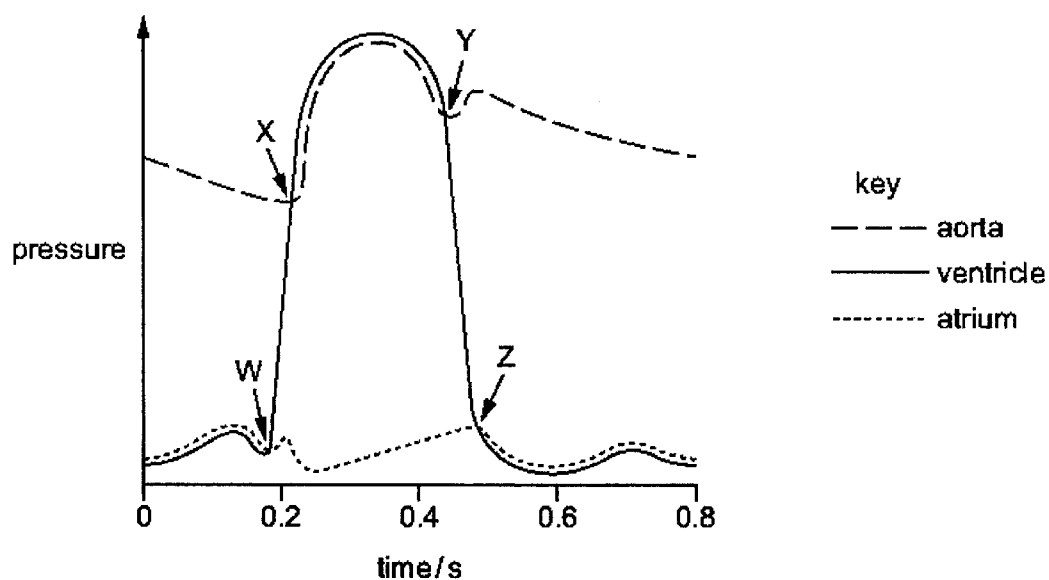
- A Transpiration is faster than water uptake by root hairs so cells have become flaccid.
 - B Transpiration is faster than water uptake by root hairs so cells have become turgid.
 - C Transpiration is slower than water uptake by root hairs so cells have become flaccid.
 - D Transpiration is slower than 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

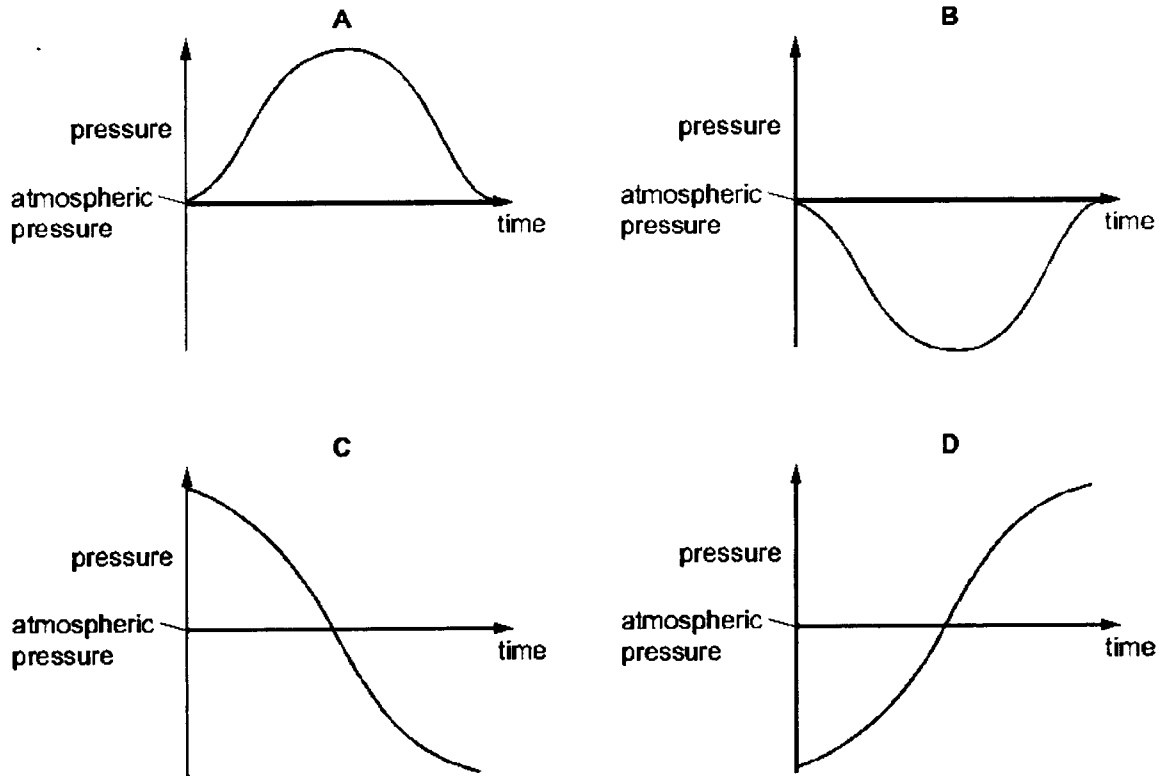
- 16 The graph shows pressure changes in different parts of the heart during a mammalian cardiac cycle. W, X, Y and Z indicate when a valve opens or closes.



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

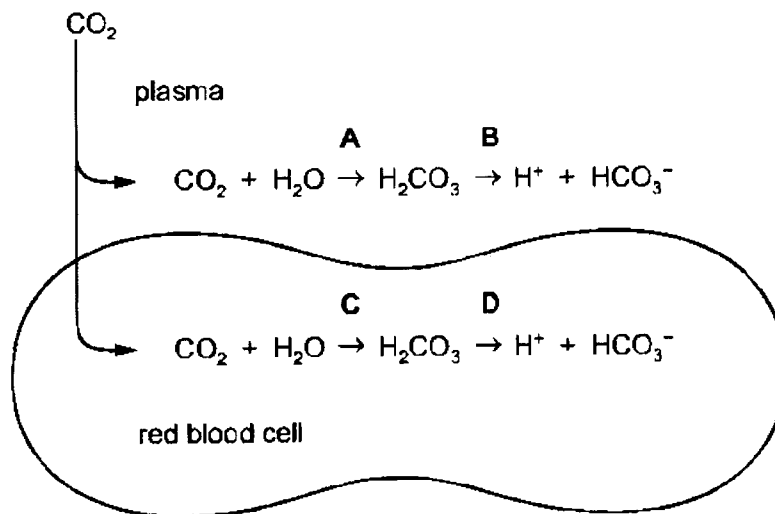
	W	X	Y	Z
A	atrioventricular valve opens	atrioventricular valve closes	semilunar valve opens	semilunar valve closes
B	atrioventricular valve closes	semilunar valve opens	semilunar valve closes	atrioventricular valve opens
C	semilunar valve opens	semilunar valve closes	atrioventricular valve opens	atrioventricular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

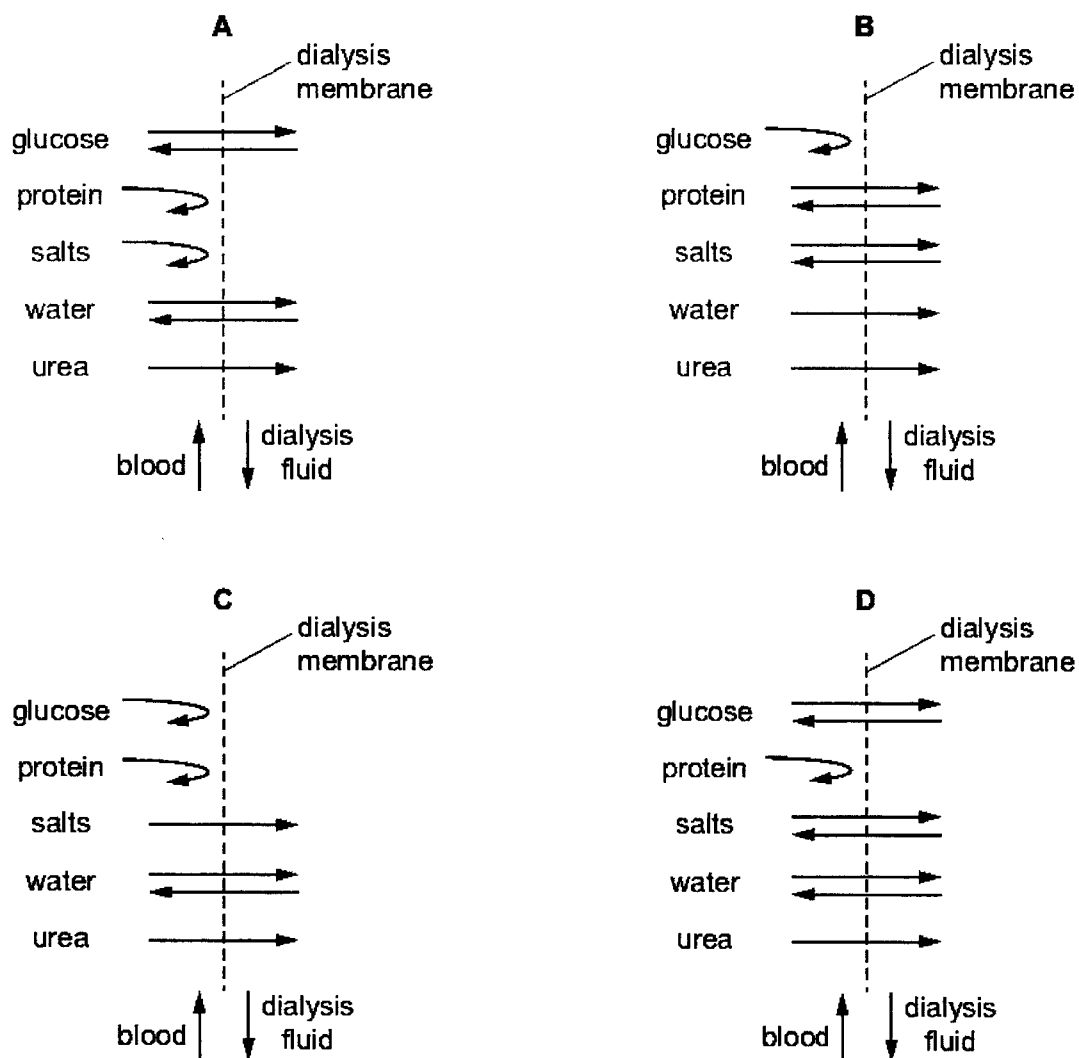


- 18 The diagram shows some of the reactions of carbon dioxide when it enters the blood from cells in a metabolically active tissue.

Which reaction is catalysed by the enzyme carbonic anhydrase?

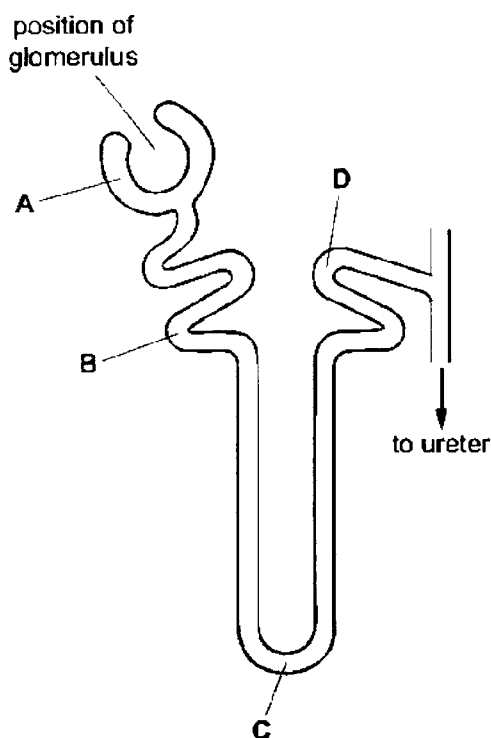


- 19 Which diagram shows the diffusion of substances between the blood and dialysis fluid during dialysis?



- 20 The diagram shows a kidney tubule.

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

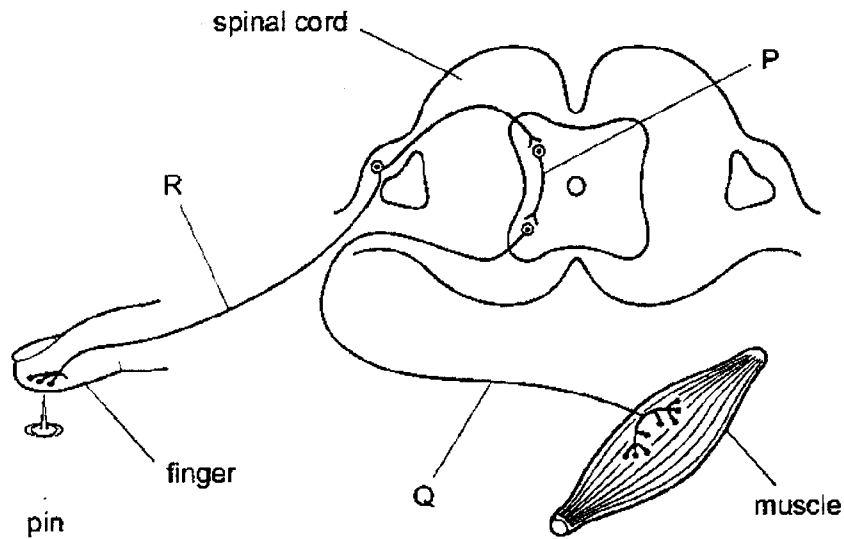


- 21 A student carried out an experiment to investigate the effect of temperature on the volume of urine produced.

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

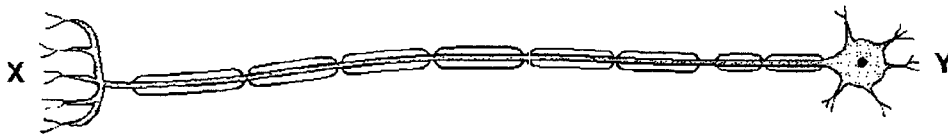
22 The diagram represents a simple reflex arc.



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	✓	✓	x
C	✓	x	✓
D	x	✓	✓

key
✓ : yes
x : 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?

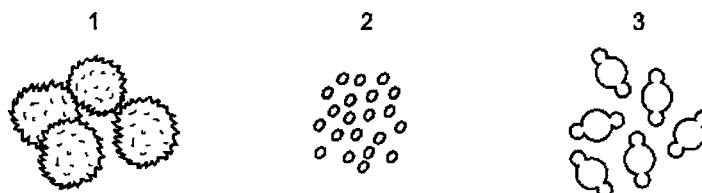
	ciliary muscles	suspensory ligaments	lens shape
A	contracted	slackened	more spherical
B	contracted	tight	more spherical
C	relaxed	slackened	less spherical
D	relaxed	tight	less spherical

- 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?

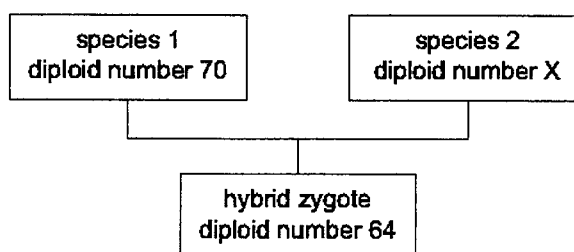
- A** 1 2 4 3
B 1 3 2 4
C 2 3 1 4
D 3 1 2 4
- 29** The diagrams show pollen grains from three different species of plant as they appear under the microscope. The diagrams are all to the same scale.



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.

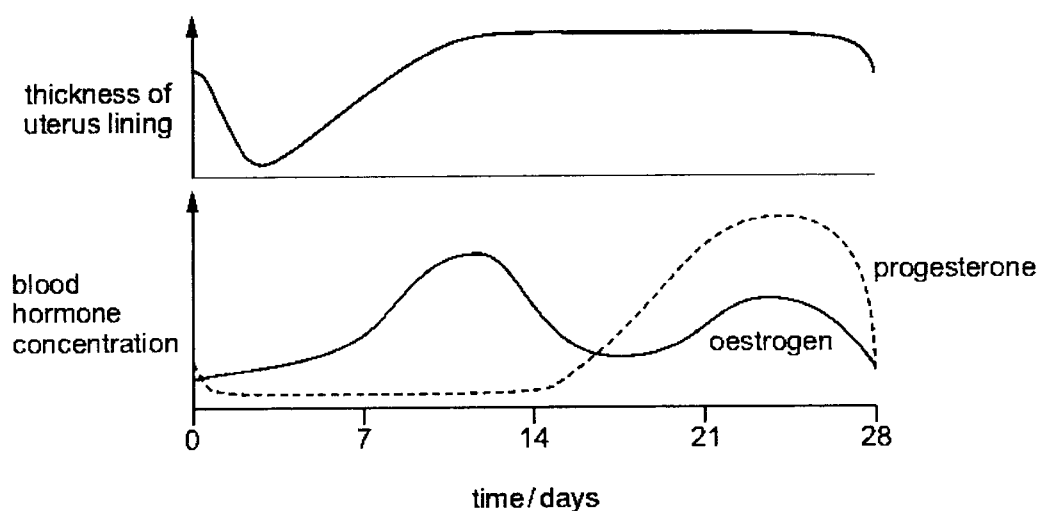
The diagram shows a cross between plants with different diploid numbers.



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.

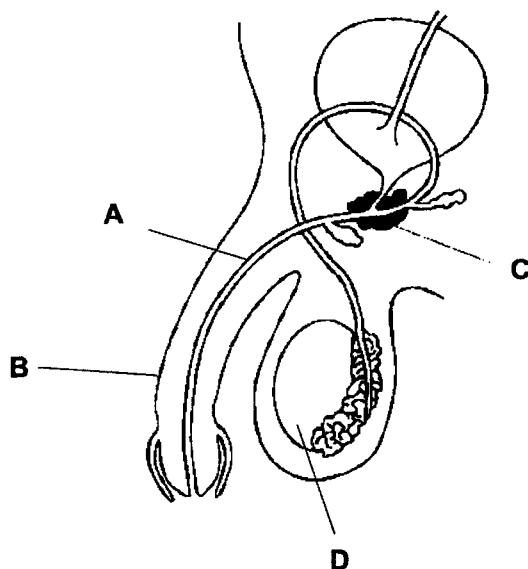


Which statement is supported by evidence in the graphs?

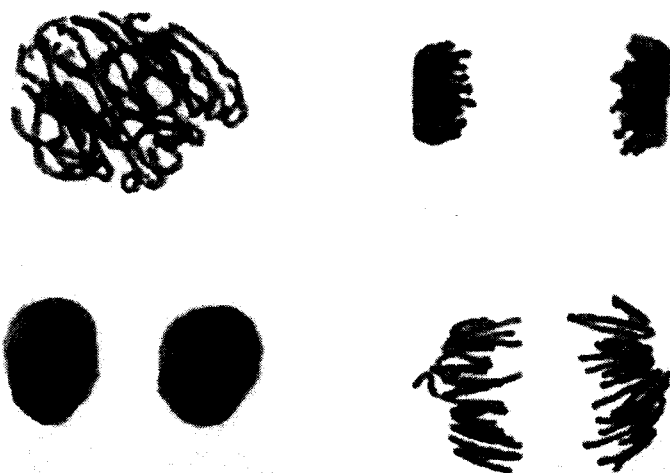
- A A large increase in progesterone concentration always results in thickening of the uterus lining.
- B At ovulation, the uterus lining is at its thickest.
- C Each time the oestrogen concentration rises, the uterus lining becomes thicker.
- D Within 5 days of ovulation, the uterus lining gets thinner.

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?

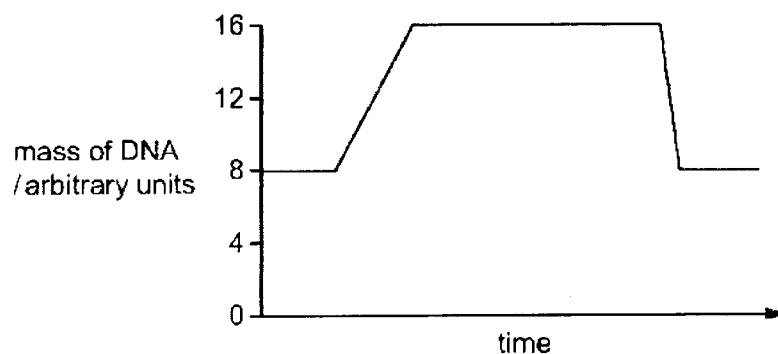
- A anaphase
 - B prophase
 - C metaphase
 - D telophase
- 34 A DNA sample was tested to identify its bases.

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?

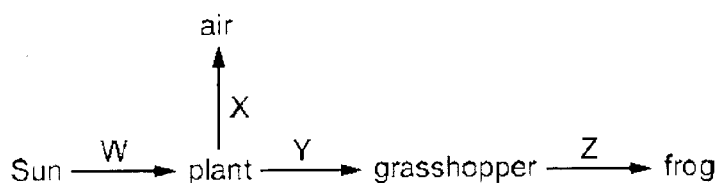
- A** 1 and 3
- B** 1 only
- C** 2 only
- D** 2 and 4

38 Which row correctly best describes human blood groups?

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

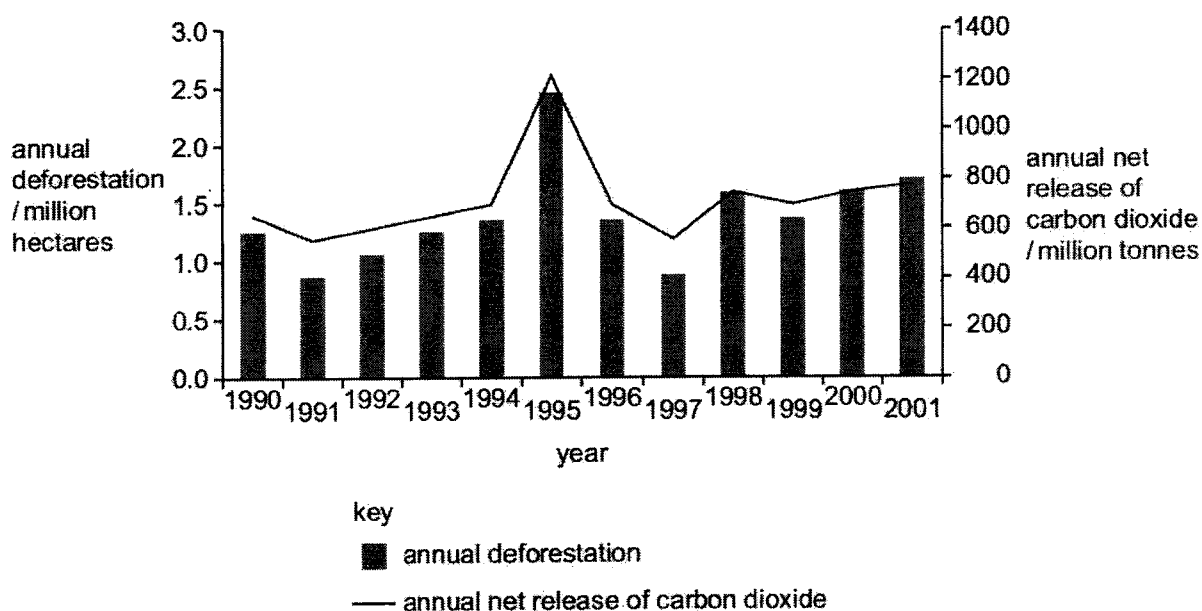
key
✓ : yes
x : no

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

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**FUCHUN SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2022
SECONDARY FOUR EXPRESS**

CANDIDATE NAME

CLASS

CENTRE NUMBER

INDEX NUMBER

BIOLOGY

6093/02

Paper 2

Tuesday, 30 Aug 2022

1 hour 45 minutes

Additional materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen in the spaces provided on the Question Paper.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Section A
Answer **all** questions.

Section B
Answer all the questions, the last question is in the form either/or.
The use of an approved scientific calculator is expected, where appropriate.

You are advised to spend no longer than **1 hour** on Section A and no longer than 45 minutes on Section B.

The number of marks is given in brackets [] at the end of each question or part-question.

Setter: Mr Philemon Foo

For Examiner's Use	
Section A	/50
Section B	/30
TOTAL	/80

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Section A

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

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

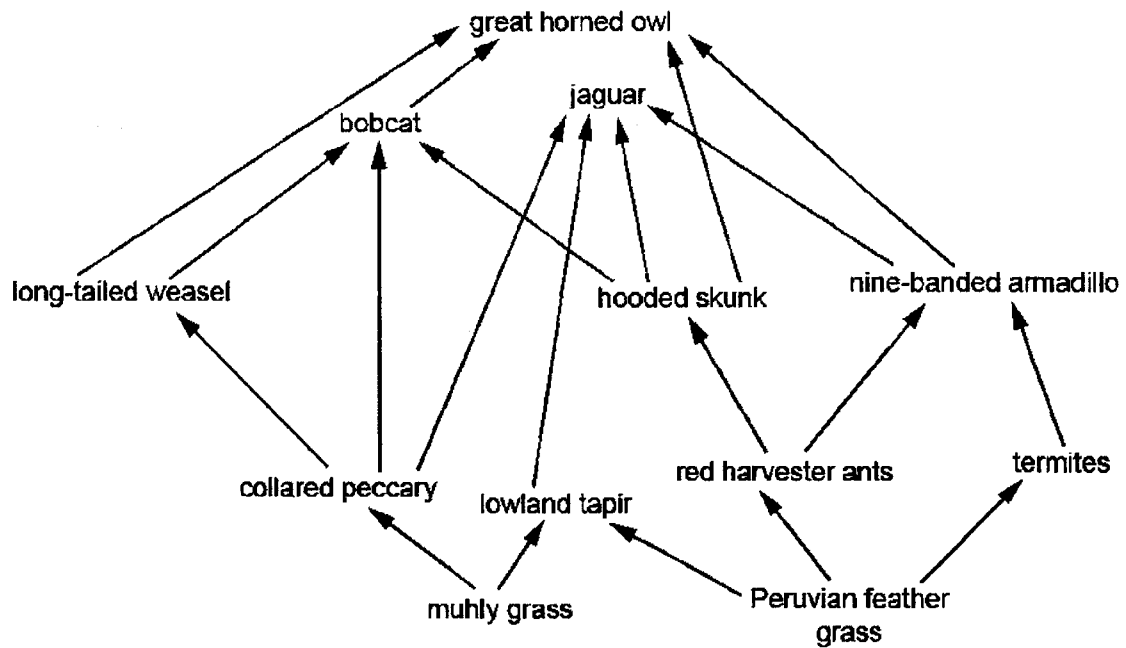


Fig. 1.1

- (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		

[3]

- (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.

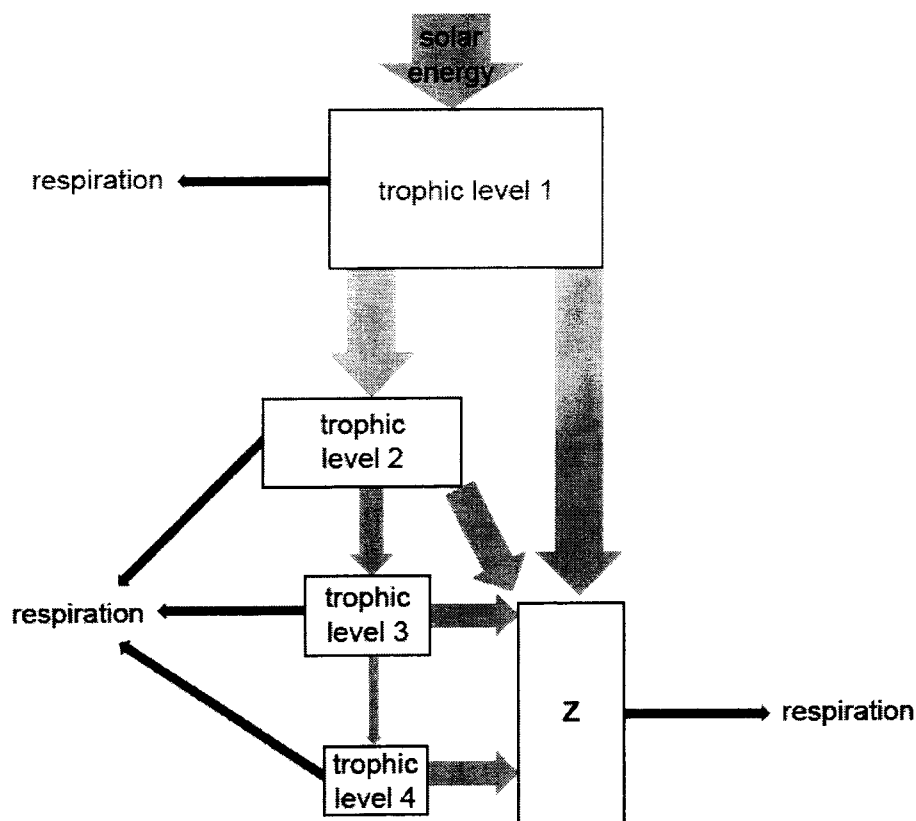


Fig. 1.2

- (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.

.....

.....

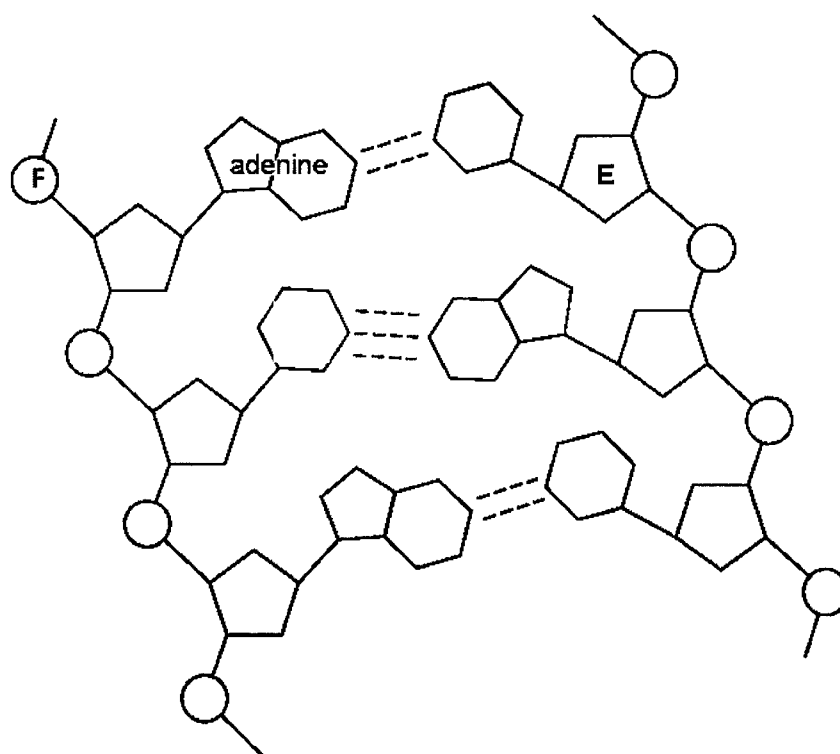
.....

.....

..... [4]

[Total: 8]

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.

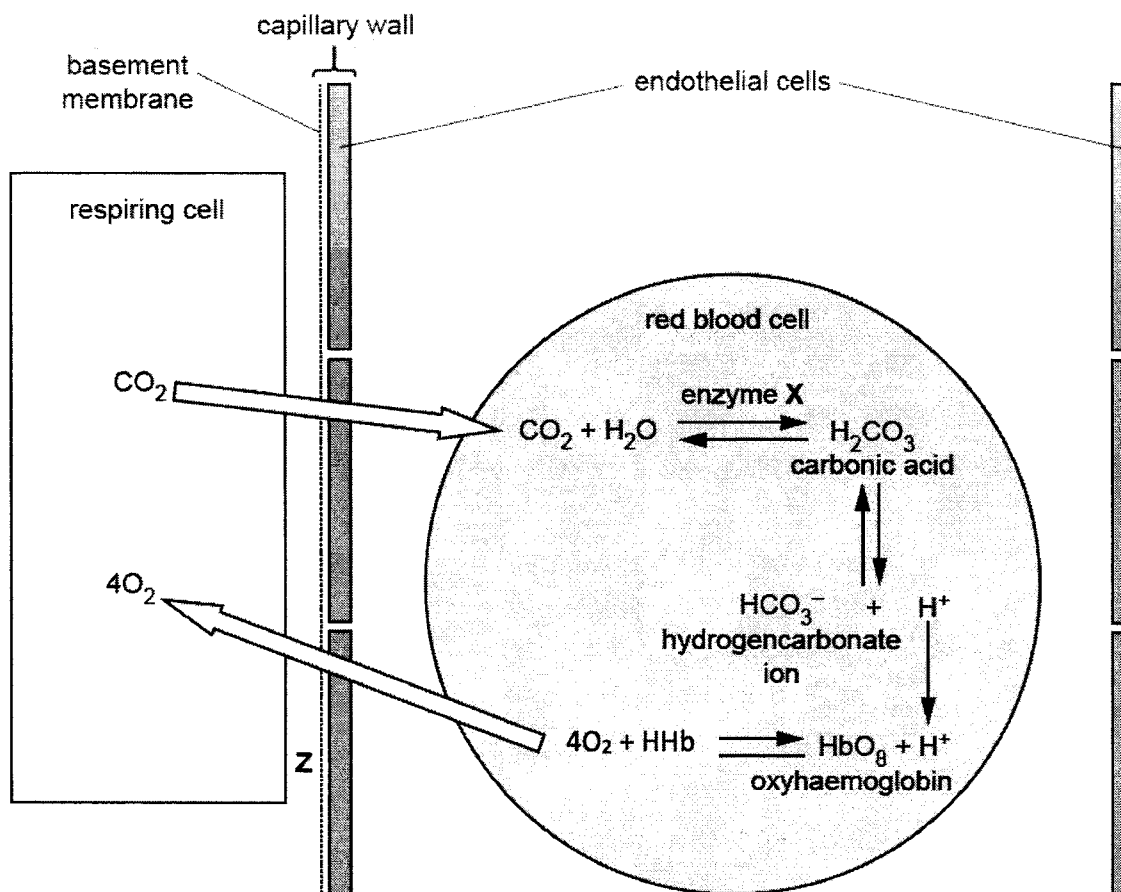


Fig. 3.1

- (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.

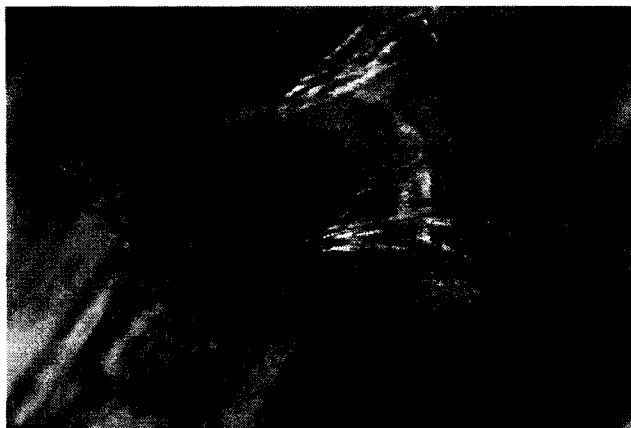


Fig. 4.1

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.

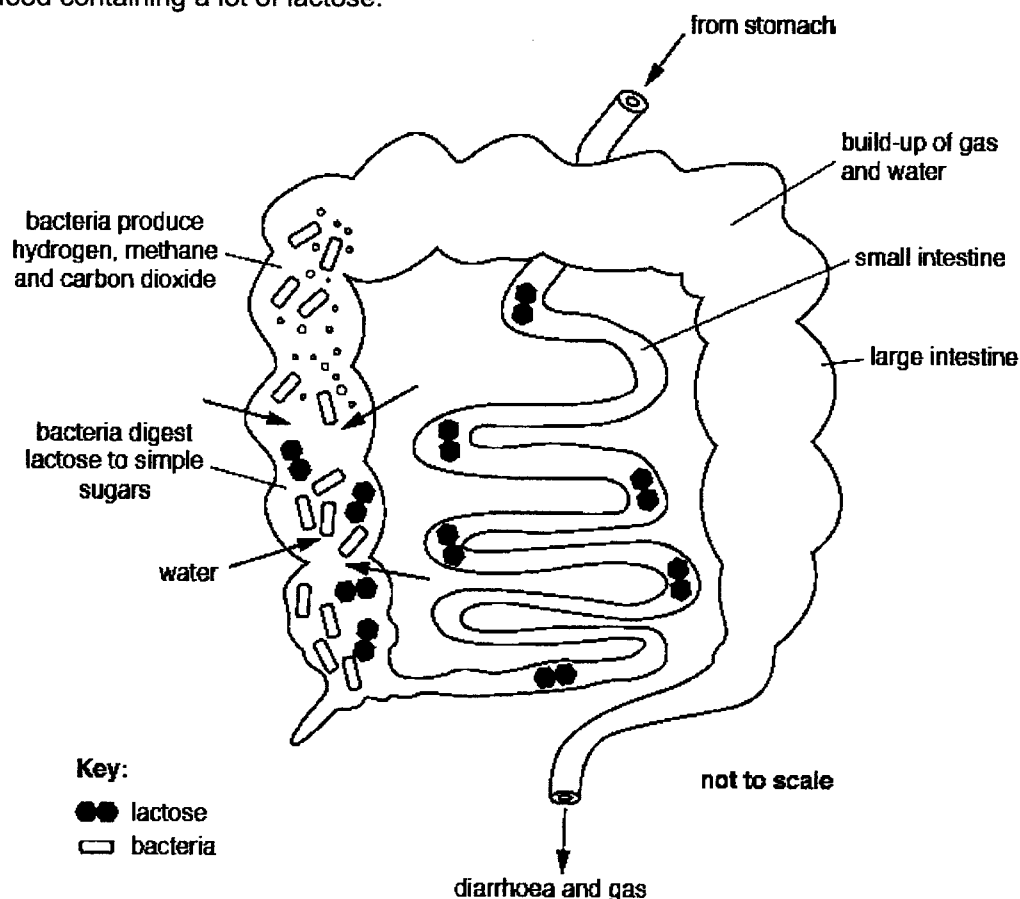


Fig. 5.1

- (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.

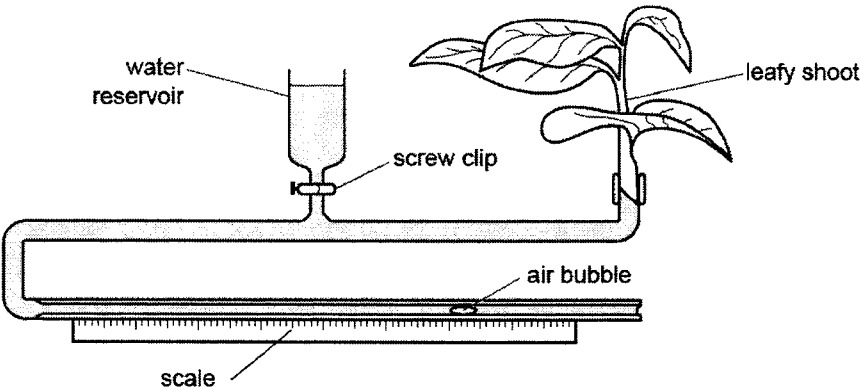


Fig. 6.1

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.

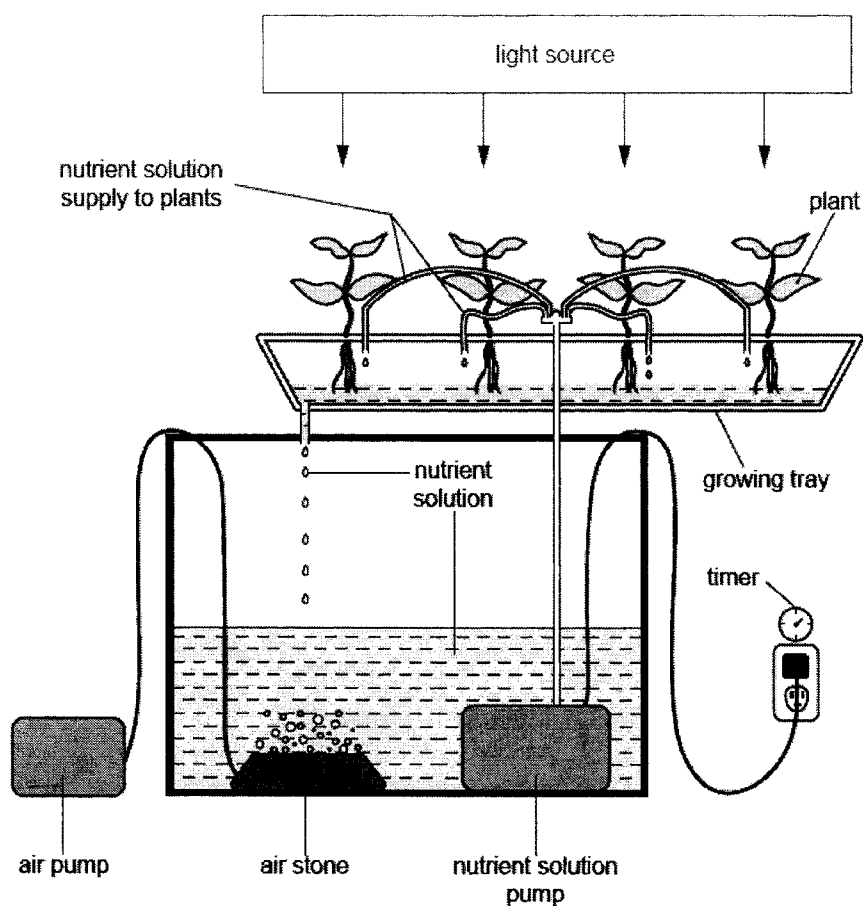


Fig. 7.1

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

State, in symbols, the equation for photosynthesis.

[1]

- (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).

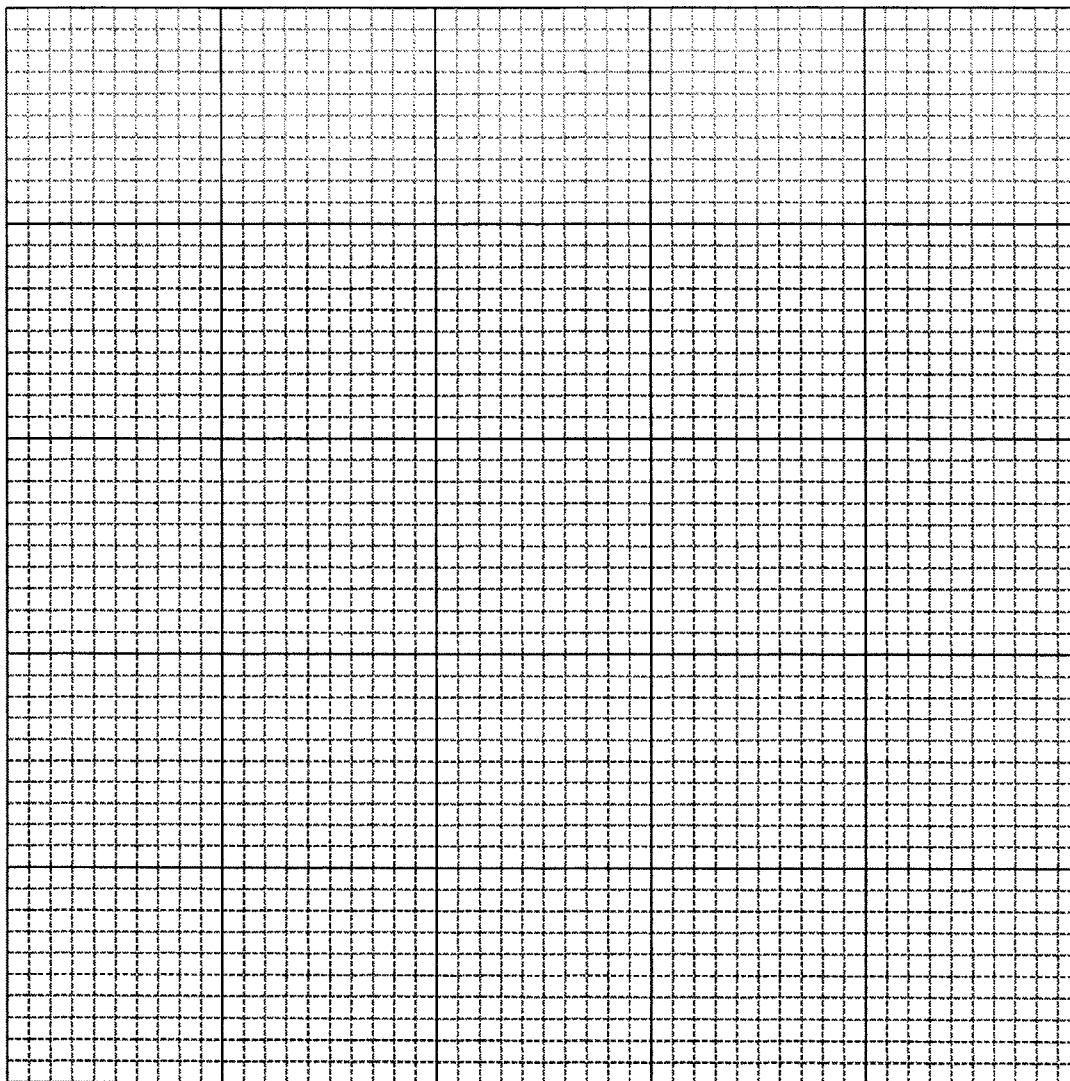
Table 7.1

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.

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

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.

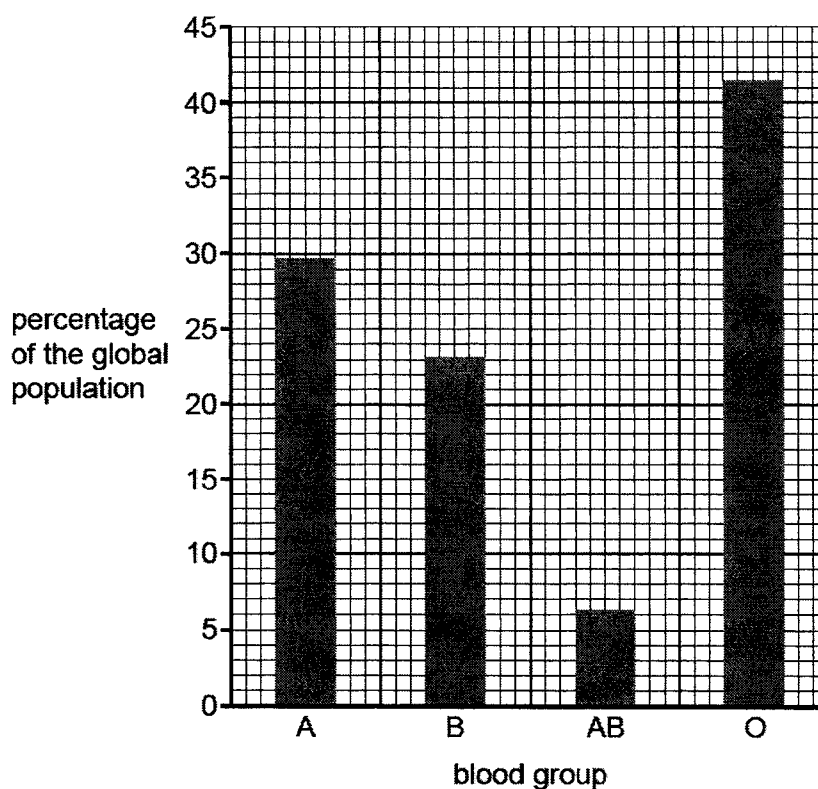


Fig. 8.2

- (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.

.....

.....

.....

.....

.....

.....

.....

..... [5]

9 Or

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

.....

.....

.....

.....

.....

.....

[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.

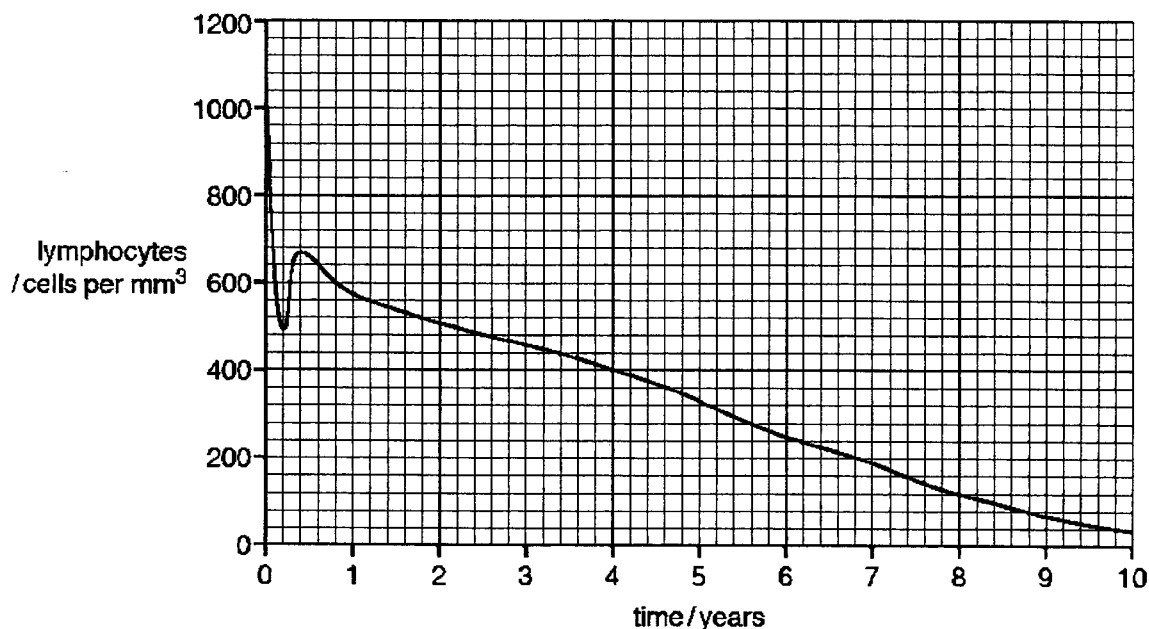


Fig 9.2

- (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]

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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)	<table><tr><th>trophic level</th><th>description</th><th>example from Fig. 3.1</th></tr><tr><td>producer</td><td>makes own food / photosynthesis / autotrophic</td><td>mainly grass / Peruvian feather grass ;</td></tr><tr><td>quaternary / 4^o / fourth / 4th, consumer</td><td>feeds on tertiary consumers</td><td>great horned owl ;</td></tr><tr><td>secondary consumer</td><td>gets energy from / feeds on, primary consumers / herbivores</td><td>long-tailed weasel / bobcat / jaguar / nine-banded armadillo / hooded skunk ;</td></tr></table>	trophic level	description	example from Fig. 3.1	producer	makes own food / photosynthesis / autotrophic	mainly grass / Peruvian feather grass ;	quaternary / 4 ^o / 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]	
trophic level	description	example from Fig. 3.1														
producer	makes own food / photosynthesis / autotrophic	mainly grass / Peruvian feather grass ;														
quaternary / 4 ^o / 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 ;														
	(b)(i)	(named) decomposers ;	[1]													
	(ii)	1 <i>idea that</i> 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)	<i>any four from:</i> 1 ref to mucus, 2 mucus (is sticky and) traps particles of dust ; 3 cilia 4 cilia, waft / move, mucus / AW ; 5 <i>idea of</i> 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)	<i>any three from:</i> 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) <u>membrane(s)</u> ; 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)	$1\ 6\text{CO}_2 + 6\text{H}_2\text{O} = \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$;	[1]	
	(i)			
	(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 $I^A I^O + I^B I^O$; gametes indication accordingly; genotype offspring: $I^A I^B$, $I^B I^O$, $I^A I^O$, $I^O I^O$; <i>phenotypes of the children: AB, B, A, O</i> ; <i>probability of next child with blood group O:</i> 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 / $I^A I^B$;	[max: 2]	
	(c)	<i>any two from:</i> phenotype is determined only by a gene ; (i) 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 ; nerve impulse + 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)	MMO		
	(i)	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]	

	(iv)	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>H₂O₂ used by discs AW;</td><td>concentration of H₂O₂ 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>	source of error	explanation	difficult to cut discs;	poor cutting instrument AW ;	discs not all same size / thickness / surface area;	different amount of enzyme in discs;	discs not all same mass;	different mass requires different amount of gas to float;	H ₂ O ₂ used by discs AW ;	concentration of H ₂ O ₂ not the same for replicate discs;	temperature not controlled;	variation will affect rate of enzyme reaction;	discs taken from different parts of tuber / different tubers AW ;	amount of enzyme in discs may vary;	[4]	1 mark for suggestion and 1 mark for relevant explanation. source of error and explanation must be related
source of error	explanation																	
difficult to cut discs;	poor cutting instrument AW ;																	
discs not all same size / thickness / surface area;	different amount of enzyme in discs;																	
discs not all same mass;	different mass requires different amount of gas to float;																	
H ₂ O ₂ used by discs AW ;	concentration of H ₂ O ₂ not the same for replicate discs;																	
temperature not controlled;	variation will affect rate of enzyme reaction;																	
discs taken from different parts of tuber / different tubers AW ;	amount of enzyme in discs may vary;																	
	(e)	ACE bottom of tube / stays the same / doesn't move / where it started AW ; no H₂O₂ present or substrate present / catalase or enzyme doesn't react with water + no bubbles / O₂ / gas produced ; purpose : control;	[3]															
	(f)	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 ;	[max: 6]															

		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		

end of answer key

