END-OF-YEAR EXAMINATION 2016

SECONDARY FOUR EXPRESS

BIOLOGY PAPER 1

5158/1

TIME: 1 HOUR

INSTRUCTIONS TO CANDIDATES:

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name and index number 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.

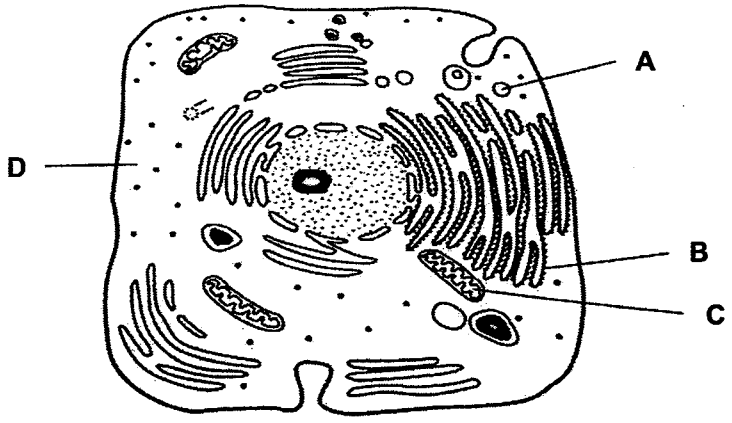
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.

Additional Materials provided by the School:

Answer Sheet

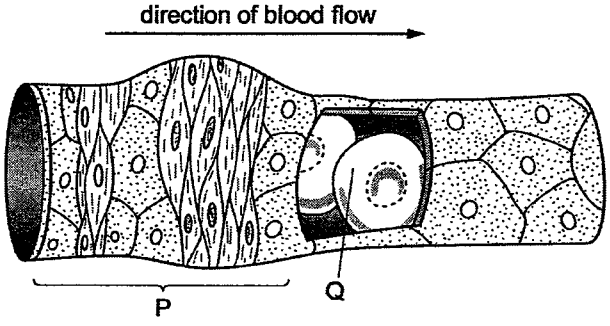
This question paper consists of **23** *printed pages.*

1 The diagram shows a cell as it appears in an electron micrograph.



In which part of a living cell is the carbon dioxide concentration the highest?

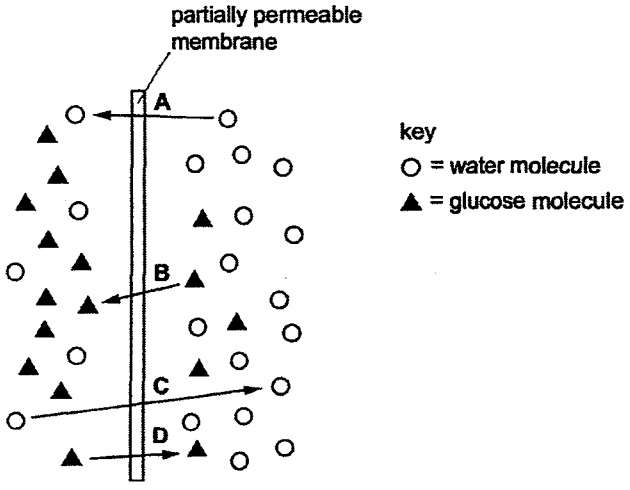
2 The diagram shows blood passing through an arteriole into a capillary. Part of the capillary wall has been cut away to show the blood.



What is the level of organisation of the structures labelled P and Q?

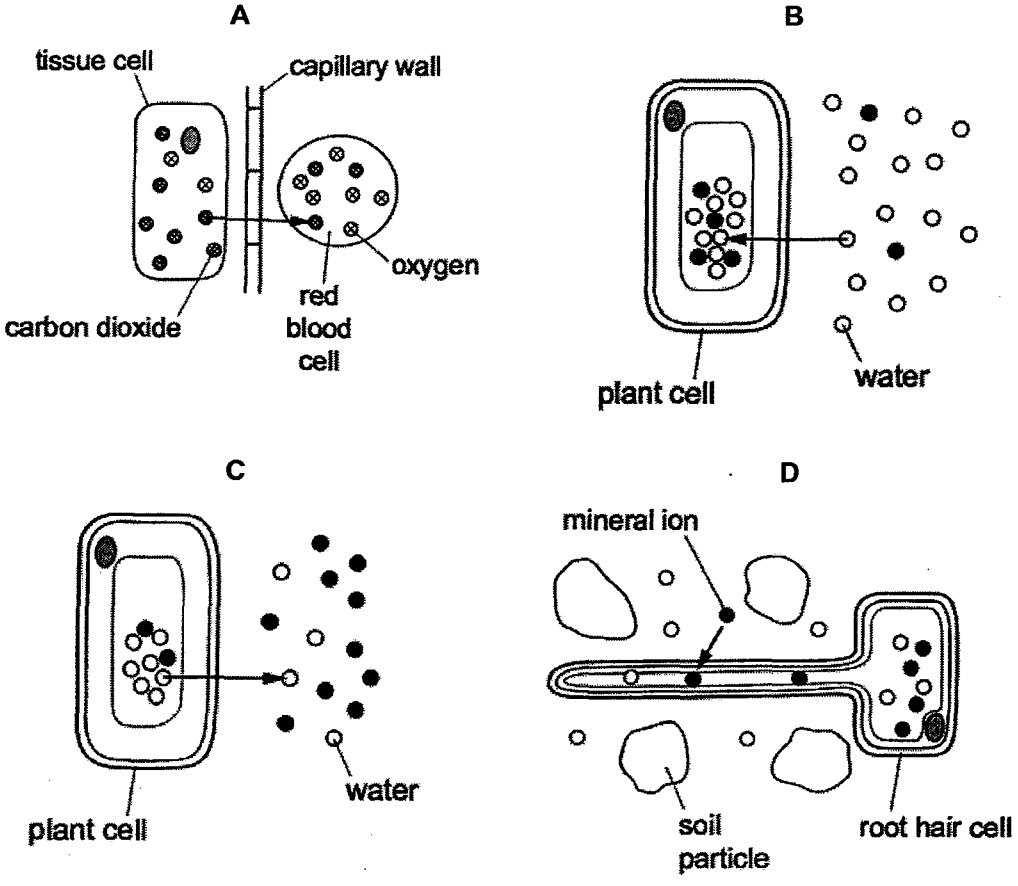
	P	Q
A	organ	cell
B	organ	tissue
C	tissue	cell
D	tissue	tissue

3 The diagram represents the passage of water molecules and glucose molecules across a partially permeable cell surface membrane.

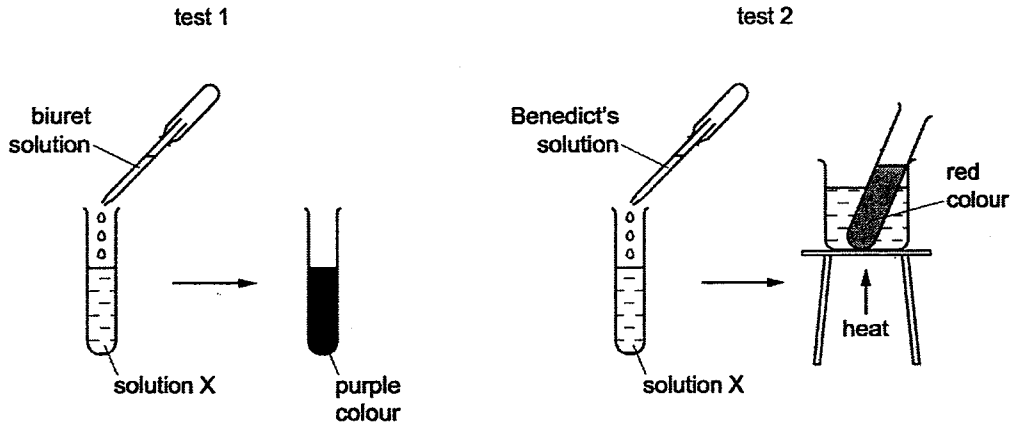


Which arrow indicates osmosis?

4 Which diagram illustrates the process of active transport?



5 The diagram shows two food tests carried out on solution X.



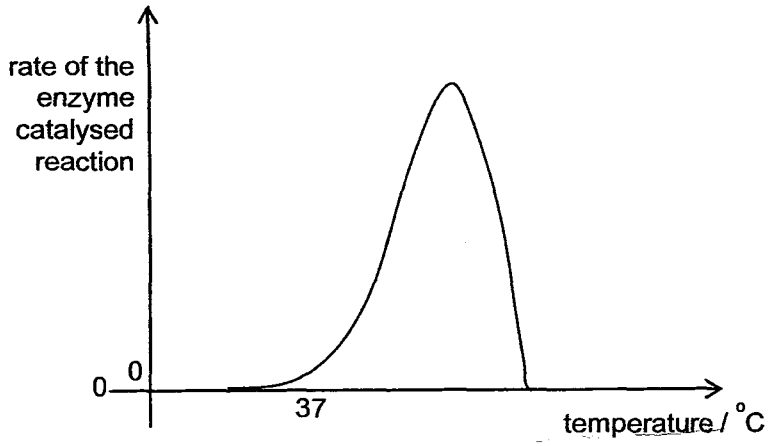
Which nutrients are present in solution X?

A protein and starch
B protein and reducing sugar
C fat and sugar
D starch and reducing sugar

6 Which conversion does not take place in a plant?

A amino acids into polypeptides
B glucose into glycogen
C nucleotides into DNA
D starch into maltose

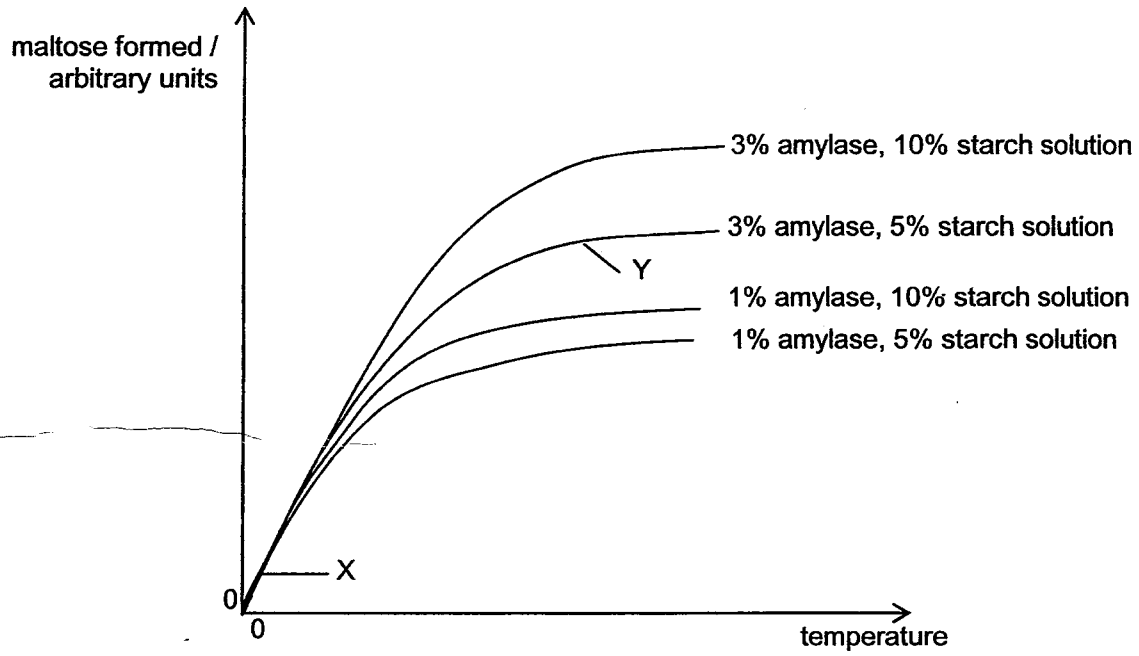
7 The graph below shows the activity of an enzyme found in a strain of bacteria.



Which is the most likely habitat of the bacteria?

A a hot spring
B keyboard of a laptop
C mouth of a cow
D soil in a rainforest

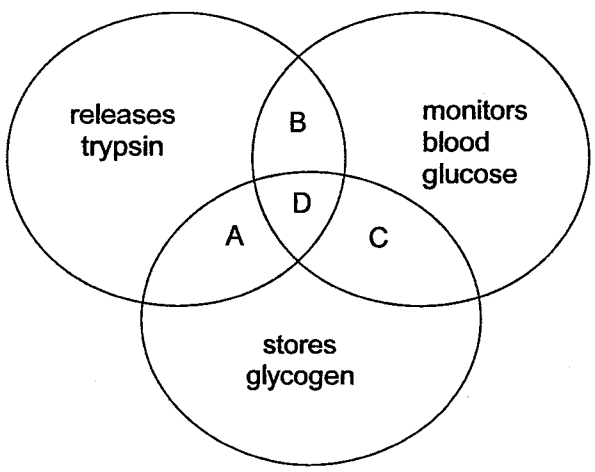
8 The graph shows the effect of various factors on the rate of starch digestion.



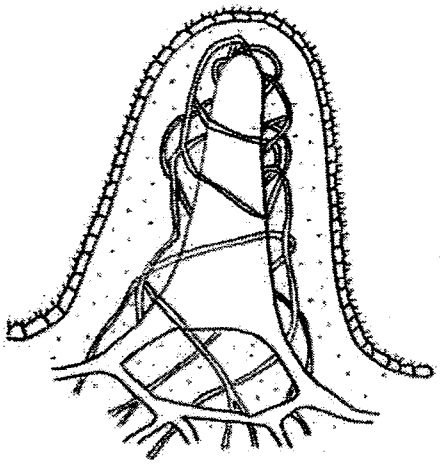
Which factors are limiting at X and at Y?

	X	Y
A	substrate concentration	enzyme concentration
B	enzyme concentration	substrate concentration
C	temperature	enzyme concentration
D	temperature	substrate concentration

9 Which area best represents the functions of the pancreas?



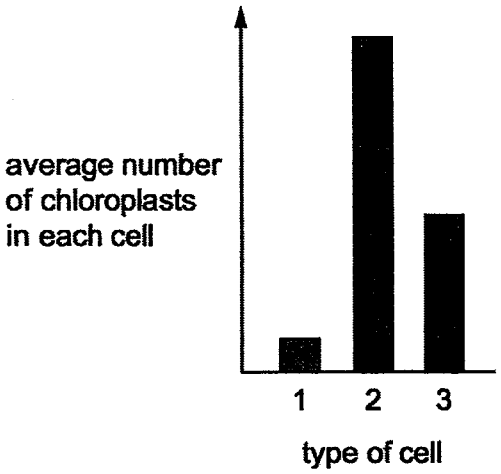
10 The diagram below shows a part found in the ileum.



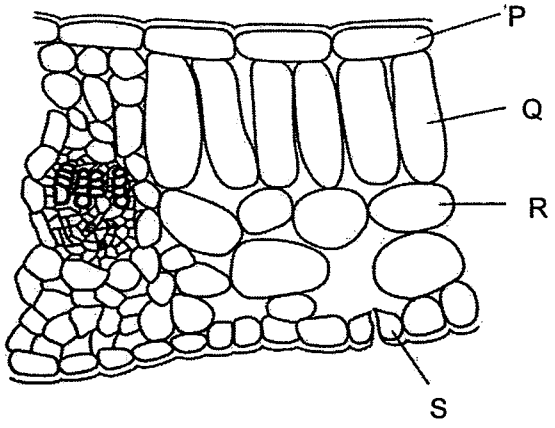
Which is not a function of the part?

A absorption of fat
B absorption of amino acid
C secretion of mucus
D expansion of surface area

11 The bar chart shows the average number of chloroplasts in each of three different types of leaf cell.



The diagram below shows the transverse section of a leaf.



Which row correctly matches cells 1 – 3?

	1	2	3
A	P	Q	R
B	R	P	Q
C	S	Q	R
D	S	P	Q

12 Transpiration enables water to reach the top of trees.

Which two statements are incorrect?

1 Water evaporates into the intercellular airspaces from the mesophyll cells.

2 Gaseous exchange does not affect the movement of water in the xylem.

3 Water molecules are drawn upwards in the xylem.

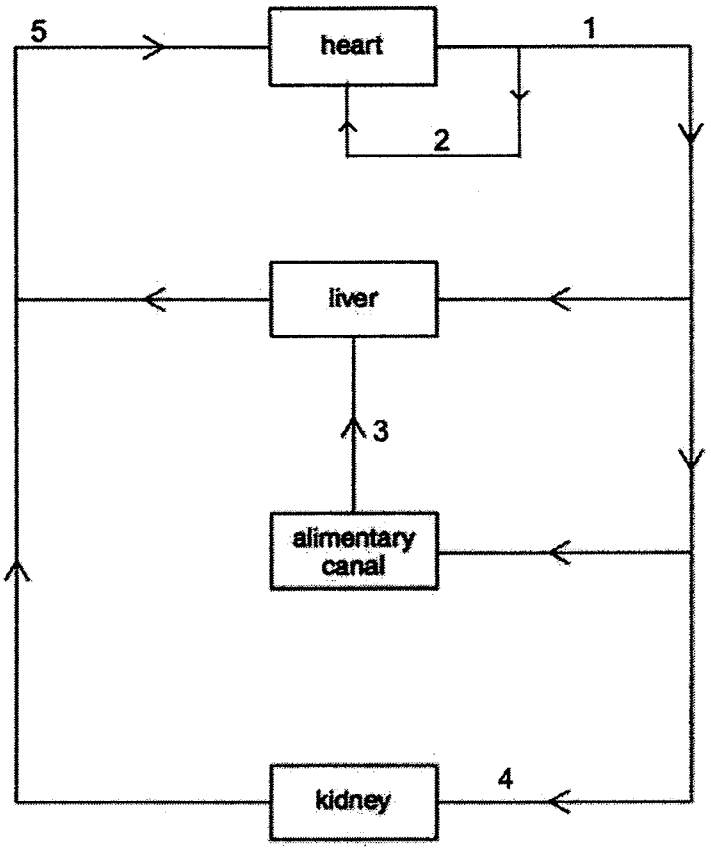
4 Water vapour diffuses through the epidermal cells.

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

13 What is the path of water through a plant?

A cortex cells → xylem → stomata → roots
B root hair → xylem → mesophyll cells → stomata
C roots → cortex cells → stomata → phloem
D roots → root hair → stomata → xylem

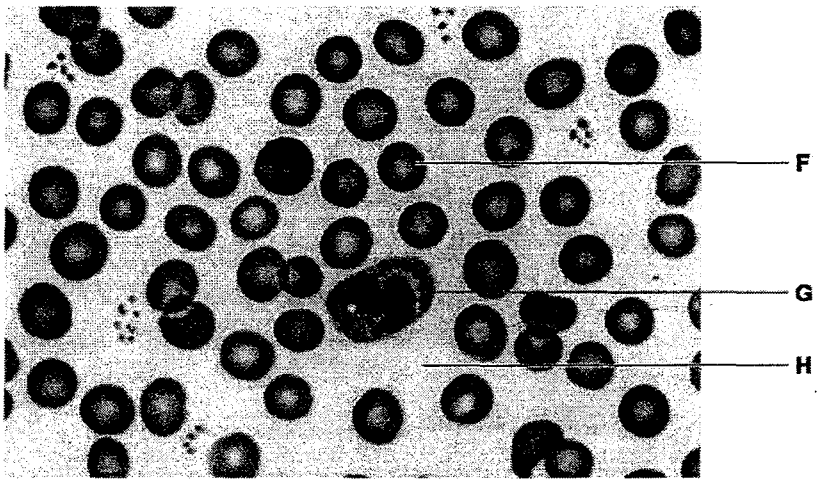
14 The diagram below represents part of the human circulatory system. The arrows indicate the direction of blood flow.



Which row correctly lists the names of the blood vessels shown?

	1	2	3	4	5
A	aorta	aortic arch	hepatic artery	renal artery	vena cava
B	aorta	aortic arch	hepatic portal vein	renal artery	pulmonary vein
C	aorta	coronary artery	hepatic portal vein	renal artery	vena cava
D	vena cava	coronary artery	hepatic artery	renal vein	aorta

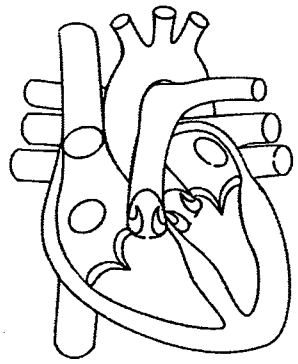
15 The diagram below shows the components of blood as seen through a light microscope.



Which row correctly identifies the functions of F, G and H?

	F	G	H
A	blood clotting	tissue rejection	transport of blood cells
B	carry haemoglobin	produce fibrinogen	transport of carbon dioxide
C	oxygen transport	phagocytosis	transport of blood cells
D	transport of carbon dioxide	phagocytosis	transport of hormones

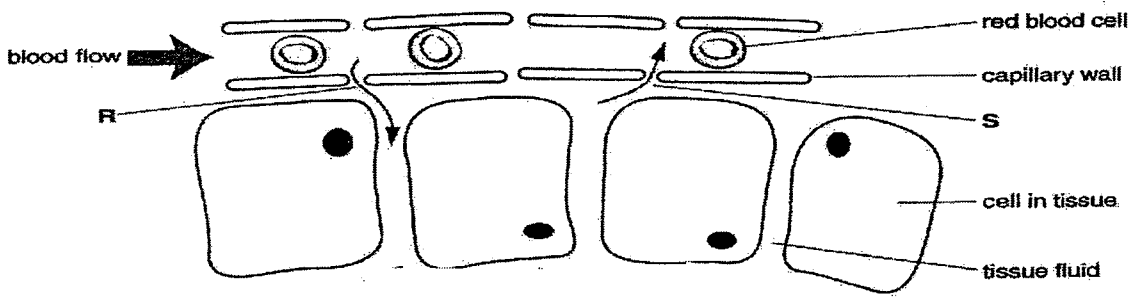
16 The diagram below shows part of the human heart.



Which row is correct at the instant shown?

	muscle action at atrial wall	muscle action at ventricular wall	heart sound
A	contract	relax	'lub'
B	relax	contract	'lub'
C	contract	relax	'dub'
D	relax	contract	'dub'

17 The diagram shows a capillary and some tissue cells. The arrows indicate the direction of flow of tissue fluid.



The statements below compare the fluids at R and S. Which statements are correct?

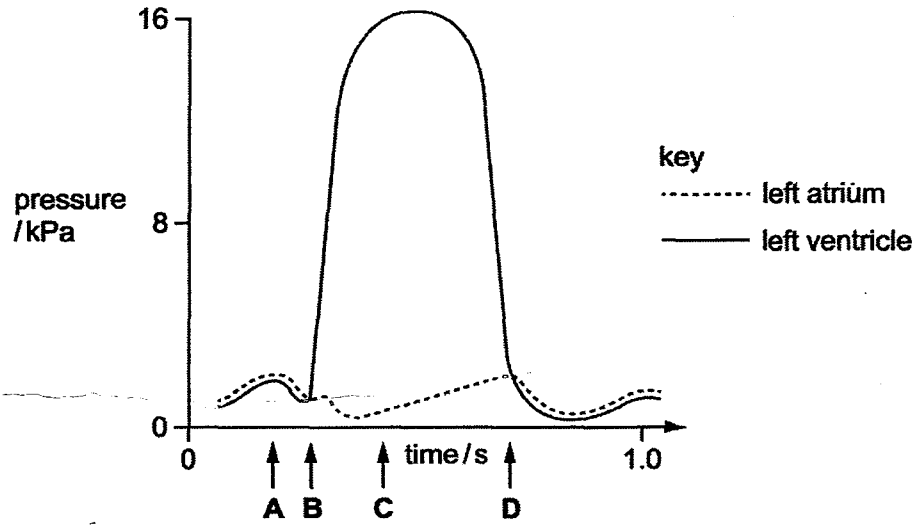
1 R has higher oxygen concentration than S.
2 R has higher levels of plasma proteins than S.
3 R has lower carbon dioxide concentration than S.
4 R has lower pressure than S.

Which statements are correct?

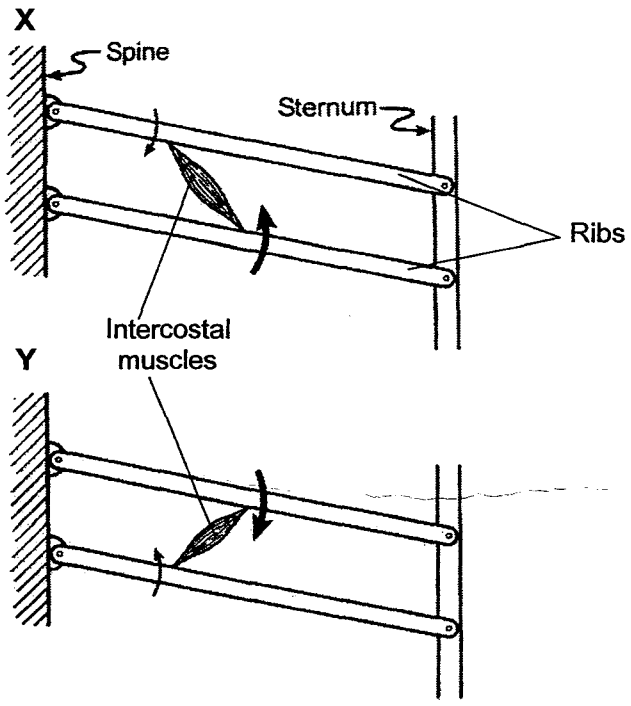
A 1 and 2
B 1 and 3
C 2 and 4
D 3 and 4

18 The graph shows the pressure changes in the left atrium and the left ventricle while the heart is beating.

When does the atrio-ventricular (bicuspid) valve start to open?



19 Panels X and Y show a model of the intercostal muscles at the rib cage.



The two bars oriented obliquely in each panel represent two adjacent ribs. The external and internal intercostal muscles are depicted as single bundles, and the moments acting on the ribs during contraction of these muscles are represented by arrows.

When the external intercostal contracts, the moment acting on the lower rib is greater than that acting on the upper rib; the opposite is true when the internal intercostal contracts.

Which row correctly identifies the muscles represented in panels X and Y, and the breathing process activated when the muscle is contracting?

	muscle represented at panel X	breathing process activated when muscle in X contracts	muscle represented at panel Y	breathing process activated when muscle in Y contracts
A	external intercostal	inhalation	internal intercostal	exhalation
B	external intercostal	exhalation	internal intercostal	inhalation
C	internal intercostal	inhalation	external intercostal	exhalation
D	internal intercostal	exhalation	external intercostal	inhalation

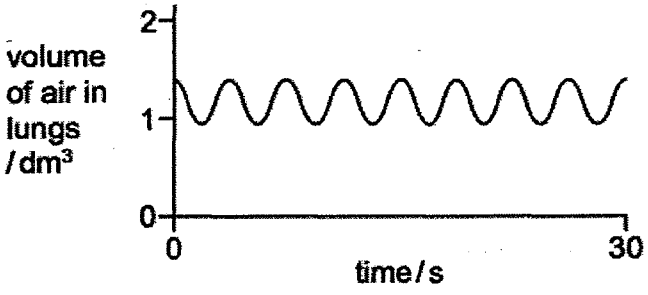
20 Which processes are catalysed by carbonic anhydrase?

$$CO_2 + H_2O \underset{4}{\overset{1}{\rightleftharpoons}} H_2CO_3 \underset{3}{\overset{2}{\rightleftharpoons}} HCO_3^- + H^+$$

carbon dioxide + water — *carbonic acid* — *bicarbonate + hydrogen ion*

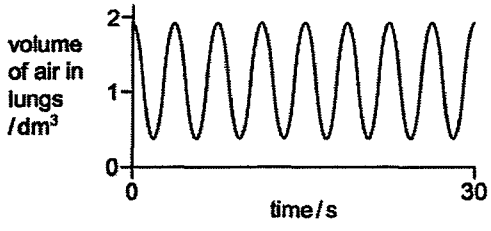
A 1 and 4
B 1 and 2
C 2 and 3
D 3 and 4

21 The graph shows changes in the volume of air in the lungs of a person at rest, over a period of 30 seconds.

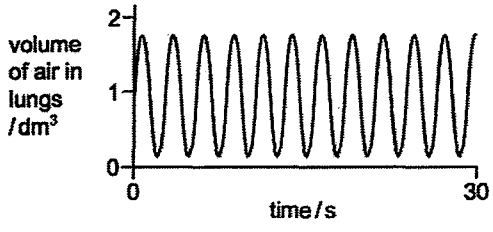


Which graph shows changes in the volume of air in the lungs of the same person immediately after he has done five minutes of vigorous exercise?

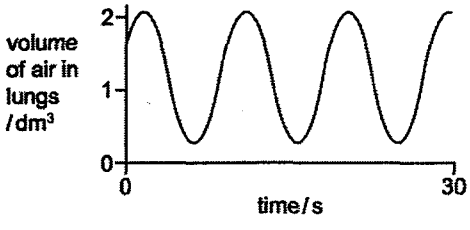
A



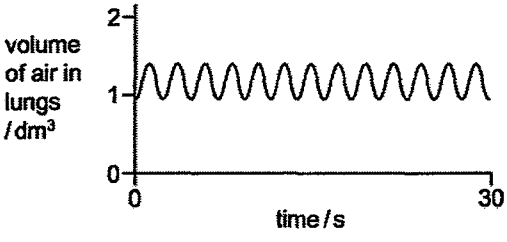
B



C



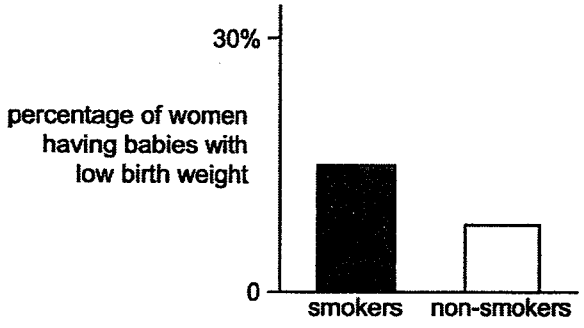
D



22 What is the effect of cigarette smoke on the bronchi?

	cilia	gland cells
A	beat faster	release more mucus
B	beat faster	release less mucus
C	beat slower	release more mucus
D	beat slower	release less mucus

23 The bar chart shows the percentage of women who had babies of low weight, amongst smokers and non-smokers.



What best explains the results?

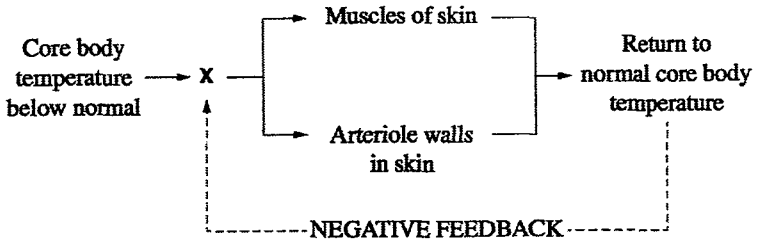
A Carbon monoxide causes less oxygen to be transferred at the placenta in smoking mothers.
B Nicotine causes an increase in heart rate of smoking mothers.
C Tar levels in the blood of smoking mothers are higher.
D The speed of blood flow at the placenta is increased in smoking mothers.

24 Drinks that contain caffeine inhibit the production of anti-diuretic hormone (ADH).

Which row shows the results of these drinks on the kidney tubule and the urine produced?

	amount of water reabsorbed by kidney tubule	effect on urine produced	
		quantity	concentration
A	decreased	decreased	concentrated
B	decreased	increased	diluted
C	increased	decreased	concentrated
D	increased	increased	diluted

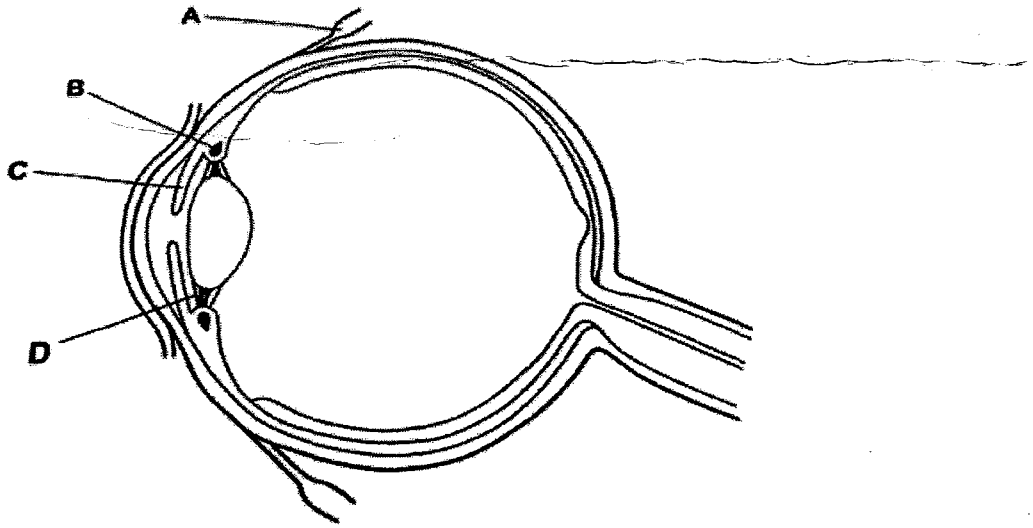
25 The diagram shows a homeostatic mechanism in a mammal.



What does X represent in the diagram?

A thermoreceptors in the skin
B hypothalamus
C pituitary gland
D blood

Refer to the diagram below for questions 26 and 27, which shows a section through the eye.



26 Which part contracts when focussing on a near object?

27 Opticians sometimes place drops of a chemical in a patient's eye to keep the pupil wide open.

Which muscles contract when this chemical is used?

28 The photographs below show the vision of a normal person and the vision of a person with an eye defect.

normal vision

vision with eye defect

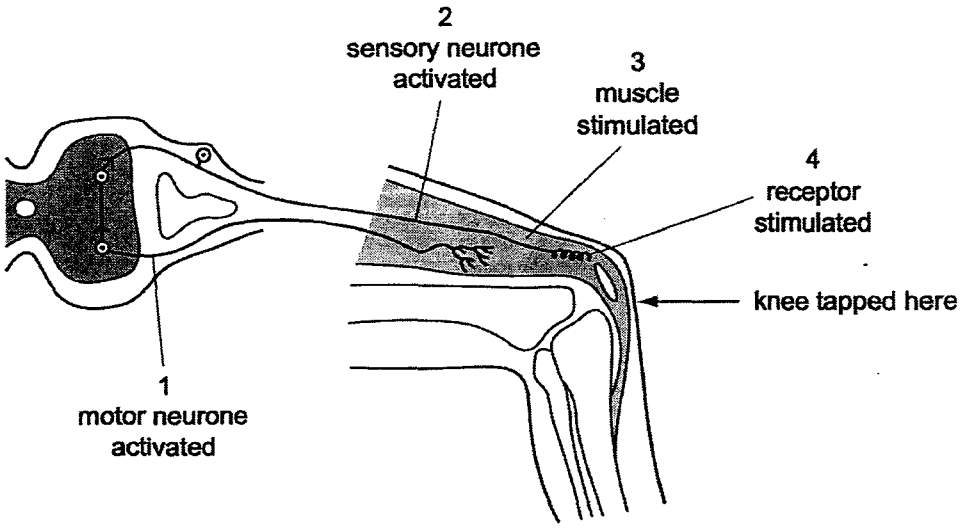
Which is the most likely eye defect?

A A cloudy lens.
B A lens that is too curved.
C An eyeball that is too long.
D The optic nerve is severed.

29 What is the role of motor neurones in reflex action?

A carrying nerve impulses from the central nervous system to an effector
B connecting a receptor to the central nervous system
C forming a synapse with a sensory neurone
D transferring energy from the stimulus to a nerve impulse

30 The diagram shows a simple reflex arc.



What is the correct order of events after the knee is tapped?

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

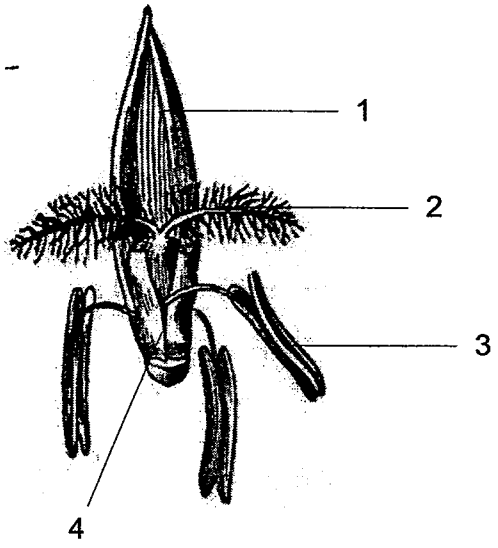
31 The table shows comparisons between hormonal and nervous coordination.

feature number	feature	hormonal coordination	nervous coordination
1	speed of transmission	slower	faster
2	function supported	homeostasis and growth only	reflexes and homeostasis only
3	mode of transmission	through bloodstream	through neurones
4	degree of control	always involuntary	may be voluntary or involuntary

Which comparisons are correct?

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

32 The diagram shows the flower of a species of grass that is growing extensively in a grassland.



Both the male and female reproductive parts matured within 48 hours of each other three days ago.

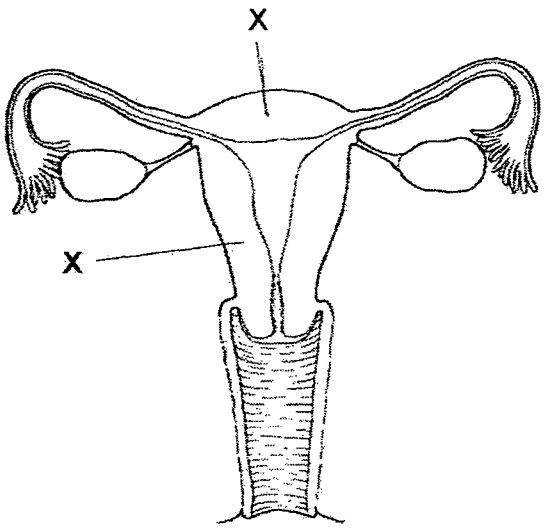
Assuming normal climatic conditions, where can intact pollen grains be found in the flower above?

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

33 Which statement is correct?

A Cross-pollination must always involve two parents.
B Self-pollination leads to offspring with identical genotypes.
C Natural selection causes dominant alleles to be favoured.
D Asexual reproduction occurs in all plants.

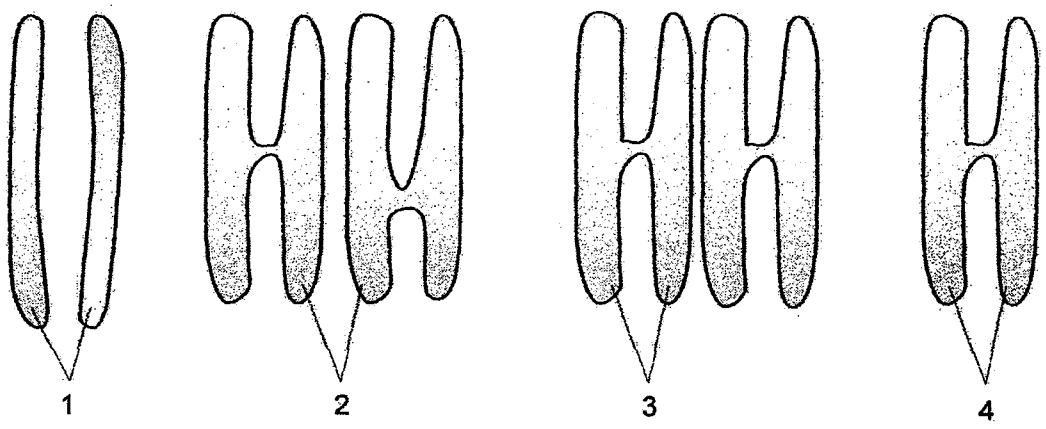
34 The diagram below shows a section through the female reproductive system.



What happens when structure X is removed by surgery?

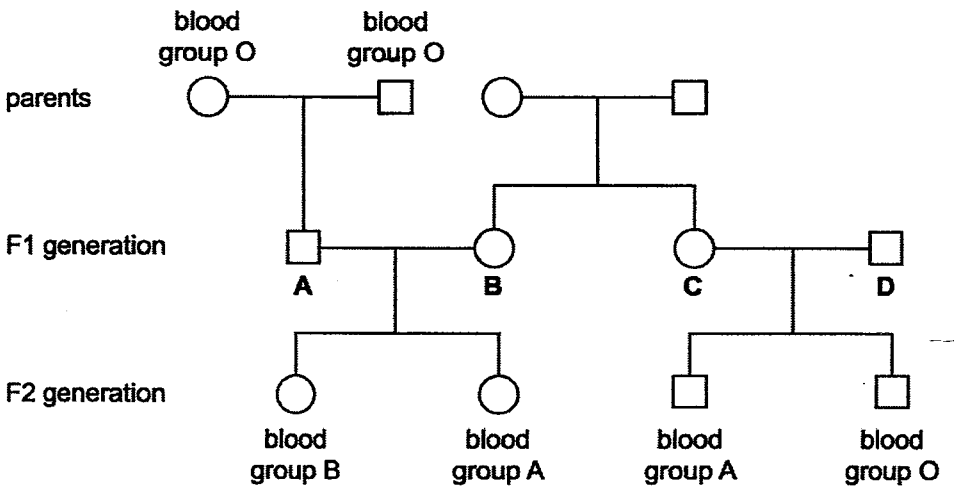
A Fewer eggs are released
B *No menstruation occurs*
C Less oestrogen is released
D Less progesterone is released

35 Which two diagrams represent a pair of sister chromatids?



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

36 The diagram shows the blood group phenotypes of some members of a family.



Which member of the F1 generation must be heterozygous, with two co-dominant alleles?

37 Which of the following statements about genes are correct?

1 A gene codes for a specific polypeptide.
2 A gene is a double helix.
3 A gene is a length of DNA on a chromosome which determines a specific feature.
4 A gene is made up of DNA wrapped around proteins.
5 A gene often exists in two or more allelic forms.
6 A gene is made up of the nucleotides adenine, cytosine, thymine and guanine.

A 1, 2, and 3
B 1, 3, and 5
C 2, 4 and 6
D 4, 5, and 6

38 Which process(es) over time help produce organisms best fitted for the natural environment?

1 competition
2 mitosis
3 gene mutation
4 random fertilisation
5 selective breeding

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

39 The following are statements about evolution.

1 Evolution is driven by a need to adapt.

2 Evolution is the process by which existing species give rise to new species.

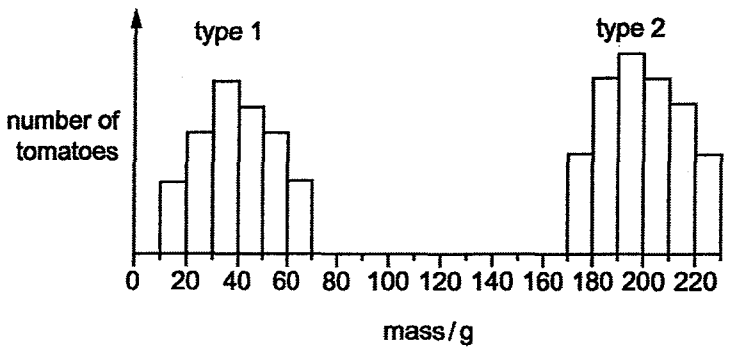
3 Evolution requires the inheritance of acquired traits.

4 Natural selection is a mechanism by which evolution occurs.

Which two statements are incorrect?

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

40 The graph shows the masses of two different types of tomato.



What can be concluded from the graph?

A Genes do not affect the mass of tomatoes.
B Type 1 tomatoes show continuous variation.
C Type 2 tomatoes are sometimes smaller than type 1 tomatoes.
D Type 2 tomatoes show discontinuous variation.

INDEX NO.	

MID-YEAR EXAMINATION 2016

SECONDARY FOUR EXPRESS

BIOLOGY PAPER 2

5158/2

TIME: 1 Hour 45 Minutes

READ THESE INSTRUCTIONS FIRST

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

Section A
Answer **all** questions.
Write your answer in the spaces provided on the question paper.

Section B
Answer **all** questions including questions 6, 7 and 8 **Either** or 8 **Or**.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
You are advised to spend no longer than one hour on Section A and no longer than 45 minutes on Section B.

	Marks
Section A	
Section B	
6	
7	
8	
TOTAL	

*This question paper consists of **19** printed pages.*

For examiner use only

Section A

Answer **all** questions.

Write your answers in the spaces provided.

1 (a) **Fig. 1.1** shows a cell as it appears in an electron microscope.

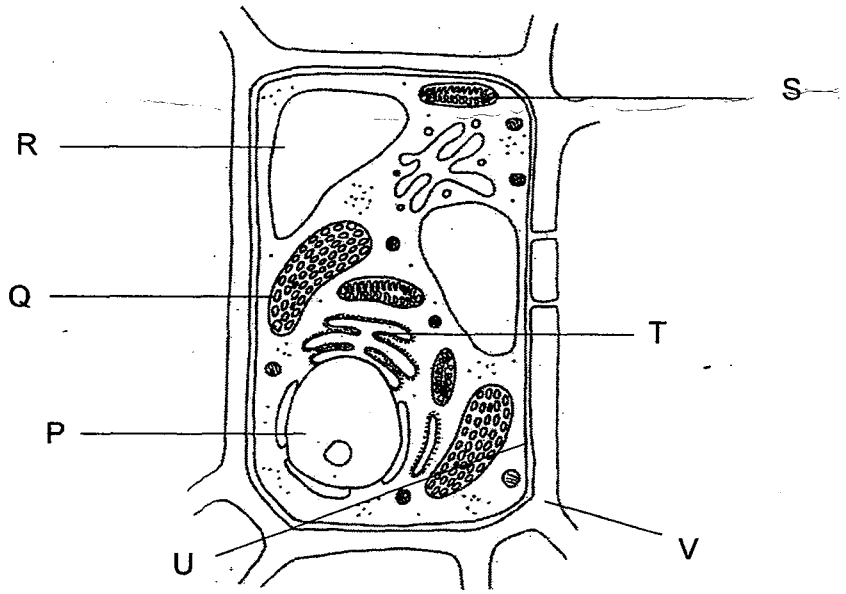


Fig 1.1

Using the labels P, Q, R, S, T, U or V, identify the site where

(i) cellulose chains are present .....

(ii) new enzymes are made .....

(iii) glucose is made .....

(iv) transcription occurs .....

(v) energy is released ..... [5]

For examiner use only

(b) Large molecules are synthesised from smaller basic subunits in the cell.

Complete the table below to show the basic subunits and element(s) present in the following macromolecules.

	fat	polypeptide	DNA
name of basic subunit(s)			
element(s) present			

[6]

[Total = 11]

For examiner use only

2 Read the following extract.

> It has been reported that Singapore has the second highest proportion of diabetics among developed nations.
>
> Diabetes mellitus can be prevented, at the pre-diabetes stage. Pre-diabetics have a reading between 7.8 and 11 mmol/l for blood sugar levels, two hours after an Oral Glucose Tolerance Test.
>
> Adapted from The Straits Times (8 April 2016)

(a) Other than elevated blood sugar levels, state one other sign of diabetes mellitus.

..... [1]

(b) Doctors recommend avoiding soft drinks and spacing out meals to prevent the onset of diabetes mellitus. Explain how these measures prevent the onset of diabetes mellitus.

.....

.....

.....

..... [3]

(c) With regular exercise and weight-loss, the blood glucose for some patients at the pre-diabetes stage can be brought back to normal levels.

Suggest how regular exercise can help reduce blood sugar levels.

.....

.....

.....

..... [2]

(d) Alcoholism promotes the onset of diabetes mellitus. Suggest a reason for this.

.....

..... [1]

For examiner use only

(e) Some diabetic patients require insulin therapy.

Describe how the gene for human insulin protein can be inserted into a bacterial host cell through genetic engineering processes.

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..... [4]

(f) Insulin therapy cannot be taken through the mouth. Suggest a reason why.

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..... [1]

(g) Before genetic engineering processes were invented, diabetics were treated with insulin protein extracted from the pancreas of pigs and cows slaughtered for food.

State one advantage of using human insulin protein made by genetic engineering processes over cow or pig derived insulin.

.....

..... [1]

[Total = 13]

For examiner use only

3 (a) The plasma solute concentration, plasma antidiuretic hormone (ADH) concentration and feelings of thirst were tested in a group of volunteers. **Fig. 3.1** shows the relationship between intensity of thirst, plasma ADH concentration and plasma solute concentration.

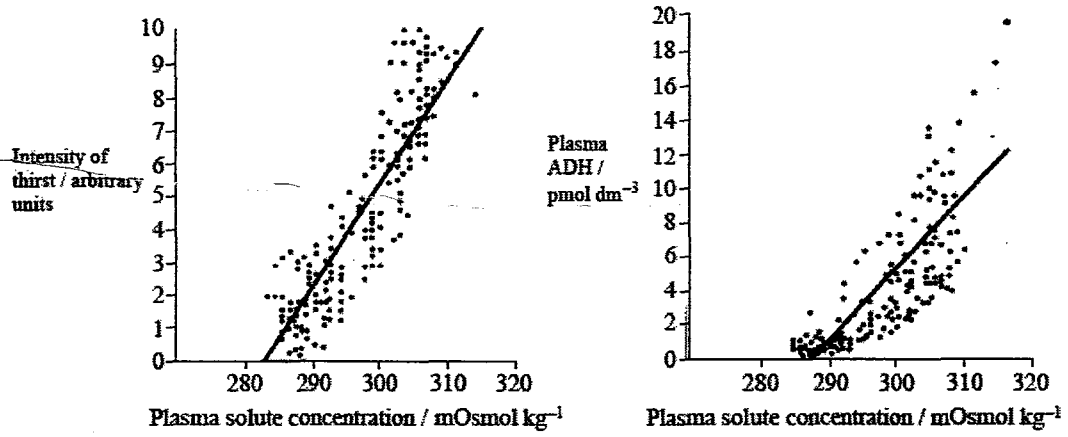

Fig 3.1

State three conclusions that can be drawn from **Fig. 3.1**.

1 .....

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2 .....

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3 .....

..... [3]

For examiner use only

(b) The graphs in **Fig 3.1** show the regulation of an important internal factor of the human body by negative feedback. Name the factor, and outline the regulation of this factor by negative feedback.

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..... [4]

(c) Describe two differences in how urea is removed from the body by a healthy person and by a patient undergoing kidney dialysis.

difference 1 .....

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difference 2 .....

..... [2]

[Total = 9]

organisms.

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..... [2]

(d) State three ways in which meiosis and fertilisation result in genetic variation.

1 .....

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2 .....

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3 .....

..... [3]

[Total = 12]

For examiner use only

5 **(a)** Explain what is meant when an allele is described as *dominant*.

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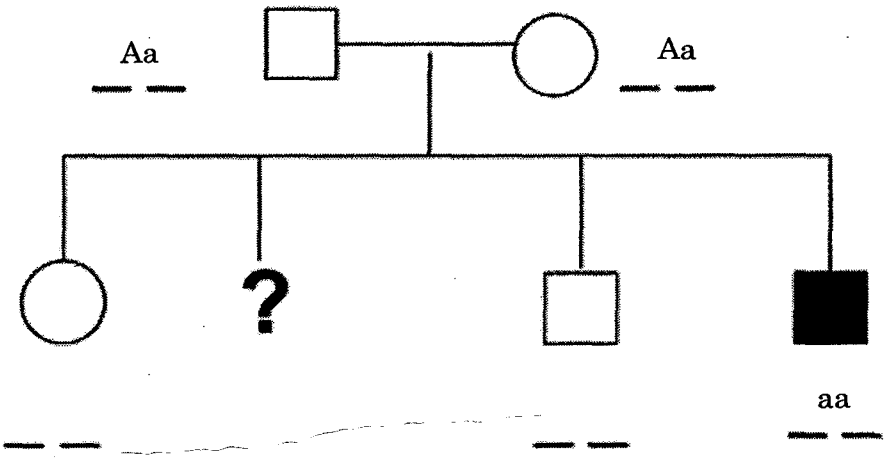
..... [1]

(b) The pedigree tree shows an individual affected by a disease caused by a recessive allele. The gene is not found on the X chromosome. Fill in the genotypes that can be determined using 'A' for dominant and "a" for recessive.



[2]

(c) Calculate the probability that **X** will be a phenotypically normal boy. Show your working fully.

[2]

[Total = 5]

For examiner's use only

Section B

Answer **three** questions

Question 8 is in the form of an **Either/Or** question. Only one part should be answered.

6 Chilli peppers produce a chemical, capsaicin, which has a pungent odour and results in a burning sensation when eaten. In the wild, capsaicin protects the chilli peppers against harmful fungal infections and mammalian predators.

(a) **Fig 6.1** shows the changes in the proportion of plants that produce pungent chillies in a mountainous area of Bolivia that experiences variation in rainfall.

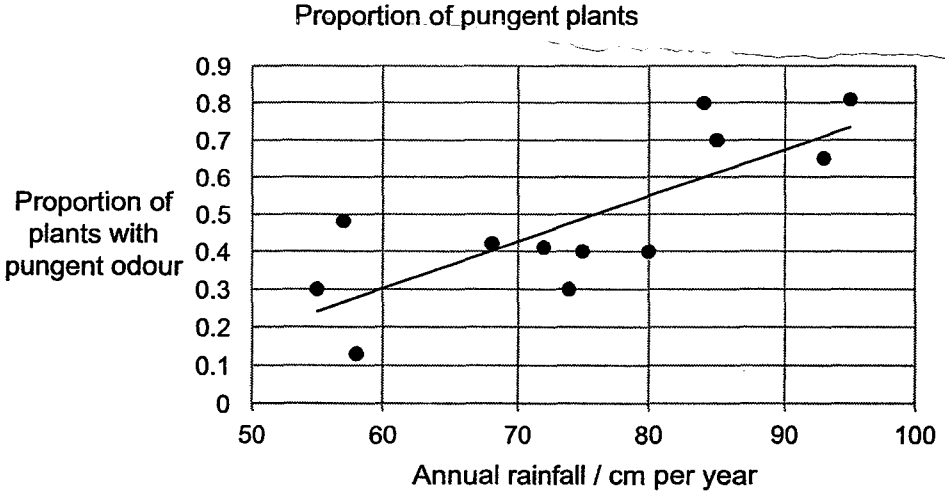


Fig. 6.1

Calculate the difference in the proportion of pungent plants present in an area with rainfall of 90 cm per year and in an area with rainfall of 60 cm per year.

[1]

(b) The stomatal density of pungent and non-pungent plants was measured. **Fig 6.2** shows the results.

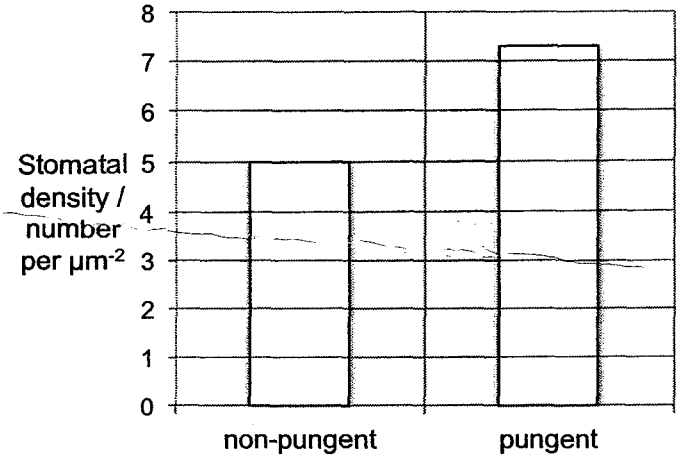


Fig. 6.2

Which strain is more likely to lose water by transpiration? Explain your reasoning.

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..... [2]

(c) Pungent and non-pungent strains were grown in a lab. **Fig 6.3** shows the differences in seed production of pungent and non-pungent plants.

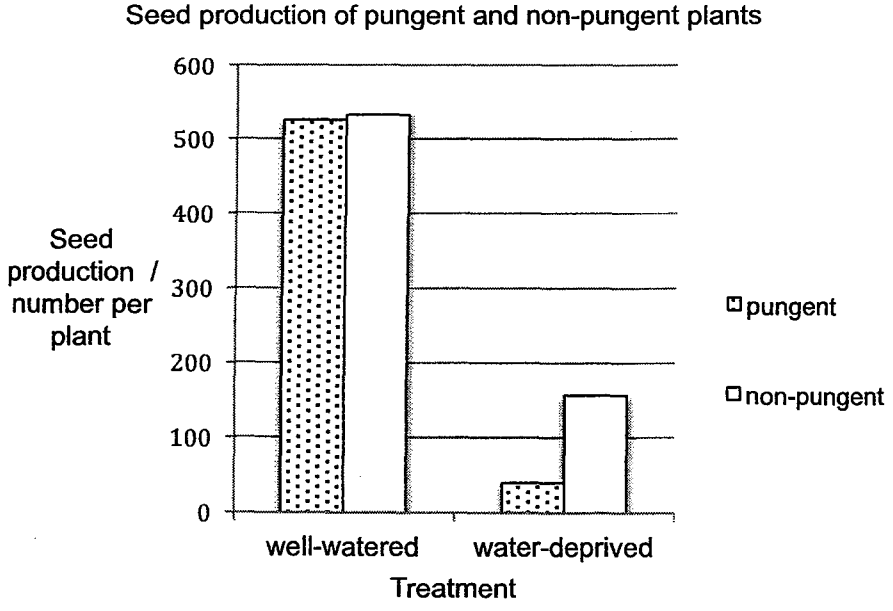

Fig. 6.3

For examiner use only

Explain how the evidence above shows that non-pungent plants have a selective advantage in dry conditions.

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.....

..... [2]

(d) The evidences above suggest that wild strains of chilli plants in hot and dry conditions produces less chilli peppers, with less pungent odours, and have a lower density of stomata than strains in wetter conditions.

Propose an explanation why such a phenotypic variation exists among strains of chilli plants.

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..... [4]

[Total = 9]

For examiner's use only

7 **(a)** Explain how an unhealthy diet may accelerate coronary heart disease.

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..... [3]

(b) Explain how and why lactic acid concentration in the blood increases during heavy exercise and reduces after it.

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..... [5]

For examiner use only

(c) **Fig 7.1** below shows how oxygen consumption varies with exercise intensity.

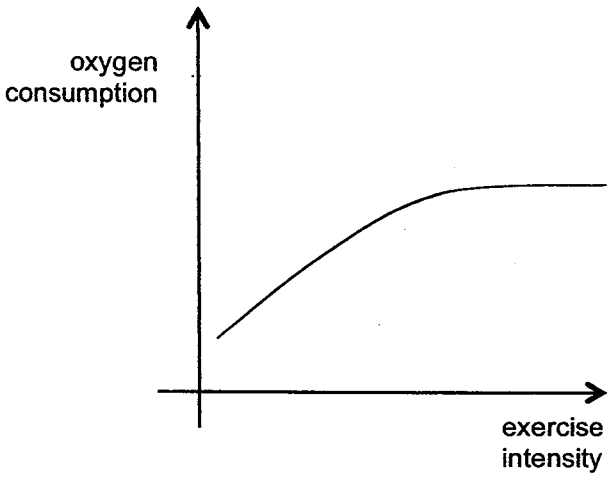

Fig 7.1

Describe and explain the shape of the graph.

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..... [3]

[Total = 11]

For examiner's use only

EITHER

8 **(a)** Describe the role of the placenta and umbilical cord during pregnancy.

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..... [5]

(b) Compare the routes taken by the male gamete of a human and a papaya plant, from the time each leaves site of production, to the time fertilisation occurs.

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For examiner use only

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..... [5]

[Total = 10]

For examiner's use only

OR

8 (a) Briefly describe the events in the menstrual cycle.

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..... [5]

(b) Describe the similarities and differences in the structure and functioning of the male gamete of a human and of a papaya plant.

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For examiner's use only

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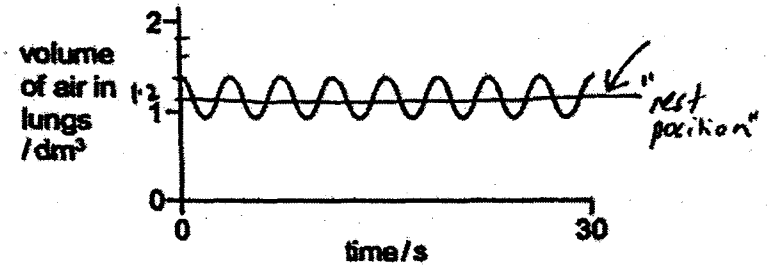
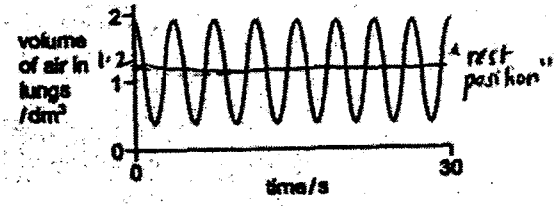
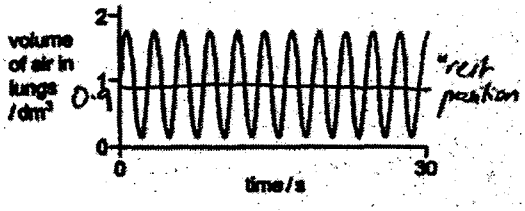
..... [5]

[Total = 10]

End of Paper

Paper 1
MCQ

Qn	Ans	Feedback and guidance
1	C	Site of aerobic respiration which produces carbon dioxide
2	C	P = tissue because more than 1 type of cell is present.
3	A	
4	D	
5	B	
6	B	Option is describing protein/polypeptide synthesis from amino acids. We expect protein synthesis to happen in plant cells too.
7	A	
8	D	The limiting factor is defined as the factor that directly changes the process when its quantity is changed. It increases the process when its quantity is increased. Answer is not C because: to show that enzyme concentration is limiting at Y, we need a comparison with a higher enzyme concentration to be able to say whether enzyme concentration is limiting the rate of reaction.
9	B	
10	A	The secretion of mucus is a function of the entire part. Absorption of fat is not. The epithelium absorbs fatty acids and glycerol. Once absorbed, they recombine and the lacteal transports the fat away.
11	A	Fact: the epidermal cells have NO chloroplasts.
12	C	Statement 1: Water does evaporate from the mesophyll cells, from the film of water that lines the outer surface of the mesophyll cells. Statement 2: Gaseous exchange requires stomata to be open. Open stomata enable transpiration, and hence, gaseous exchange does affect water movement up the xylem.
13	B	
14	C	Blood vessel 3 connects the liver with the alimentary canal (intestine) - so it can only be the hepatic portal vein.
15	C	
16	B	At the instant shown, bicuspid and tricuspid valves are closed. This creates the first heart sound which is the 'lub'
17	B	Answer is not A. Plasma proteins do not pass through the walls of the capillaries.
18	D	The AV valves (bicuspid and tricuspid) **start** to open at the instant when the atrium

Qn	Ans	Feedback and guidance
		pressure **starts to** be higher than the ventricle. This is at point D.
19	A	The arrows in Panel X fits the description described in the text "when the external intercostal muscles contracts, the moment acting on the lower rib is greater than the upper rib". So the muscle in Panel X must be external intercostal muscle. Since in Panel X the ribs move upwards, the breathing process is inhalation. (From theory, contraction of external intercostal muscles bring about inhalation)
20	A	Carbonic anhydrase is an enzyme. Enzymes catalyse reversible reactions.
21	A	During exercise, the depth and frequency of breathing is increased. Answer is A and not B because the "rest position" of the lungs must remain the same (at around 1.2 dm^{-3}).  **Which graph shows changes in the volume of air in the lungs of the same person immediately after he has done five minutes of vigorous exercise?** **A**  **B**  Rest position remains the same since the size of lungs remains the same as its pressure equalises with the atmosphere.
22	C	
23	A	
24	B	The amount of water reabsorbed directly affects the amount of urine produced downstream, since urine is derived from the filtrate in the nephron. ADH helps retain water in the bloodstream, by increasing the amount of water reabsorbed at the collecting duct. So inhibition of ADH tends to decrease the water reabsorbed by the kidney tubule.
25	B	The arrows in the diagram shows that X sends signals to both muscles of the skin and arterioles. X is therefore playing the role of a coordinator i.e., hypothalamus.

Qn	Ans	Feedback and guidance
26	B	Answer is not D because D is the suspensory ligament. This part does not contract or relax. The ligaments become more slack or taut as the ciliary muscle contract more or relax more respectively.
27	C	The iris muscle is muscle C. A is the muscle that controls the movement of the eye-ball, while B is the ciliary muscle that controls the slackness in the suspensory ligament.
28	A	The entire field of view is blurred. If myopia (B and C), then near objects (the children) should be clearer than the distant objects (the tree)
29	A	
30	C	
31	B	
32	C	Wind pollination should have occurred. We expect stigma to capture pollen grains, and anthers to contain remnants of pollen grains. We don't expect intact pollen grains in the ovary at all times.
33	A	Self-pollination is a form of sexual reproduction. Gametes are still formed and so they will never be identical.
34	B	The uterus is site where the lining builds up. So the lack of uterus will eliminate menstruation. Answer is not D because the ovaries, which will contain corpus luteum that releases progesterone, are still intact.
35	D	Sister chromatids are identical strands of a replicated chromosome joined at the centromere.
36	B	
37	B	
38	B	Mitosis does not help create varieties in the population, meiosis does. Selective breeding is not relevant, since the context is that of producing organisms best suited for the NATURAL environment.
39	C	Question is asking for incorrect statements. So C not the correct answer, because statements 2 and 4 are true statements. Statement 1 is wrong because evolution unfolds as better-adapted varieties reproduce at a higher rate, and NOT because of a "need" by a species to adapt. Statement 3 is wrong because traits that are acquired by the organism over its lifetime may not be a result of its genotype.
40	B	Type 2 tomatoes shows sizes that range continuously from 170 - 230g. If discontinuous variation is seen, we don't expect to see multiple adjacent bars with no spaces in between the class intervals.

Paper 2
Structured & Free response

Table below shows the meaning of the markings used by the teacher.

✓	Answer given is worthy of a mark.
x	Wrong response
NAQ	Not answering the question / irrelevant points
^	Omission / missing points
bod	Benefit of the doubt (where professional judgment and discretion is exercised)
ecf	Error carried forward
M	Misconception
V	Answers vague / answers are somewhat correct but not precise enough
~~	Poor expression
?	Meaning not clear – what are you trying to say?
Sp	Wrong spelling
↗	Cause and effect relationship described is wrong / illogical / contradiction
R	reject

Overall comments

- For explain, we need to say what is the cause OR say why how something supports
- Skills gap: comparisons, explanations and using data to support reasoning.

<table>
<tr><th colspan="2">Qn</th><th>Answers</th><th>Marks</th><th>Feedback and guidance</th></tr>
<tr><td>1 (a)</td><td>(i)</td><td>V</td><td>1</td><td>Cellulose molecules are part of cell wall</td></tr>
<tr><td></td><td>(ii)</td><td>T</td><td>1</td><td>Enzymes are proteins, so are made in rough endoplasmic reticulum</td></tr>
<tr><td></td><td>(iii)</td><td>Q</td><td>1</td><td>Glucose is made by the chloroplast via the chloroplasts;
The chloroplasts are identified by "stacks"</td></tr>
<tr><td></td><td>(iv)</td><td>P</td><td>1</td><td>Transcription involves copying DNA. This happens at the nucleus.</td></tr>
<tr><td></td><td>(v)</td><td>S</td><td>1</td><td>Energy is released via respiration at the mitochondria;

Mitochondria are identified by "folds"</td></tr>
<tr><td>(b)</td><td></td><td>
<table>
<tr><th></th><th>fat</th><th>polypeptide</th><th>DNA</th></tr>
<tr><td>name of basic subunit(s)</td><td>Glycerol

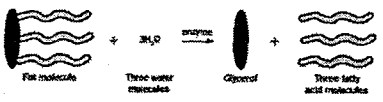
Fatty acids</td><td>Amino acid</td><td>Nucleotide</td></tr>
<tr><td>element(s) present</td><td>C, H, O</td><td>C, H, O, N</td><td>C, H, O, N, P</td></tr>
</table>
</td><td>6

1 mark for each correct cell</td><td>Recommendation for students:

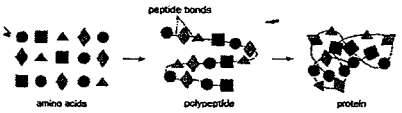
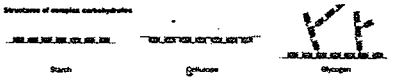
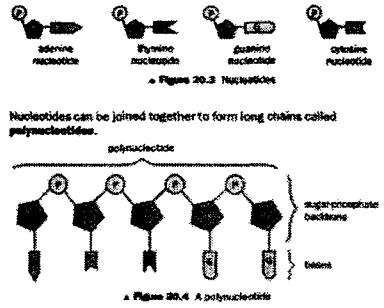
Make a table including fat, polypeptide, DNA, named carbohydrates and write out the names of the basic subunits and chemical elements present.

Note:

Constituents of fat

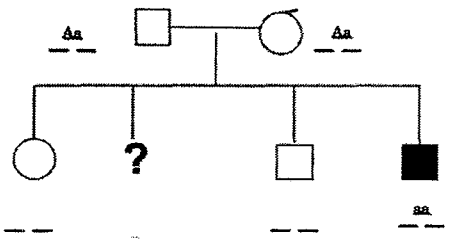
Constituents of proteins</td></tr>
</table>

Qn	Answers	Marks	Feedback and guidance
			 Constituents of starch, cellulose and glycogen are all glucose  Constituents of DNA 
2 (a)	Presence of glucose in urine	1	Other signs that are commonly associated with, but not specifically linked to, diabetes mellitus, were not accepted. Examples of answers not accepted: High blood pressure Poor wound healing
(b)	<u>Avoiding sugary drinks</u> reduce spikes to blood glucose; simple sugar in soft drinks enter bloodstream directly in intestine; <u>Spaced out meals</u> allows gradual absorption of sugars from digested carbohydrates; Smaller spike to blood glucose level; Sufficient time for glucose to be absorbed in cells / liver / muscles;	 1 1 1 1 1	Prevention of diabetes is based reducing the increase in blood glucose levels.
(c)	more glucose used by muscles **cells**; for respiration to release more energy; more glucose used to replenish glycogen stores in liver and muscles;	1 1 1	There was gross confusion between the functions of the pancreas and liver. Please review pg 95, 103 - 107

Qn	Answers	Marks	Feedback and guidance
(d)	Liver cirrhosis + less capacity to store glucose; Alcohol is converted to glucose + contributes to blood sugar spikes	1 1	
(e)	Restriction enzyme used to isolate gene of interest from a cell; Same restriction enzyme used to linearise a **plasmid extracted from a bacterial cell**; gene fragment and linearized plasmid combine + complementary base pairing; Ligase to seal; Transformation by suitable means (heat shock)	1 1 1 1 1	This part of the syllabus was not well learnt. Students must review the notes and TB pg 394 again. Common misconception: the recombinant plasmid is NOT put **back** into the bacterial cell. To extract a plasmid from a bacterial cell, the cell membrane will be destroyed.
(f)	Insulin will be denatured / digested by stomach acids / enzymes Insulin too big to pass through small intestine;	1	
	More ethical for vegetarians as no animals were sacrificed; Less risk of allergic reactions; Less religious objections to use of animal-based extracts;	1 1 1	
3 (a)	Plasma ADH concentration rises with plasma solute concentration Intensity of thirst experienced rises with increasing plasma solute concentration Intensity of thirst experienced correlates with concentration of plasma ADH	1 1 1	R: "directly proportional" / "directly proportionate" / "in proportion to" For a relationship to be described using the word "proportional", the equation below holds. $y = kx$

Qn	Answers	Marks	Feedback and guidance
	-		This relationship is not shown by the graphs as they are described by $y = mx + c$
(b)	Factor: blood water potential; the greater the plasma concentration, the larger the corrective effect (more ADH released); More ADH causes more water reabsorption at the collecting duct cells Blood water potential increases and this causes less ADH released	1 1 1 1	R: inaccurate answers such as "blood water level" / "water concentration" Blood water potential is the tendency water to move out of a given area. This is affected by various factors such as blood levels, water concentration and solute concentration.
(c)	<u>How urea is removed from the blood:</u> In a healthy person, urea removed from blood by ultrafiltration while in kidney dialysis patient urea is removed by diffusion from blood <u>Formation of urine</u> Urea removed as via urine in a healthy person while in a kidney dialysis patient this is not present.	1 1	When making comparisons by describing differences (or similarities), one needs to be clear about what feature is being used as a basis for comparison. In this exam, there were lots of invalid comparisons because some answers start by talking about process in the healthy person (e.g., diffusion) and end by talking about material (e.g., dialyzing fluid) in the patient.
4 (a) (i)	7	1	Not 8 because 8 is actually showing separation of homologous chromosomes (anaphase)
(ii)	9	1	The answer is not photomicrograph12 because by the end of telophase I, the daughter cells are already haploid (all pairs of homologous are equally divided among 2 daughter cells). This is the first time haploid daughter cells are formed during meiosis.
(iii)	11	1	The answer is not photomicrograph 8 because the question is asking about

Qn	Answers	Marks	Feedback and guidance
			separation of **sister chromatids**.
(b)	Homologous chromosomes pair up; Arms of homologous chromosomes may cross over / exchange segments; Condensation of chromosomes; Movement to the equator; Lining up at the equator; Attachment of spindle fibre to centromere;	1 1 1 1 1 1	Misconception alert: DNA replication does not occur in any of the photomicrographs because they are all representing meiosis ~~(a nuclear~~ **division**) Examples of incorrect use of terms: "identical homologous chromosomes" "sister chromosomes" "homologous chromatids"
(c)	Meiosis produces haploid gametes; Restores normal chromosome number during fertilization;	1 1	
(d)	Independent assortment / random separation of each homologous pair (gametes have unique combination of maternal and paternal chromosome); Crossing over between **chromatids of homologous chromosomes** (creates new allelic combinations along each chromosome); Random fusion of gametes (zygote has a unique combination of chromosome from);	1 1 1	R: "crossing over of sister chromatids"
5 (a)	An allele that expresses its effects regardless of the other allele that is present		
(b)	Both parents Aa Affected child "aa" Minus 1 mark if other non-affected child are given a specific genotype	1 1	We cannot be sure for the other unaffected children whether they are Aa or AA.

Qn	Answers	Marks	Feedback and guidance
			
(c)	Probability of a boy = ½ An offspring can be AA, Aa, Aa or aa. Probability of being normal = ¾ Overall = 3/8	1 1	Many students subtracted the probabilities for the already assigned genotypes from the 4 theoretical outcomes. This is wrong. Actually, the outcomes in a genetic diagram show the probabilities and outcomes for EACH offspring.
6 (a)	0.65 – 0.3 = 0.35	1	Some students gave too precise estimations e.g, 0.675.
(b)	Pungent; Higher stomatal density in pungent plants (7.2 compared to 5) provides a larger surface area through which water vapour molecules diffuse	1 1	We ought to have used data to support our answers.
(c)	In water deprived area, non-pungent plants produce more seeds (15) than pungent plants (50); Quote data; (There is greater reproductive success for non-pungent seeds in dry areas.)	1 1	We ought to have used data to support our answers. Note the meaning of selective advantage: the trait that confers greater reproductive advantage
(d)	<u>In dry and hot conditions</u> Seed production is inhibited by lack of water; Lower stomatal density helps reduce water loss in dry climates; <u>In wet conditions</u> Pungency favoured because of protection	1 1 1	

Qn	Answers	Marks	Feedback and guidance
	against fungal infection; More mammals tend to be present in wetter climates natural selection; mutation;	 1 1 1	
7 (a)	High fat / high cholesterol diet accelerates; Atherosclerosis / Build up within lining of arteries; Narrow the lumen / arteries clogged / less blood flows through / clogged (R: "clotting")	1 1 1	Note that coronary heart disease (CHD) refers to when the coronary arteries (the arteries that supply your heart muscle with oxygen-rich blood) become narrowed by a gradual build-up of fatty material within their walls. This condition is called atherosclerosis. The fatty build up starts from **within** the lining, not *on* the lining. M: "undigested food flows in blood vessels and clogs them" Actually, undigested food simply passes out of the body as faeces
(b)	Higher demand of energy in **muscle cells**; Demand exceeds energy available by aerobic respiration; Glucose → lactic acid + energy / "lactic acid produced + anaerobic respiration"; (lactic acid) diffuses from muscle cells into blood stream;	1 1 1 1	
	which releases energy; (lacti acid) converted back to glucose; using oxygen breathed in during repayment of oxygen debt; at the liver;	1 1 1 1	

<table>
<tr><th>Qn</th><th>Answers</th><th>Marks</th><th>Feedback and guidance</th></tr>
<tr><td></td><td>muscle stop producing lactic acid</td><td>1</td><td></td></tr>
<tr><td>(c)</td><td><u>Description of Trend</u>

At lower exercise intensity, oxygen consumption increases with exercise intensity + the oxygen consumption eventually plateaus;

<u>Explanation for linear part of graph</u>

More carbon dioxide produced from greater aerobic respiration + stimulates higher rate / depth of breathing;

OR

Oxygen consumption increases to support higher rates of aerobic respiration;

<u>Explanation for plateau</u>

a limit to extent of expansion and recoil of lungs / fatigue from lactic acid;</td><td>1

1

1</td><td>M: “the body switches from aerobic respiration to anaerobic respiration”

Actually, anaerobic respiration and aerobic respiration happen concurrently i.e., when anaerobic happens, it contributes energy over and on top of the energy provided by aerobic respiration occurring at maximal rate in the body</td></tr>
<tr><td>8 (a)</td><td><u>Placenta</u>
Site of exchange surface or AW;
Diffusion between mother blood and foetal blood;
From mother's blood: Oxygen, glucose, amino acids;
From foetal blood: Carbon dioxide; diffusion;

<u>Umbilical cord</u>
Contains arteries and veins which transports blood to and from foetus and placenta;
Attaches foetus to placenta;</td><td>1

1

1

1

1</td><td>Students lack understanding of the relationship between umbilical cord and placenta. Please review pg 346 - 347 again.</td></tr>
<tr><td>(b)</td><td><table>
<tr><td>Feature</td><td>Human</td><td>Plant</td></tr>
<tr><td>How fertilization enabled</td><td>Intercourse</td><td>Insect pollination</td></tr>
<tr><td>Route</td><td colspan="2">Moves within the female reproductive organ to reach egg cell</td></tr>
<tr><td>Movement</td><td>Continuous until sperm expends its</td><td>Intermittent depending on</td></tr>
</table></td><td>1

1

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Many simply wrote a paragraph on sperms, and then a paragraph on pollen grains.</td></tr>
</table>

<table>
<tr><th>Qn</th><th>Answers</th><th>Marks</th><th>Feedback and guidance</th></tr>
<tr><td></td><td>
<table>
<tr><td></td><td>energy</td><td>conditions (e.g., correct species of flower, flowers visited by insect pollinator)</td></tr>
<tr><td>Route</td><td>Sperm travel through male sperm duct to be matured and mixed with fluids from glands before being released</td><td>Pollen grains are released immediately to be exposed from the anther</td></tr>
<tr><td>Exposure to external environment</td><td>Not exposed</td><td>Exposed during pollination process</td></tr>
</table>
</td><td>1

1</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>8 (a) O</td><td>At the beginning of cycle, old lining is shedded off + together with unfertilized egg);

New egg develops;

Oestrogen relased;

New growth of endometrium;

Follicile matures and ovulation;

Corpus luteum formed from scar tissue;

Progesterone released;

Endometrium becomes thick and spongy;</td><td>1

1

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1</td><td></td></tr>
<tr><td></td><td>
<table>
<tr><td>Feature</td><td>Human</td><td>Plant</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Found in</td><td>Sperm

Diagram of sperm cell</td><td>Pollen grain

Diagram of pollen grain</td></tr>
</table>
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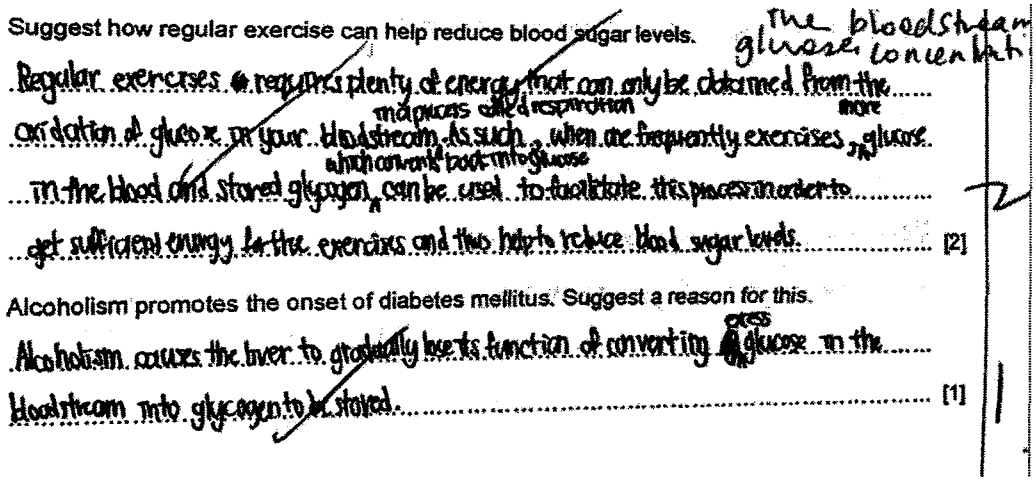
Qn	Answers	Marks	Feedback and guidance
	<table><tr><td>Motile</td><td>Yes</td><td>No</td></tr><tr><td>Movement</td><td colspan="2">Towards egg cell</td></tr><tr><td>Enzyme</td><td>To digest egg membrane</td><td>To digest style tissue</td></tr><tr><td>Mode of nutrition</td><td>Via fructose in semen</td><td>Via sucrose in style tissue</td></tr></table>		Many simply wrote a paragraph on sperms, and then a paragraph on pollen grains.

Samples of good writing

2(c)



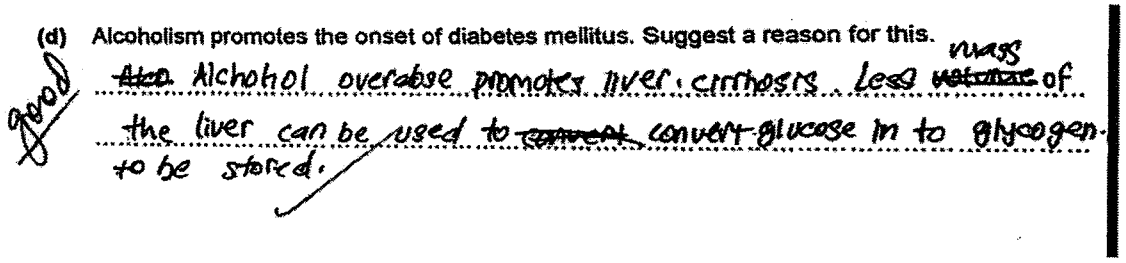
Suggest how regular exercise can help reduce blood sugar levels.

Regular exercises requires plenty of energy that can only be obtained from the oxidation of glucose in your bloodstream. As such, when one frequently exercises, glucose in the blood and stored glycogen can be used to facilitate this process in order to get sufficient energy for the exercises and thus helps to reduce blood sugar levels. [2]

(d) Alcoholism promotes the onset of diabetes mellitus. Suggest a reason for this.

Alcoholism causes the liver to gradually lose its function of converting glucose in the bloodstream into glycogen to be stored. [1]

2(d)



(d) Alcoholism promotes the onset of diabetes mellitus. Suggest a reason for this.

good

Also Alchohol overabse promotes liver cirrhosis. Less mass of the liver can be used to convert glucose in to glycogen to be stored.

2(e)

(e) Some diabetic patients require insulin therapy.

Describe how the gene for human insulin protein can inserted into a bacterial host cell through genetic engineering processes.

A strand of DNA containing the insulin gene is taken and a restriction enzyme is used to cut this gene off of the DNA strand leaving sticky ends on the ~~ends of~~ the insulin gene. Then a plasmid is taken from the bacteria that is ~~acted~~ selected to host this gene and the same restriction enzyme is used to cut a section off the plasmid with a ~~complementary base pairing~~ sticky end which has complementary base pairings with the sticky end of the insulin gene. Then mix the insulin gene and the plasmid together and add DNA Ligase which will ~~comp~~ combine the ~~DNA~~ insulin gene to the plasmid at its sticky ends. Then mix this plasmid containing insulin gene with the bacterial host and ~~pass~~ use an electric shock to open the pores of the bacteria for the plasmid to enter the bacteria [6]

) Some diabetic patients require insulin therapy.

Describe how the gene for human insulin protein can inserted into a bacterial host cell through genetic engineering processes.

1) Using a restriction enzyme, cut the section of 2) Human DNA which produces Insulin, it 3) should produce sticky ends. Cut the a plasmid with the same restriction enzyme, it should produce the complementary sticky ends. Insert the section of DNA into the gap in the plasmid and use DNA ligase to seal it, forming a recombinant plasmid. 4) Apply temperature heat or electric shock to bacterium so that combined plasmid can enter the pores. Bacteria will then produce insulin using the DNA code.

3(b)

(b) The graphs in Fig 3.1 shows the regulation of an important internal factor of the human body by negative feedback. Name the factor, and outline the regulation of this factor by negative feedback.

The factor is blood water potential level. When the blood water potential level is too low, the hypothalamus sends a signal to the pituitary glands to secrete more ADH into the blood stream. The ADH is transported by the blood to the collecting duct in the kidney and the ADH increases the permeability of the walls of the collecting duct to reabsorb more water back into the blood stream. When the blood water potential reaches the norm, a negative feedback is sent to the pituitary gland to lower the secretion of ADH into the blood stream.

3(c)

Describe two differences in how urea is removed from the body by a healthy person and by a patient undergoing kidney dialysis.

difference 1 In a healthy person, urea is removed internally in the kidneys while in a patient, urea is removed externally by the dialysis machine.

difference 2 In a healthy person, ultrafiltration helps to remove urea while in a dialysis patient, urea can only be removed by diffusion. [2]

2

[Total = 01]

4(b)

(b) Describe what is happening to the nuclear material in the stages represented by photomicrographs 3 to 7.

The homologous chromosomes would pair up, one from the mother one from the father. The chromatids of the homologous chromosomes will coil and twist around each other and sometimes the coiling will be so strong that it causes parts of the chromatids from the homologous chromosomes to break off and switch places. This is called crossing over and it allows for variation as it forms new combinations of alleles. Then the homologous chromosomes will line up at the equatorial plane of the cell and the spindle fibre from each pole of the cell would attach to one of the centromer of the homologous chromosomes [4]

good

4

4(c)

c) Explain the importance of meiosis in maintaining genetic stability in sexually reproducing organisms.

With meiosis it plays an important role in producing gametes which are haploid cells which will later be used to fuse with another gamete during sexual reproduction. Without it, the gametes diploid number would continue to multiply increasingly through the future generations, with meiosis it ensures that the offspring of future generations all have the same diploid number in their body cells to have genetic stability

(c) Explain the importance of meiosis in maintaining genetic stability in sexually reproducing organisms.

Meiosis prevents the doubling of chromosomes after each generation, and allows the offspring to receive genes from both parents, resulting in genetic variation.

good

6(c)

Explain how the evidence above shows that non-pungent plants have a selective advantage in dry conditions.

when well-watered, both pungent and non-pungent plants produce a similar number of seeds, however in when water deprived, the non-pungent plant produced about 150 seeds while the pungent plant only produced about 50 seeds, showing that they are able to produce more seeds in dry [2]

Good

(d) The evidences above suggest that wild strains of chilli plants in hot and dry conditions produces less chilli peppers, with less pungent odours, and have a lower density of

6(d)

(d) The evidences above suggest that wild strains of chilli plants in hot and dry conditions produces less chilli peppers, with less pungent odours, and have a lower density of stomata than strains in wetter conditions.

Propose an explanation why such a phenotypic variation exists among strains of chilli plants.

producing chillipeppers as attraction organs only?

Pungent odours require energy to make glands to store such smells. In dry conditions, both a lack of water, plants tend to decrease energy usage as much as possible. As such, less chillipeppers would be produced, since the plants would not have such a great energy

Chilli plants also have less stomatal density as there is not a lot of water in the near surroundings, need less stomatal density would mean smaller openings of the stomata, which would prevent too much water loss through transpiration

It is known that phenotype of an organism can be altered by external environment. In this particular instance, the external factor is a hot and dry weather.

Good job

7(a)

(a) Explain how an unhealthy diet may accelerate coronary heart disease.

An unhealthy diet means the consumption of increased amounts of fatty molecules. Fatty molecules build up on arteries and soon slow down the movement of blood in the arteries. As the fat builds up, the blood can be restricted from flowing through the artery. This condition is known as atherosclerosis (sp). Coronary heart disease occurs when the artery restricted brings blood to the heart. A restricted will cause blood to stop pumping to the heart which is an onset of coronary heart disease.

good

7(b)

(b) Explain how and why lactic acid concentration in the blood increases during heavy exercise and reduces after it. [3]

When the body exercises → Glucose + Oxygen → Carbon dioxide + Water + Large amount of energy. This continues until these starts to receive insufficient oxygen, they then conduct anaerobic respiration whereby Glucose → Lactic acid + Small amount of energy, this is used to facilitate the heavy exercises by supplying more energy as the exercise is prolonged, more energy is needed and thus more glucose would be converted to lactic acid as well which will be sourced into the bloodstream. The lactic acid is then sent to the liver to be converted to energy, this energy is then used to convert more lactic acid into glucose, this thus decreases the lactic acid concentration within the body. After exercising, there would be a lower demand of for energy, hence allowing the anaerobic respiration process to stop slow down, this reduces the production of lactic acid as well. This would then be converted to energy to convert of lactic acid into glucose, thus resulting in the overall lactic acid concentration to decrease after exercise.

good job

(b) Explain how and why lactic acid concentration in the blood increases during heavy exercise and reduces after it.

During heavy exercise, large amounts of energy are required. Aerobic respiration alone is not enough to release the energy required. Hence anaerobic respiration is also required, which produces lactic acid. Lactic acid accumulates as energy is continuously released during heavy exercise, causing there to be an oxygen debt. After the heavy exercise, lactic acid is sent to the liver and converted into glucose as the oxygen debt is being repaid. When the oxygen debt has been repaid, there would be no lactic acid left.

d
ob

8(a)

(a) Briefly describe the events in the menstrual cycle.

① Levels of progesterone and oestrogen decrease causing the endometrium lining to shed and break down. Menstruation occurs.

② A new egg matures and develops in the follicle of the ovary.

good job ③ The follicle releases oestrogen, and the endometrium lining builds up again. Tissue, blood vessels and muscles develop in the uterus.

④ When the egg is mature, the follicle pushes against the wall of the ovary. Ovulation occurs and the egg is released.

⑤ The corpus luteum builds up around the egg and releases progesterone and oestrogen to build up the endometrium lining.

⑥ The corpus luteum sheds away from the egg as it reaches the uterus. It continues to release the two hormones.

⑦ The uterus lining is thick and spongy as it prepares for the fertilisation of the egg. ~~thickens~~ changes and disappears

⑧ If no fertilisation occurs, the corpus luteum 'dies' and the levels of progesterone [5]

5

(b) Describe the similarities and differences in the structure and functioning of the male (in) action

Performance Statistics

4S1

# pass	15
# fail	3
Total	18
Class Total	19
% pass	83.30%
MSG	4.61
Mean	59.2
Highest	71.3
Lowest	43
Median	58.7
Stand. Dev.	8.49

4S2

# pass	24
# fail	9
Total	33
Class Total	34
% pass	72.70%
MSG	5.7
Mean	52.7
Highest	72.2
Lowest	20.6
Median	53.6
Stand. Dev.	12.58

4S3

# pass	8
# fail	7
Total	15
Class Total	15
% pass	53.30%
MSG	5.73
Mean	53.4
Highest	70.5
Lowest	34.1
Median	53.8
Stand. Dev.	12.28