NAME:		( )	CLASS:	

YISHUN TOWN SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2021

SEC 4 EXPRESS

BIOLOGY

(6093/1)

DATE : **13 Sep 2021** **DAY** : **Monday**

DURATION : **1 hr** **MARKS** : **40 marks**

ADDITIONAL MATERIALS

Multiple Choice Answer Sheet (OMS)

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number in the spaces provided at the top of this page and on the OMS.

There are **forty** questions. 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 OMS answer sheet.

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.

You may use an approved calculator.

This question paper consists of 17 printed pages

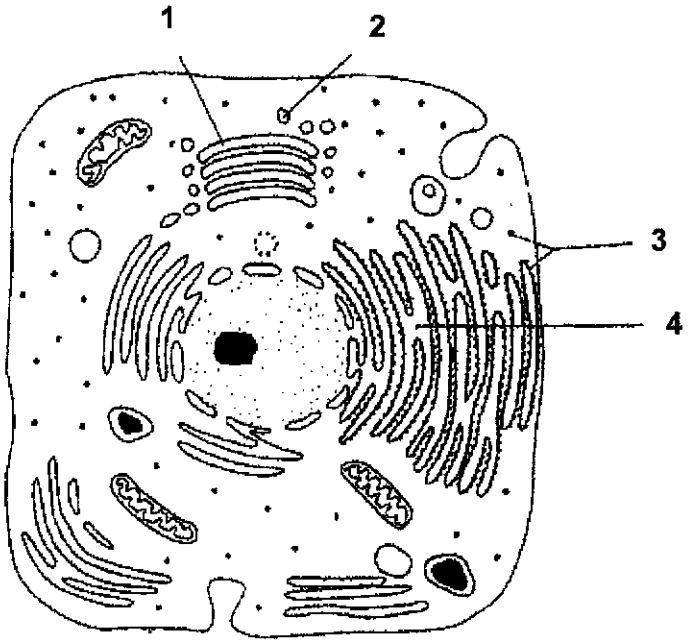
1 The diagram shows the structure of an animal cell.

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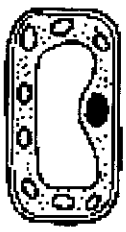


What are the functions of the labelled structures?

	synthesizing proteins from amino acids	transporting proteins	processing proteins
A	3	2	1
B	2	1	3
C	3	4	1
D	2	4	3

2 Which diagram shows one organ only?

A



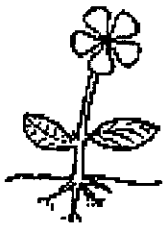
B



C

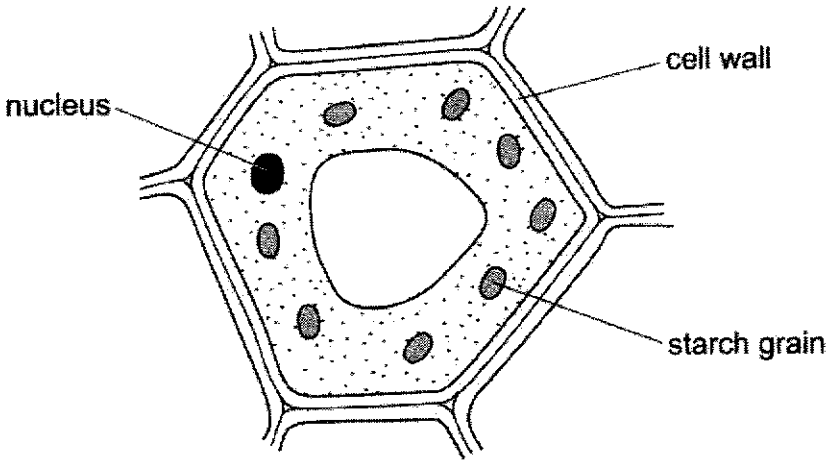


D



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3 The diagram shows a plant cell which is stained with iodine solution.



What are the colours of the cell wall and the starch grain after staining?

	Cell wall	Starch grain
A	Blue-black	Blue-black
B	Blue-black	Yellowish brown
C	Yellowish brown	Blue-black
D	Yellowish brown	Yellowish brown

4 The table shows the results of food tests carried out on a fruit.

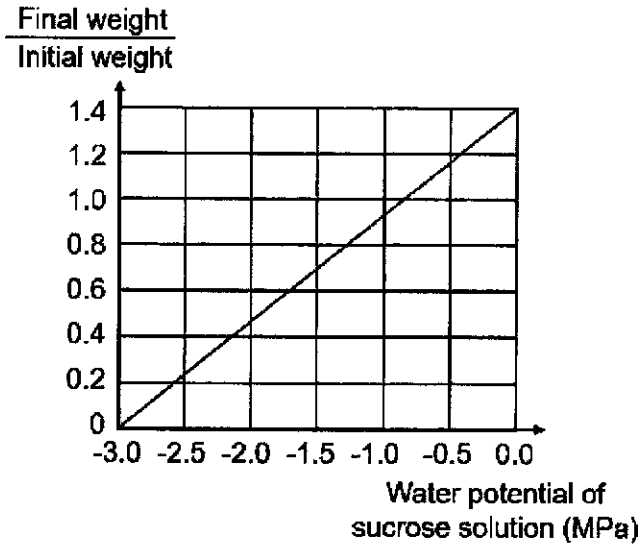
Test	Benedict's	Biuret	Ethanol-emulsion
Observed colour of mixture	Green	Violet	Clear

What does the fruit contain?

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

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5 The graph below shows the weight change of potato strips which are placed in sucrose solutions with different water potentials. The weight of each potato strip before the experiment is 4.0g.

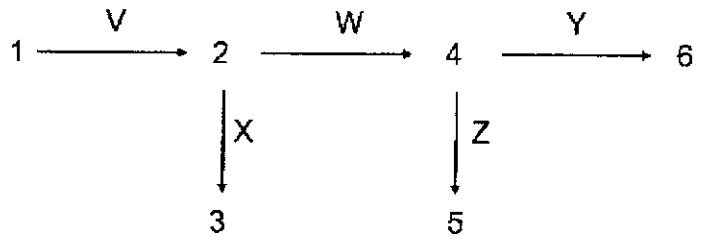


What is the water potential of the cell sap of the potato cells before the experiment?

A 0.0 MPa
B - 0.8 MPa
C -1.5 MPa
D -3.0 MPa

6 The diagram below represents a sequence of reactions in a bacterium, where amino acids (**1** to **6**) essential for survival are produced by specific enzymes (**V** to **Z**).

The original strain of the bacterium required only amino acid **1** and could produce all the other amino acids using the enzymes. A mutant strain of this bacterium could not synthesize some enzymes. It could only survive when provided with amino acids **1**, **2** and **5**.



Which enzymes were missing in the mutant strain?

A V and X only
B V and Z only
C V, X and Z
D V, W and Z

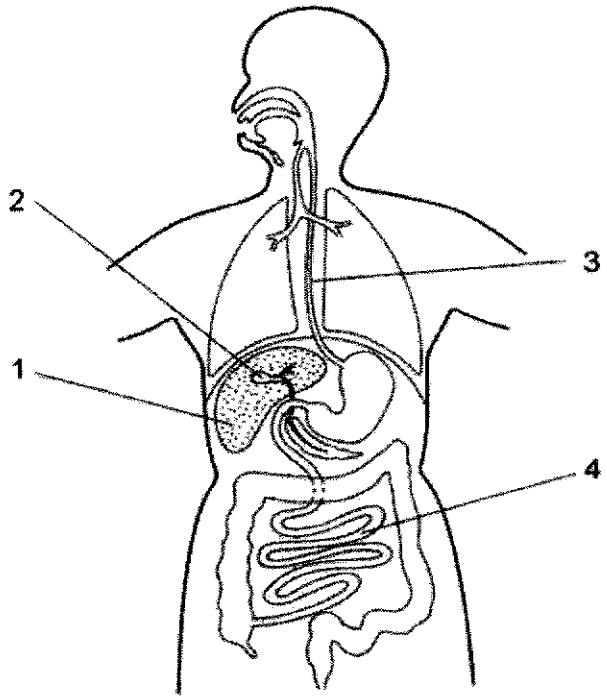
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7 Polyphenol oxidase which is found in bananas turns food molecules in the banana cells into dark coloured products which make the banana go brown or black when oxygen is present.

Which actions would show that polyphenol oxidase is an enzyme?

A To boil the banana and see if it goes black.
B To check if an unpeeled banana goes black.
C To check if the banana goes black in the absence of carbon dioxide.
D To deprive the banana of oxygen and see if it goes black.

8 For question 8 and 9, refer to this diagram which shows the human alimentary canal.



Where does peristalsis take place?

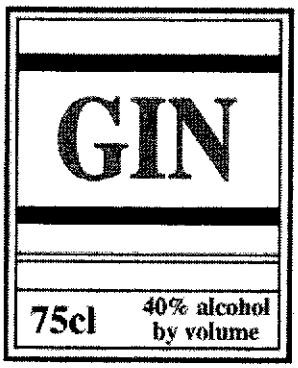
A 3 only
B 1 and 3
C 3 and 4
D 1, 3 and 4

9 If structure 2 is removed, which statement correctly describes the consequence?

A Fatty food cannot be digested.
B More fats can be absorbed.
C Oil cannot be emulsified.
D Release of bile cannot be regulated.

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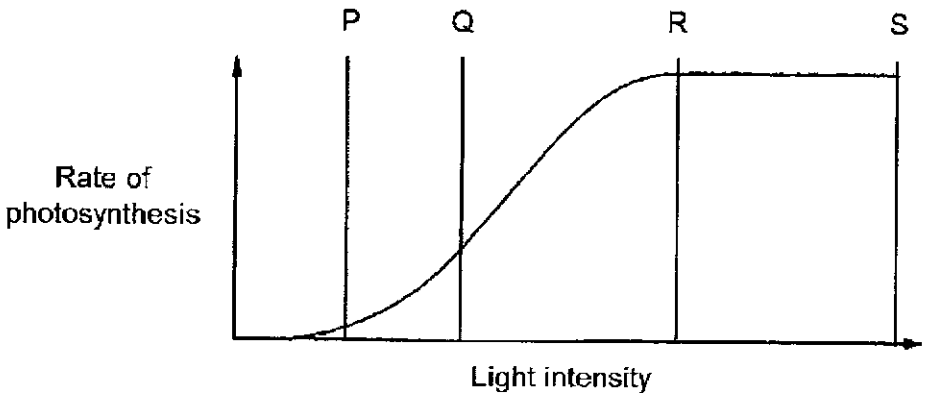
10 The diagram shows the label from a bottle of gin.



What will happen, during the next few hours, after a person drinks a large amount of gin?

A Their judgment of distance will improve.
B Their muscle control will be reduced.
C Their reaction time will decrease.
D Their urine output will decrease.

11 The graph below shows the rate of photosynthesis in a sunflower plant in an atmosphere containing 0.03% carbon dioxide at different light intensities.



At which point on the graph is light intensity a limiting factor?

A Q only
B S only
C P and Q only
D P, Q and R only

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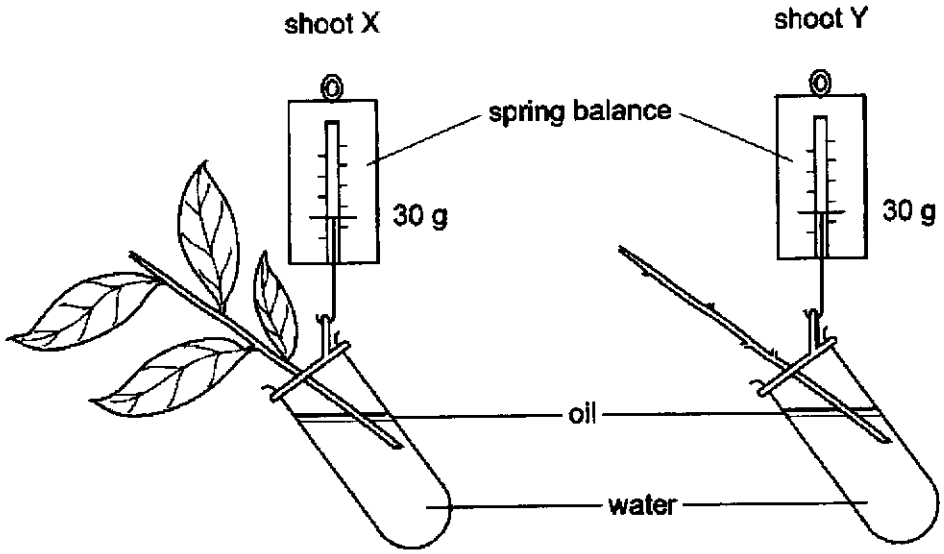
12 The pathway of water from the soil through a plant is shown below.

Soil → X → Y → Z → Mesophyll cells

Which cells are represented by X, Y and Z?

	X	Y	Z
A	Root hair cells	Root cortex cells	Xylem
B	Root hair cells	Xylem	Root cortex cells
C	Xylem	Root cortex cells	Root hair cells
D	Xylem	Root hair cells	Root cortex cells

13 The diagram shows two shoots at the start of an experiment on transpiration.



What are the readings on the spring balances after three days?

	Shoot X	Shoot Y
A	30 g	30 g
B	30 g	25 g
C	25 g	30 g
D	25 g	25 g

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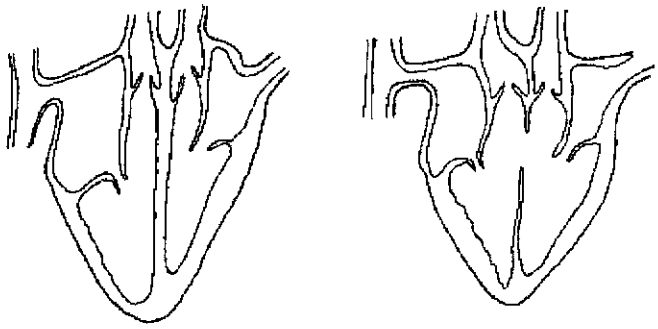
14 The table below shows the outcome of an investigation on the uptake of bromide ions by a plant.

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

These results show that the uptake of bromide ions

A is via active transport only.
B is via diffusion only.
C occurs during aerobic respiration only.
D stops in the absence of oxygen.

15 The diagram below shows the hearts of a bird and a reptile.



Bird Reptile

Which statement correctly shows the comparison between the two hearts?

A Both hearts are equally efficient in the pumping action of the heart.
B The aorta of the reptile will carry less oxygen than that of the bird.
C The pulmonary vein carries less oxygen in the reptile.
D The reptile heart would be more efficient as two ventricles contribute to pumping blood around the body.

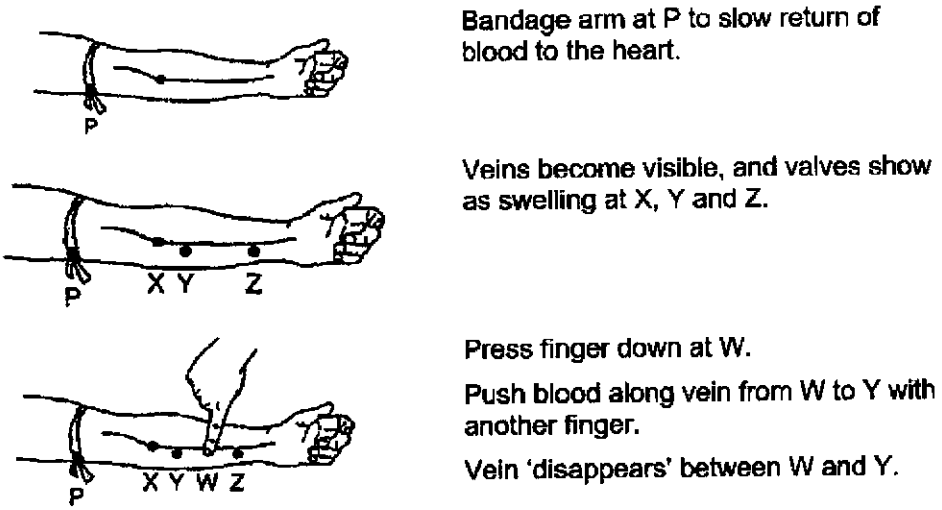
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16 During the process of blood clotting, damage to blood vessels stimulates L, followed by the conversion of M to N.

Which row shows the correct substances involved in blood clotting?

	L	M	N
A	Fibrin	Platelets	Fibrinogen
B	Fibrinogen	Platelets	Fibrin
C	Platelets	Fibrin	Fibrinogen
D	Platelets	Fibrinogen	Fibrin

17 The diagram below shows how the flow of blood in the veins of the lower arm is affected by certain actions.



Bandage arm at P to slow return of blood to the heart.

Veins become visible, and valves show as swelling at X, Y and Z.

Press finger down at W.

Push blood along vein from W to Y with another finger.

Vein 'disappears' between W and Y.

Some possible reasons why the vein 'disappears' are listed.

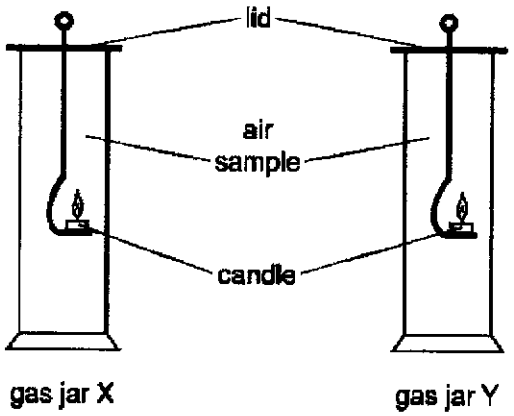
1 The bandage at P prevents backflow.
2 The finger pressed at W prevents more blood entering.
3 The valve at Y prevents backflow.
4 The valve at Z prevents more blood entering.

Which are the correct reasons?

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

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18 A sample of expired air is collected in a gas jar. Another gas jar contains atmospheric air. A lighted candle is placed inside each gas jar as shown. The time taken for each flame to go out is measured. As the candles burn, they use up the oxygen available in the jar.



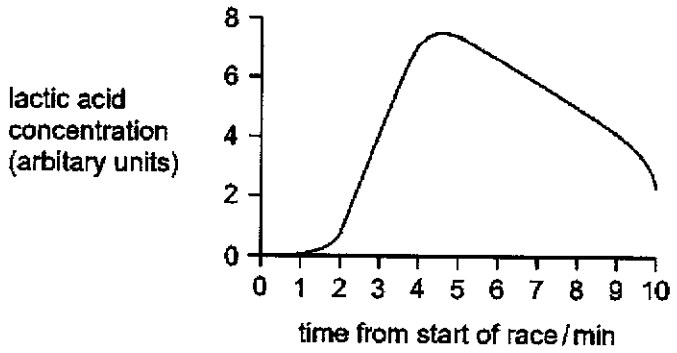
The table below shows the results of this experiment.

Gas jar	Time for candle flame to go out / s
X	15
Y	9

What is an explanation of the difference between the results in jars X and Y?

A Jar X contains atmospheric air which has more carbon dioxide.
B Jar X contains expired air which has more carbon dioxide.
C Jar Y contains atmospheric air which has less oxygen.
D Jar Y contains expired air which has less oxygen.

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

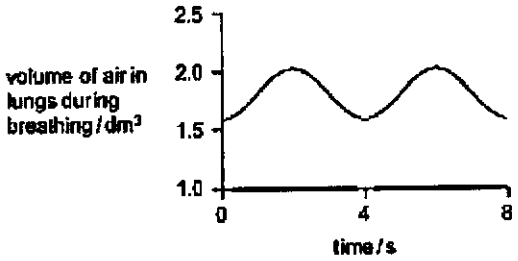


How long did the athlete run?

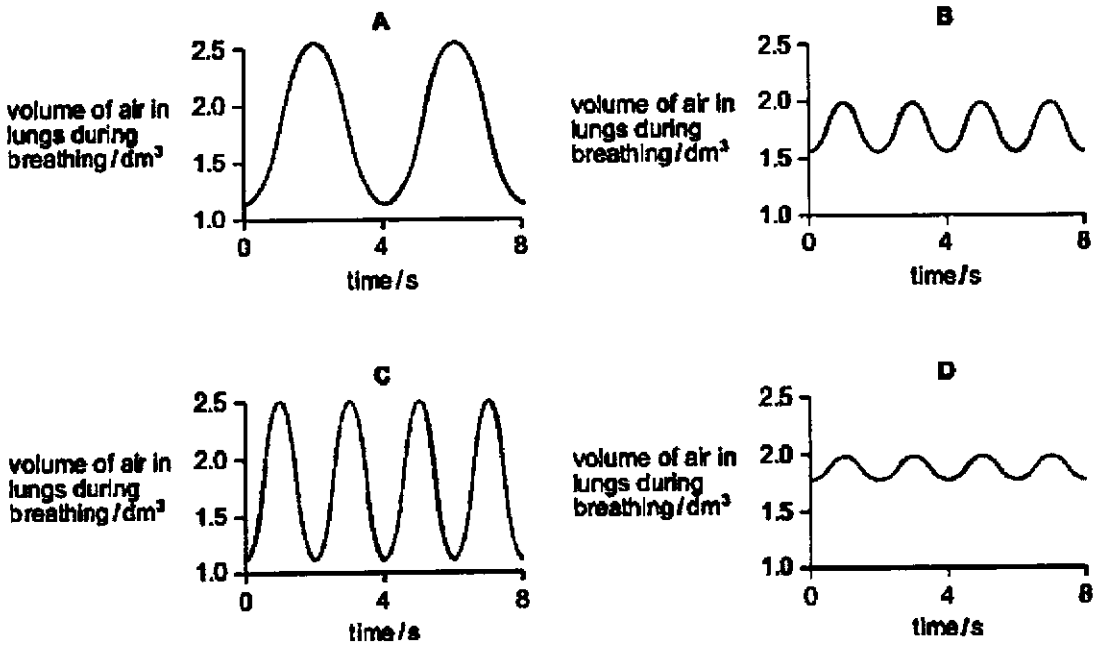
A 2 minutes
B 4 minutes
C 6 minutes
D 10 minutes

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20 The graph below shows the depth of breathing in a person before a period of intense exercise.



Which graph will show the depth of breathing of the same person immediately after a period of intense exercise?



21 Which statement correctly describes the part of the urinary system?

A Ureter carries urine from the bladder.
B Ureter carries urine from the kidneys.
C Urethra carries urine to the bladder.
D Urethra carries urine to the kidneys.

22 What is the possible effect of osmoregulation in humans after sweating?

	Antidiuretic hormone (ADH) secretion	Concentration of urine
A	Increased	Increased
B	Increased	Decreased
C	Decreased	Increased
D	Decreased	Decreased

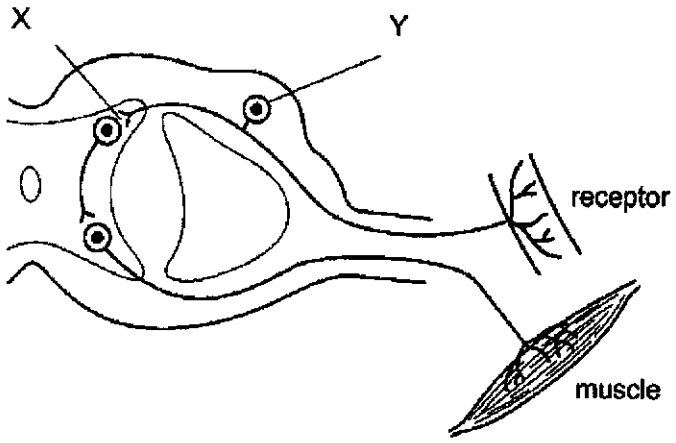
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23 The temperature of the skin at the wrist and the forearm were measured and recorded.

Why is the temperature of the wrist higher than that of the forearm?

A The wrist has fewer blood vessels.
B The forearm has fewer sweat glands.
C The wrist has lesser adipose tissue.
D The skin of the forearm has lesser hair

24 The diagram below shows a section through the spinal cord and the neurons involved in a reflex action.



What are the functions of structures X and Y?

	X	Y
A	Transmit impulses chemically	Transmit impulses electrically
B	Transmit impulses chemically	Contains nucleus and cell organelles
C	Transmit impulses electrically	Transmit impulses electrically
D	Transmit impulses electrically	Contains nucleus and cell organelles

25 Which changes take place in the iris of the eye when a person moves quickly from darkness into bright light?

	Circular muscles of the iris	Radial muscles of the iris	Diameter of pupil
A	Contract	Relax	Increase
B	Contract	Relax	Decrease
C	Relax	Contract	Decrease
D	Relax	Contract	Increase

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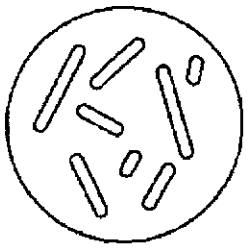
26 During a stressful situation, why does the glucose level in the blood rise?

A Glycogen stored in the muscles is released.
B The adrenal gland produces adrenaline.
C The islets of Langerhans produce more glucagon.
D There is rapid digestion of carbohydrates.

27 Which row correctly describes the effect of the hormone adrenaline on breathing rate, pulse rate and pupil size?

	Breathing rate	Pulse rate	Pupil size
A	Decrease	Decrease	Larger
B	Decrease	Increase	Smaller
C	Increase	Decrease	Smaller
D	Increase	Increase	Larger

28 The diagram shows the chromosomes in the nucleus of a body cell in an adult fly.



What are the diploid and haploid number of chromosomes in the fruit fly?

	Diploid	Haploid
A	4	8
B	8	4
C	8	16
D	16	8

29 Mammalian skin cells in tissue culture were supplied with a source of radioactive thymine. At which stage in the cell cycle will the thymine be used in the nuclei?

A Interphase
B Metaphase
C Prophase
D Telophase

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30 Some characteristics of wind-pollinated flowers are given below.

1 Flowers are odourless.
2 Stamens are large, feathery and protrude out of the flower.
3 Pollen grains have smooth surfaces and are tiny and light.

Which are likely characteristics of wind-pollinated flowers?

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

31 The following four processes occur during reproduction in a plant.

1 The male nucleus fuses with the female nucleus.
2 The male nucleus is released from the pollen tube.
3 The male nucleus travels down the pollen tube.
4 The pollen grain grows a pollen tube.

In which order do these processes occur after pollination?

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

32 An experiment was set up using four groups of insect pollinated flowers in a field. In each group, different parts of the flowers were removed, as shown in the table below. Insects were allowed to visit all the flowers in the 4 groups freely.

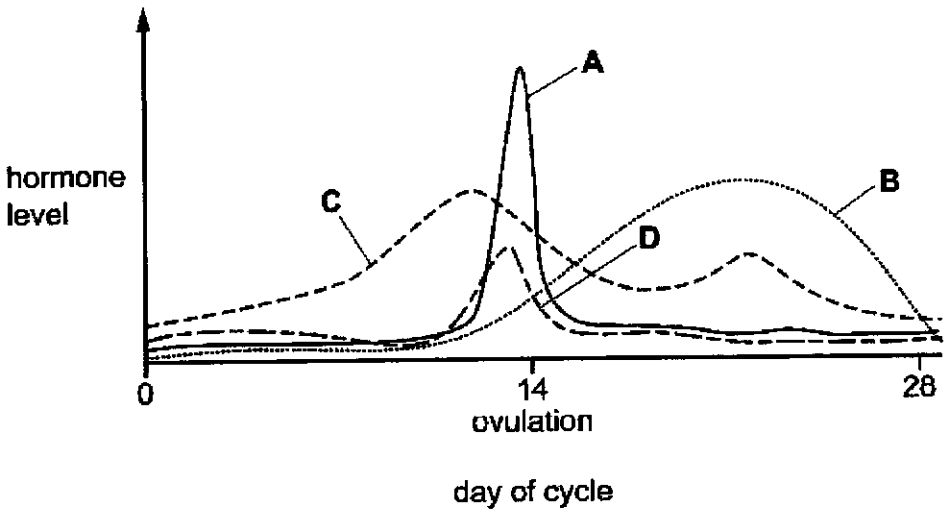
Which group of flowers will produce the most seeds?

Group	Stigma	Anther	Petals
A	Intact	Removed	Intact
B	Intact	Intact	Removed
C	Removed	Intact	Removed
D	Removed	Removed	Intact

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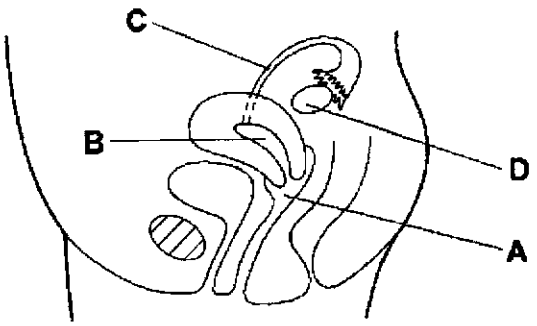
33 The graph shows the concentration of four hormones during the menstrual cycle.

Which line represents progesterone?



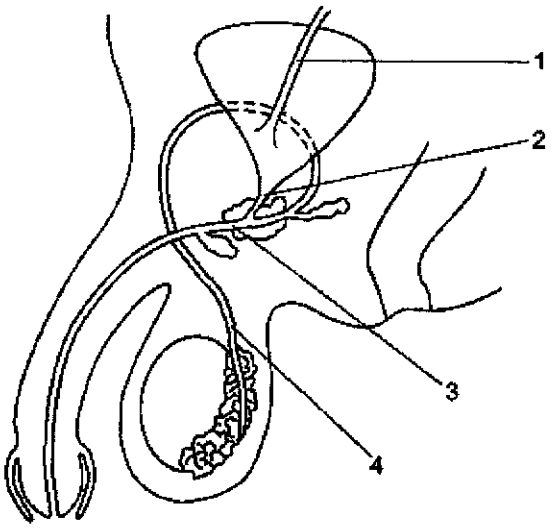
34 The diagram shows the human female reproductive system.

At which point is a surgical method of contraception usually carried out?



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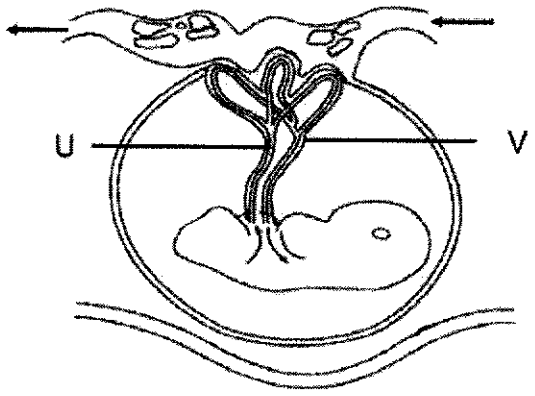
35 The diagrams shows the side view of the male urinary and reproductive system.



What is transported in the tubes labelled 1, 2, 3 and 4?

	1	2	3	4
A	Sperm only	Sperm and urine	Urine only	Urine only
B	Sperm and urine	Urine only	Sperm and urine	Sperm only
C	Urine only	Sperm and urine	Sperm only	Urine only
D	Urine only	Urine only	Sperm and urine	Sperm only

36 The diagram below shows the developing embryo inside the uterus of a mammal.



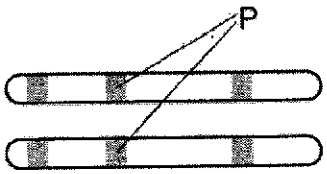
Which comparison between U and V is correct?

	U	V
A	Less carbon dioxide	More carbon dioxide
B	More oxygen	Less oxygen
C	Less urea	More urea
D	Less amino acids	More amino acids

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



What do the lines labelled P point to?

A The site of alleles made up of two or more genes which are always the same.
B The site of alleles made up of two or more genes which might be different.
C The site of genes made up of two or more alleles which are always the same.
D The site of genes made up of two or more alleles which might be different.

38 The diagram shows the inheritance of sex in humans.

		Male gametes	
		X	Y
Female gametes	X	XX	XY
	X	XX	XY

A couple had two female children.

What is the chance of the couple's next child being male?

A 25%
B 33%
C 50%
D 100%

39 What is required for natural selection to occur?

A Genetic variation between individuals.
B Humans selecting desirable characteristics.
C No competition between individuals or resources.
D Offspring produced by asexual reproduction.

40 What will cause the rate of mutation to increase?

A Increase in exposure to ionizing radiation.
B Increase in genetic variation in a population.
C Increase in phenotypic variation in a population.
D Increase in the rate of reproduction.

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YISHUN TOWN SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2021

SEC 4 EXPRESS

BIOLOGY

(6093/2)

DATE : 1 Sep 2021 **DAY : Wednesday**

DURATION: 1 hr 45 min **MARKS: 80 marks**

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number in the spaces provided at the top of this page.

Section A
Answer **all** the questions. Write your answers in the spaces provided.

Section B
Answer all **three** questions. Write your answers in the spaces provided.
The last question is in Either/Or form. Choose only one part.

INFORMATION FOR CANDIDATES

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

You may use an approved calculator.

Section A	
Section B	
TOTAL	

This question paper consists of 18 printed pages

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SECTION A (50 MARKS)

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

1 Excretion is the removal of metabolic waste products which could be toxic or in excess, from the body.

(a) Excess water is excreted from the lungs and the kidneys.

State the name of **one other** substance that is excreted from: [2]

The lungs .....

The kidneys .....

(b) The volume and concentration of urine varies with changing conditions. Table 1.1 shows two changing conditions.

Write **increase** or **decrease** in each of the boxes in Table 1.1 to show how each change affects the volume and concentration of urine. [2]

Changing condition	Volume of urine	Concentration of urine
Increase in water uptake		
Increase in temperature		

Table 1.1

(c) Glucose is not typically found in the urine, except in patients suffering from diabetes. Describe how the kidney typically ensures that glucose that underwent ultrafiltration does **not** end up in urine. [1]

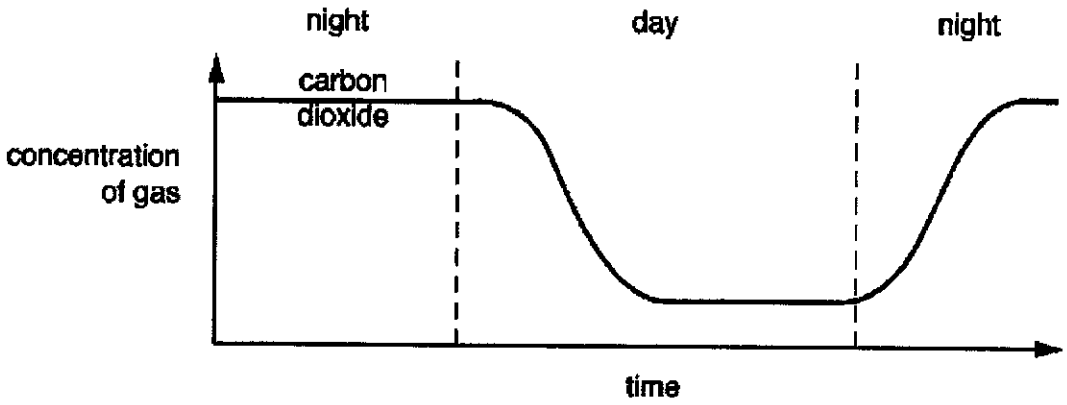
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2 The graph shows the variation in the concentration of dissolved carbon dioxide in the water of a pond over a period of 24 hours.



(a) Describe and explain how aquatic plants contribute to the changes in the concentration of dissolved carbon dioxide shown in the graph. [4]

.....

.....

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.....

(b) Draw on the graph above to show how the concentration of dissolved oxygen in the water of the same pond is likely to change over the same period of time. [2]

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3 Fig. 3.1 shows the human thorax.

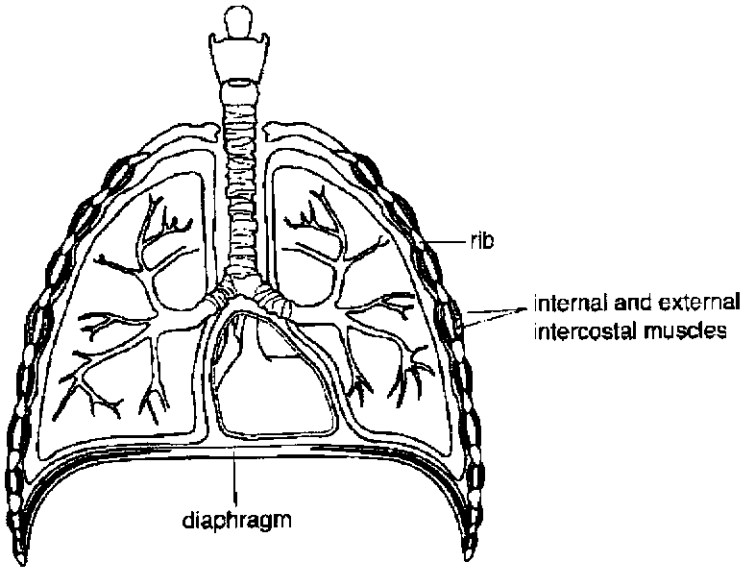


Fig. 3.1

(a) Describe how each of the structures named in the diagram helps when a person breathes out. [3]

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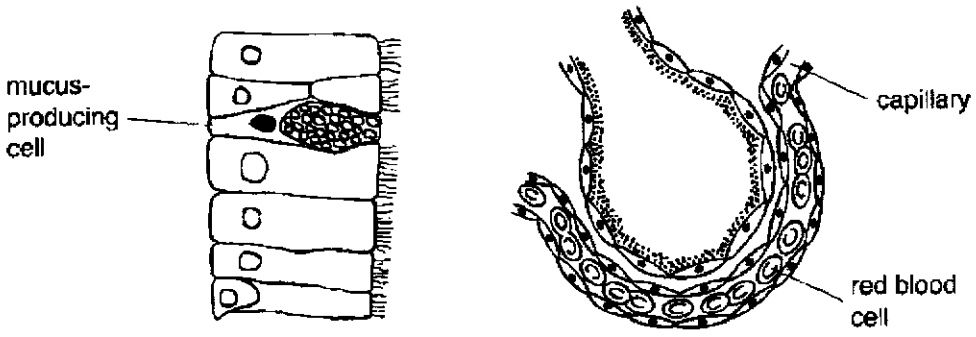
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(b) Fig. 3.2 shows two magnified structures, **D** and **E**, from the thorax.



structure D **structure E**

Fig. 3.2

Use label lines and labels to identify the positions of structure **D** and structure **E** on Fig. 3.1. [2]

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4 Coronary heart disease is a common fatal disease in Singapore.

(a) Describe the events leading up to coronary heart disease. [3]

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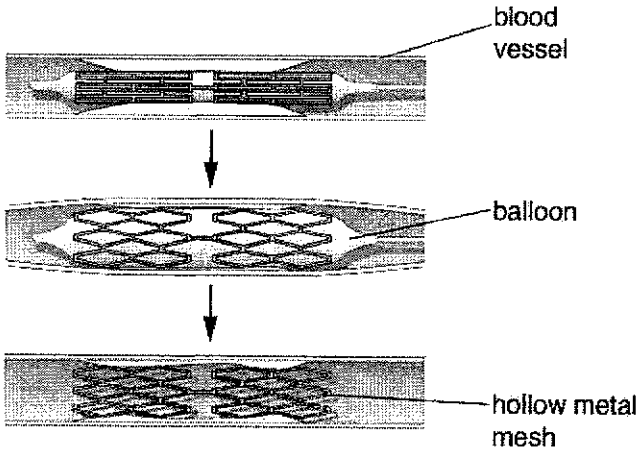
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(b) It is possible to reduce the risks of the disease by carrying out an operation.



In the operation:

- A balloon surrounded by a metal mesh is inserted into the blood vessel and inflated.
- The balloon is then deflated and removed, leaving the metal mesh in place.

Suggest the purpose of each of the following. [2]

Inflating the balloon:

.....

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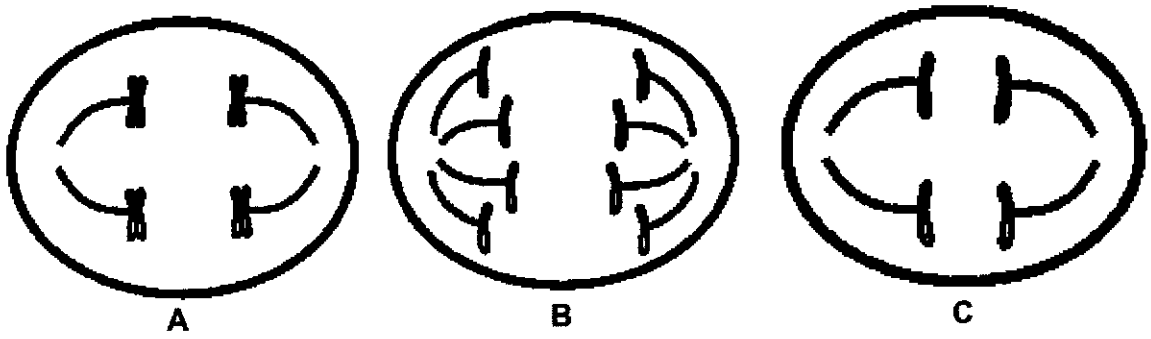
Leaving the hollow metal mesh in the blood vessel:

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5 The diagrams show cell **A**, **B** and **C** of an organism at different stages of two different types of cell divisions.



(a) Identify the stages in cell **B** and **C**. [2]

B .....

C .....

(b) State the importance of the type of cell division shown in cell **A**. [2]

.....

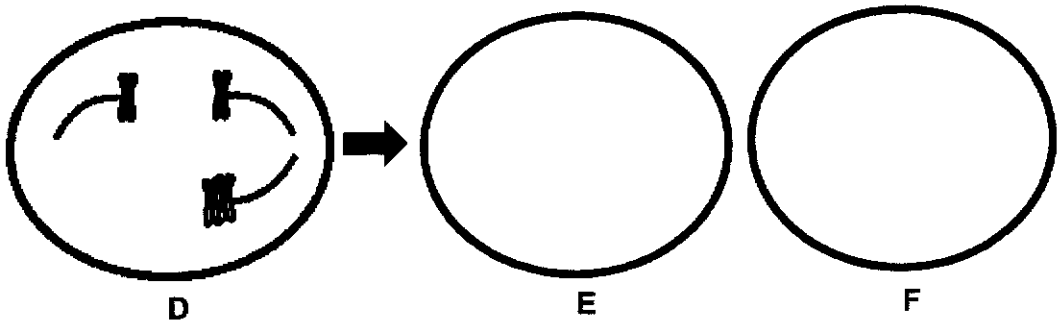
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(c) The diagram below shows cell **D** of the same organism undergoing abnormal non-disjunction unlike cell **A**.

Draw the chromosomes in two possible cells, **E** and **F** derived from cell **D** after completing the cell division. [2]



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6 The flow of blood through the skin can be investigated by using a flow-meter. Fig. 6.1 shows a flow-meter above a section of the skin.

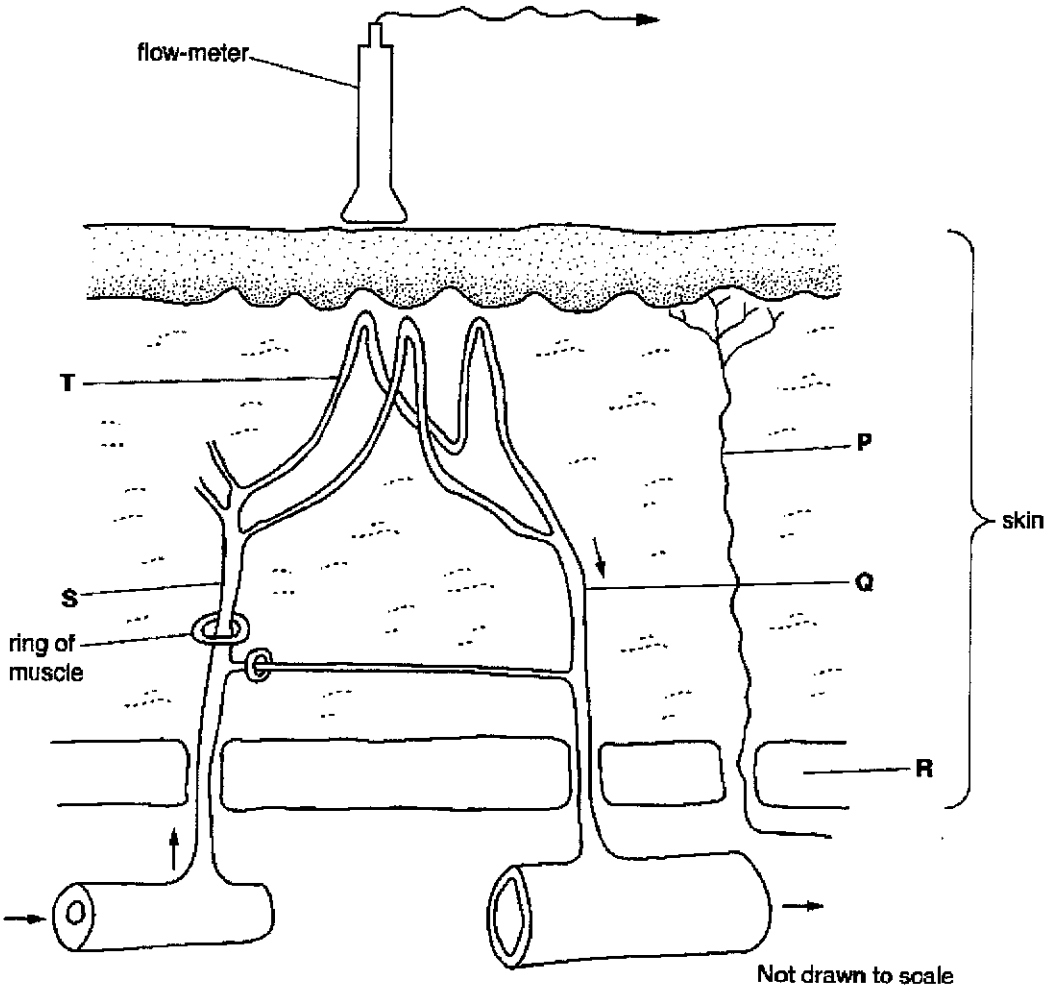


Fig. 6.1

(a) State the name of the following structures: [2]

Cell **P** .....

Vessel **Q** .....

(b) Explain the importance of regulating body temperature in humans. [2]

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(c) The blood flow through the skin of some volunteers was measured with a flow-meter when their skin was exposed to different temperatures.

Capsaicin is a compound that gives people the sensation of feeling hot when it is put on the skin. Researchers applied capsaicin to the skin of the volunteers and again measured their blood flow through their skin at different temperatures.

Fig. 6.2 shows the results.

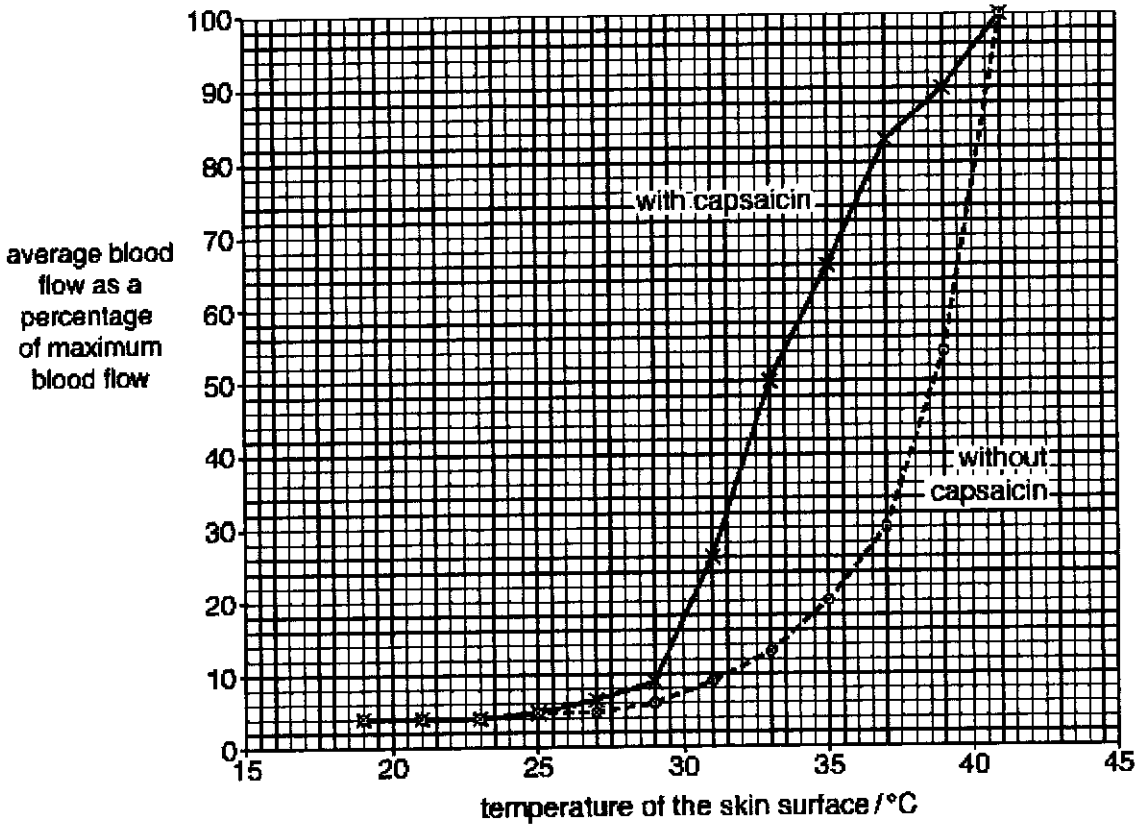


Fig. 6.2

(i) Use the information in Fig. 6.2 to describe the effect of rising temperature of the skin surface on blood flow to the skin without capsaicin. [2]

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(ii) Calculate the difference between the average blood flow for the treatments with and without capsaicin at 35°C. [1]

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(iii) Explain why there is an increase in the flow of blood. [3]

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(d) Body temperature is controlled by both hormones and nerves.

Explain how co-ordination by hormones differs from co-ordination by nerves. [3]

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7 Hereditary hemochromatosis is a condition caused by a mutation in the HFE gene. The mutation leads to a substitution of cysteine to tyrosine, at the amino acid position 282.

In affected individuals, the protein encoded by the mutated HFE gene absorbs excessive amount of iron from the food we eat, which is stored in organs like the liver, heart and pancreas. Toxic concentrations of iron may lead to liver disease, heart problems and diabetes.

(a) Define the mutation causing hereditary hemochromatosis. [1]

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(b) Fig. 7.1 shows a family tree for the condition. Individual **2** is known to be homozygous for hereditary hemochromatosis.

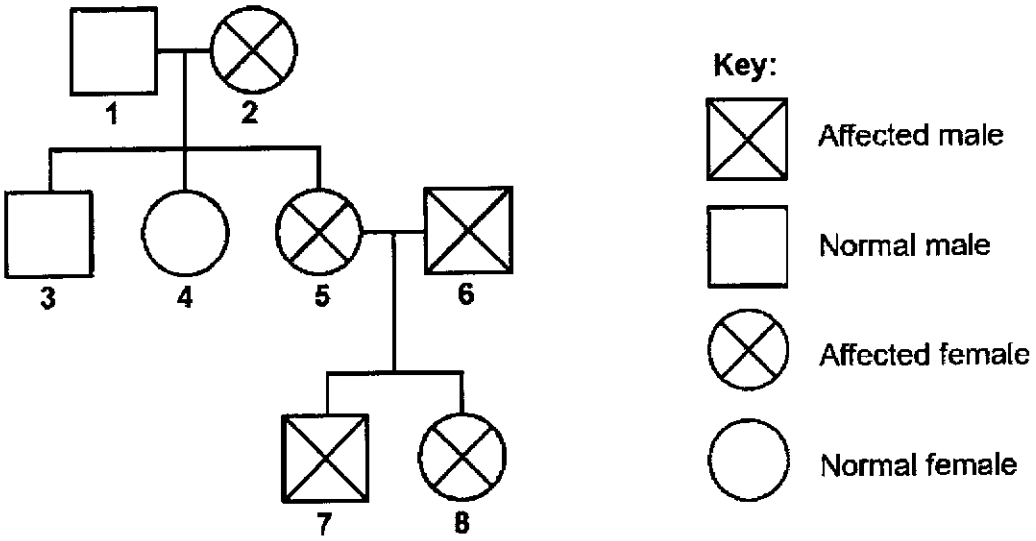


Fig. 7.1

(i) State and explain with reference to Fig 7.1, whether the condition is caused by the dominant or recessive allele. [3]

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(ii) Using **H** to represent the dominant allele and **h** to represent the recessive allele, state the genotype of individual 1. [1]

Individual 1 .....

(c) Hereditary hemochromatosis is present at birth, but in women, the symptoms are more likely to develop only after menopause. Suggest why this is so. [1]

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(d) Explain how hereditary hemochromatosis could lead to diabetes. [2]

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(e) Suggest two possible dietary change for a patient suffering from hereditary hemochromatosis. [2]

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SECTION B (30 MARKS)

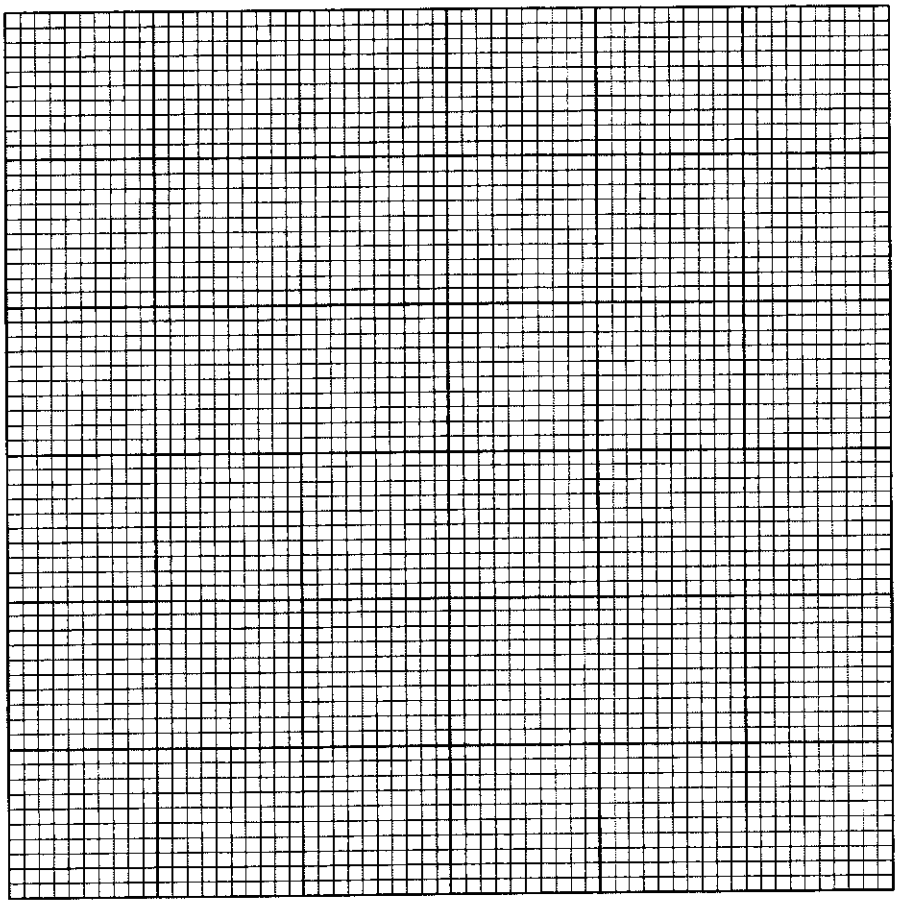
Answer three questions.
Question **10** is in the form of an Either/Or question.
Only one part should be answered.

8 Table 8.1 shows how the thickness of the lens of the eye changes when focusing on an object at different distances from the front of the eye.

Distance from eye / cm	Thickness of lens / mm
10	4.0
20	3.5
30	3.2
50	2.9
100	2.7
150	2.6

Table 8.1

(a)(i) Plot a graph of the data in Table 8.1 on the grid below. [4]



(ii) Use your graph to find the thickness of the lens when the distance from the eye is 75 cm. On your graph, show how you obtained this value. [1]

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(b) Explain how named components of the eye change the thickness of the lens when focusing on an object as it moves further from the front of the eye. [3]

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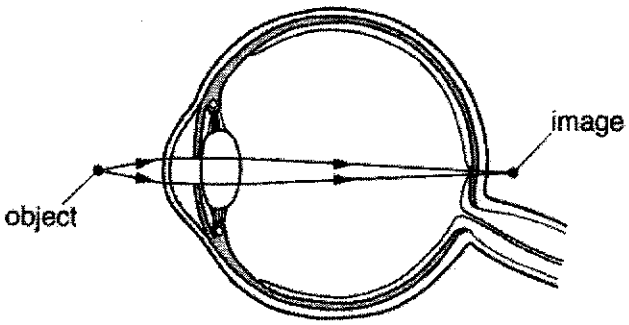
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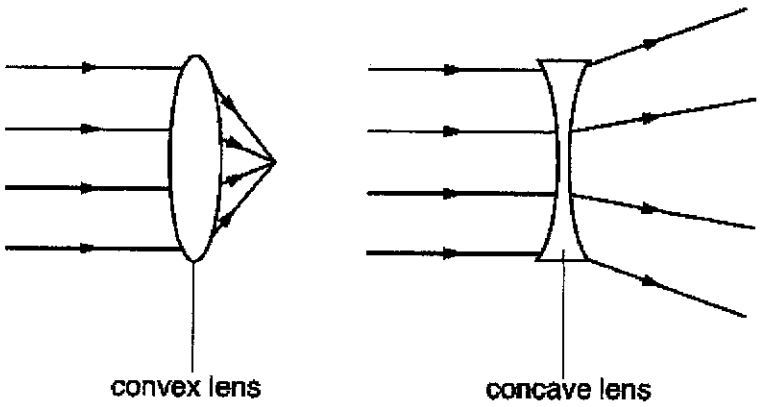
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(c) As a person becomes older, the lens of the eye becomes harder and less elastic. This results in the person seeing an image of a close object that is out of focus.



The diagram below shows how light is refracted by two types of artificial lens that may be used to manufacture spectacles.



Suggest and explain which type of lens is suitable for this older person. [2]

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9 **(a)** The cut surface of an apple usually turns brown when exposed to air. This is caused by enzymes. Three slices of apple were given different treatments and were then exposed to air for 30 minutes.

Table 9.1 shows the treatments and appearance of the apple slices.

Apple slice	pH	Temperature / °C	Appearance of apple slice at 0 minutes	Appearance of apple slice after 30 minutes
A	6	20	White	Brown
B	2	20	White	White
C	6	4	White	White

Table 9.1

Suggest why slice **B** and **C** did not turn brown after 30 minutes. [2]

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(b) In the juice industry, enzymes like cellulase are used to help extract apple juice from apples. Explain why such enzymes are used to extract apple juice. [2]

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(c) Aphids parasitism is a common problem for apple farmers. The aphids extract sweet 'honeydew' from a certain vascular tissue, and are typically found on the undersides of leaves, on growing shoot tips or the shoot stem.

State the vascular tissue and key content of the liquid which the aphids extract. [1]

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(d) Bees are pollinators of apple plants, which have bisexual flowers.

(i) Define sexual reproduction. [2]

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(ii) Describe one feature which will favour cross-pollination over self-pollination of bisexual flowers. [1]

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(iii) Explain how cross-pollination helps improve the survival of the species. [2]

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10 **EITHER**

(a) Starch is a carbohydrate stored inside plant cells. Explain why starch is a more suitable storage substance than glucose. [3]

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(b) Explain how animals are dependent on the process of photosynthesis. [3]

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(c) Suggest and explain how a woman's dietary needs should change when she is pregnant. [4]

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10 OR

(a) Transverse myelitis is the inflammation of the spinal cord. It is one of the rare diseases that may have resulted from a COVID-19 infection.

Describe the pathway of nerve impulses in such a patient who is unable to respond appropriately when he steps on a very hot surface. [5]

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(b) The mRNA vaccine for COVID-19 involves injecting an mRNA which codes for a viral protein found on the surface of the virus. When subsequently exposed to the virus, our immune system should be more ready to 'fight' the virus.

With reference to the protective function of named blood components, explain how vaccinating a pregnant woman can help to protect both the fetus and the pregnant mother against the COVID-19 virus. [5]

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End of Paper

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YTSS 2021 Biology Prelim Paper 1 Answers

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

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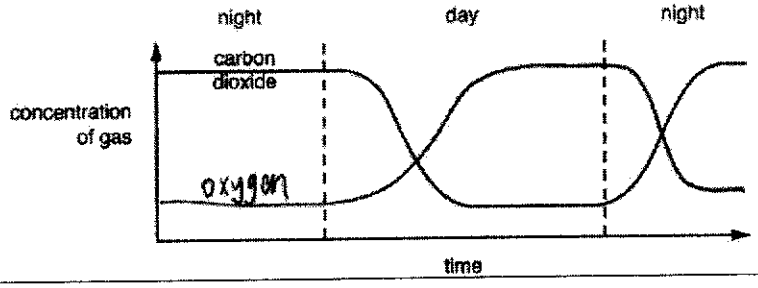
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YTSS 2021 Biology Prelim Paper 2 Answers

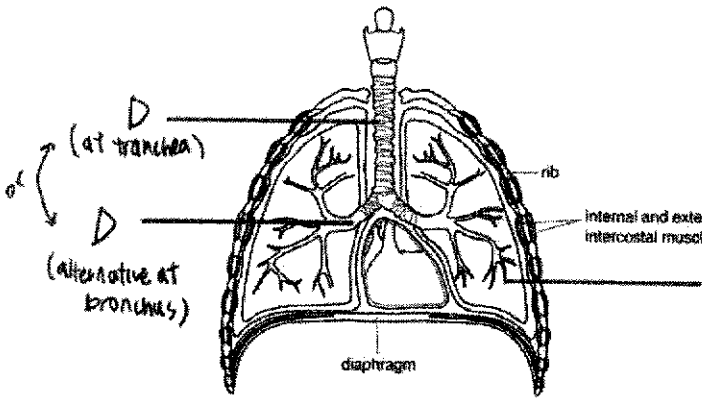
<table>
<tr><th>Qn</th><th>Answer Key</th><th></th><th>Remarks</th></tr>
<tr><td></td><td>Section A</td><td></td><td></td></tr>
<tr><td>1a</td><td>Lungs: Carbon dioxide [1]
Kidney: Urea [1]</td><td>2</td><td>A: Excess mineral salts</td></tr>
<tr><td>1b</td><td><table><tr><th>Changing condition</th><th>Volume of urine</th><th>Concentration of urine</th></tr><tr><td>Increase in water uptake</td><td>increase</td><td>decrease</td></tr><tr><td>Increase in temperature</td><td>decrease</td><td>increase</td></tr></table>[½ each]</td><td>2</td><td></td></tr>
<tr><td>1c</td><td>Typically, <u>all</u> the glucose molecules are <u>selectively reabsorbed at the proximal convoluted tubule</u> into the surrounding blood capillaries. [1]</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>2a</td><td>• Carbon dioxide falls/lower during day;
• Carbon dioxide rises/higher at night.

• Respiration during day and night;
• Respiration produces/releases carbon dioxide.

• Photosynthesis during day/not at night;
• Photosynthesis uses/absorbs/takes in/requires substrate carbon dioxide.

• Rate of photosynthesis exceeds respiration during the day,
• hence more carbon dioxide absorbed than released.
[½ each]</td><td>4</td><td></td></tr>
<tr><td>2b</td><td>Line starts at y-axis, spans entire time axis, label 'oxygen' [1]
Line lower (night) then rising above (day) then falling below existing line (night). [1]

</td><td>2</td><td></td></tr>
</table>

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3a	• During exhalation, diaphragm *muscles* relaxes and arches upwards/rises, • internal intercostal muscles contract while external intercostal muscles relax, • this leads to the rib (cage) moving downward and inward. • This decreases the volume of the thoracic/chest cavity. • There is an increase in the pressure inside thoracic cavity, above atmospheric pressure, • thus air is forced out of the lungs. [½ each]	3	
3b	D at trachea/bronchus [1] E at end of bronchiole [1]  	2	R: larynx
4a	• The build up of fatty deposits/cholesterol [0.5*] • in the inner wall of the coronary artery [0.5*], • OR Atherosclerosis (instead of first 2 points*) [1] • lumen of the coronary artery [0.5] • to be narrow or blocked. [0.5] • Greatly reduce the amount of oxygen [0.5] • and glucose supplied [0.5] • to the heart muscle (cells), [0.5] • damaging/death of heart muscle cells [0.5] • as aerobic respiration cannot occur. [0.5] [0.5m, max 3]	3	
4b	*Inflating the balloon:* • Opens/expands metal mesh [1] • Push/compress the blockage/fat [1] • Widen/increase diameter of blood vessel/lumen [1] *Leaving the hollow metal mesh:* • Maintain wider lumen [1] • Increase/ensure constant blood flow [1] [max 1 mark per point for each part]	2	

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5a	B: Anaphase (of Mitosis) [1] C: Anaphase II (of Meiosis) [1]	2	
5b	• Cell A undergoes meiosis, which produces haploid gametes. • When the male gamete fuses with the female gamete, the diploid zygote is formed. • diploid number of chromosomes is restored in the zygote / the normal diploid number of chromosomes is maintained in the species. • Increase genetic variation • Due to crossing over and independent assortment • This increases the ability of the species to adapt to the environment [0.5 each, max 1m for each big idea]	2	
5c	A B1 B2  or [Any 2 cells e.g. A & A, **A & B1**, **A & B2**, B1 & B1, B2 & B2. 1 mark each]	2	
6a	P: sensory neurone / thermo-receptor / temperature receptor [1] Q: venule [1]	2	A: small vein
6b	• So that enzymes do not denature • enzymes remain active • maintains optimum temperature for enzymes • maintaining a constant rate of, reactions / metabolism / respiration • avoids damage to other named (type of) protein • avoids damage to cell membranes • avoids, heatstroke / hyperthermia / overheating / dehydration / too cold [1 each, max 2]	2	
6ci	• average blood flow as percentage of maximum blood flow remains constant [0.5] • at 4% from 19 °C to 24°C, [0.5] • and then increases [0.5] • from 4% to 100%, from 24°C to 41°C, [0.5] OR • average blood flow as percentage of maximum blood flow increases at an increasing rate [1] • From 4% to 100%, from 19°C to 41°C [1]	2	A: data range may vary to show reasonable segmentation of graph. E.g. can also split 19-29°C gradual increase vs 29-41°C rapid increase.
6cii	46 % [1]	1	
6ciii	• Higher body/skin temperature than normal is • detected by sensory neurone / receptor (in skin) ; • nerve impulse is generated ;	3	

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<table>
<tr><td></td><td>• brain / hypothalamus as control centre stimulated ;
• send nerve impulses to motor / effector neurones ;
• muscles in shunt vessels contract / arterioles relax ;
• so shunt vessels, constrict / close ;
• arterioles dilate / vasodilation ;
• increased / more, blood flow, into capillaries / near surface (of skin)
• to remove latent heat via conduction, convection and radiation
[1/2 each, max 3]</td><td></td><td></td></tr>
<tr><td>6d</td><td><table>
<tr><td>Coordination by hormones …</td><td>while coordination by nerves …</td></tr>
<tr><td>Involve hormones/chemical substances</td><td>Involve nerve impulses/electrical signals</td></tr>
<tr><td>Require hormones to be transported by the blood/circulatory system</td><td>require impulses to be transmitted by neurones</td></tr>
<tr><td>Usually lead to slow(er) responses</td><td>Usually lead to quick(er) responses</td></tr>
<tr><td>Have responses that may be short-lived or long-lived</td><td>Have responses that are short-lived</td></tr>
<tr><td>Are always involuntary</td><td>May be involuntary or voluntary</td></tr>
<tr><td>May affect more than one target organ/tissue</td><td>Are usually localised / usually affect one effector</td></tr>
<tr><td></td><td></td></tr>
</table>
[1 each, max 3]</td><td>3</td><td>R: coordination by hormones does not always require a stimulus (true) but coordination by nerves always require stimulus (not true, brain can generate nerve impulse without stimulus)

R: coordination by hormones require endocrine gland vs does not require endocrine gland / require nervous system (these are not quite comparable).</td></tr>
<tr><td></td><td></td><td>4</td><td></td></tr>
<tr><td>7a</td><td>Mutation is a <u>sudden random change</u>
in the <u>structure of the HFE gene / the sequence of bases in HFE gene / the sequence of nucleotides in the HFE gene.</u> [1]</td><td>1</td><td>R: any mention of chromosome number change.

R: answers not specific to HFE gene.</td></tr>
<tr><td>7bi</td><td>• Recessive allele. [1]

• Individual 2 is homozygous for the condition hence would pass down the allele responsible for the condition to all her offspring. [1]

• But only one out of three of her offspring (3, 4, 5) were affected (as offspring heterozygous for the condition were normal) [1]
• OR Otherwise, a dominant allele would cause all offspring to be affected. [1]</td><td>3</td><td></td></tr>
<tr><td>7bii</td><td>Hh [1]</td><td>1</td><td></td></tr>
</table>

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7c	Women after menopause no longer regularly lose iron in the form of haemoglobin when red blood cells are lost during menstruation. [1]	1	R: excretion
7d	• When iron accumulates, pancreas including the Islets of Langerhans is damaged, • It may not be able to secrete insulin (or glucagon) adequately to lower high blood glucose concentration. OR • When liver is damaged, • it may not be able to convert excess glucose into glycogen adequately, hence blood glucose concentration may remain above normal. [1 each]	2	
7e	• Reduce intake of protein/meat sources high in iron content. • Consume carbohydrates/sugar/glucose in smaller quantities (more regularly). [1 each]	2	
	Section B		
8ai	Axes [1] Scale [1] Points [1] Curve [1]	4	1 or 0 each. S: 0 if no origin. C: no need to extrapolate beyond data given, but not penalized.
8aii	Good to indicate the thickness on graph when distance is 75cm. Answer read off accurately from graph with units, to nearest half a box. Appx 2.75 – 2.825mm range. [1]	1	Can give to 3sf/4sf or exact. e.g. 2.7875 mm = 2.79 mm (3sf)
8b	• Ciliary muscles relax, • Suspensory ligaments tighten/taut, • Lens pulled/stretched/thinner/less convex. [1 each]	3	
8c	• Convex lens • So that light rays converge/focused on/meet at the retina/fovea [1 each]	2	
9a	Slice B: • pH was (too) low / acidic, [0.5] • hence enzymes were denatured. [0.5] Slice C: • Temperature was (too) low / cold, [0.5] • hence enzyme was inactive. [0.5]	2	
9b	• Enzymes are biological catalysts • Required in minute amounts as they remain chemically unchanged at the end of the reaction • Which help to speed up/increase the rate of reaction to • Break down cellulose cell wall of apple cells [1 each]	2	

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9c	Phloem [0.5] Sucrose [0.5]	1	
9di	• Sexual reproduction is the process involving the fusion of two gametes to form a zygote, • resulting in the production of genetically dissimilar offspring. • Gametes are produced due to a process called meiosis. [1 each, max 2]	2	
9dii	• The anthers and the stigmas may mature at different times. • Stigmas of plants with bisexual flowers may be situated some distance away from the anthers [1 each, max 1]	1	
9diii	• Offspring produced may have inherited beneficial qualities from both parents • More varieties of offspring can be produced / higher genetic variation in population. • For example, any change in the environment is less likely to destroy all the varieties in a species. / The species will be better adapted to changes in the environment. • More viable seeds are produced. Such seeds are capable of surviving longer before germination. [1 each, max 2]	2	R: increase adaptability of the *offspring* (it should of the *species*, as natural selection occurs over generations not within an individual)
10 **Either** a	• Starch is insoluble/large/complex/compact molecule or polysaccharide • It remains inside cell/cannot pass through/diffuse across cell membrane • Does not change water potential inside cell • Prevents gain of water by cells through osmosis [1 each, max 3]	3	
10b	• Animals cannot photosynthesize/ make their own food • Plants (a form of carbohydrate) are eaten/ingested, digested, absorbed (and assimilated). • This provides glucose used for respiration/release of energy • Animals use the oxygen produced by plants during photosynthesis for aerobic respiration • Plants use carbon dioxide produced by animals during respiration [1 each, max 3]	3	
10c	• Woman will require more energy/food • For growth/development of fetus • For instance, more carbohydrates/protein/fats/named vitamin or mineral is needed • For (role of named nutrient). • Woman should reduce/stop alcohol consumption • To reduce risks of negative effect on fetus brain development / nervous system / toxic effects of alcohol. [1 each, max 4]	4	
10 **Or**	• Stimulus received by thermoreceptors on the skin/feet OR Thermoreceptor will generate a nerve impulse,	5	

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a	• Impulse is transmitted along the sensory neurone • To the relay neurone in the spinal cord, which is damaged. • Hence no impulse is transmitted along the motor neurone • To the effector which is the leg muscles to remove leg. [1 each]		
10b	• When viral protein is present in the bloodstream, they stimulate lymphocytes to produce antibodies against it. [1] • Antibodies may stay in the blood for some time / when exposed to the virus, the same antibodies are produced. [1] Any 2 effects to protect the mother from the negative effects of viral infection [2]: • which destroys the virus by causing its surface membrane to rupture; • cause the virus to clump together/agglutinate • so that they are easily ingested by phagocytes • Since the antibodies can diffuse from the mother's blood into the fetal blood across the placenta, the antibodies can likewise protect the fetus. [1]	5	

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