Name and Index Number: ( )	Class:

SENG KANG SECONDARY SCHOOL
PRELIMINARY EXAMINATION

BIOLOGY (REVISED) 6093/01

Secondary 4 Express

26 August 2020

Paper 1 Multiple Choice

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

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

There are **forty** questions in 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 Multiple Choice 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 question paper.
The use of an approved scientific calculator is expected, where appropriate.

Parent's / Guardian's Signature: .....

This document consists of **20** printed pages and **0** blank page.

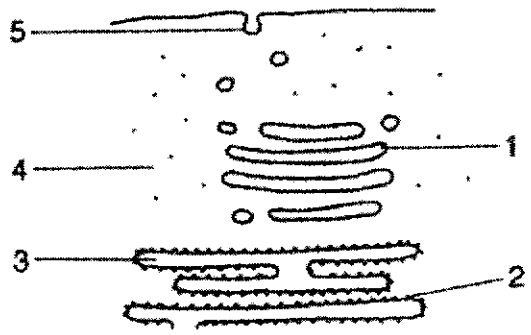
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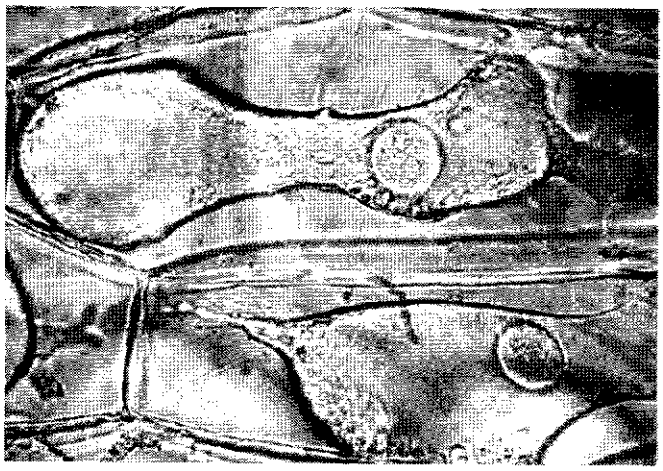
1 Radioactive amino acids are supplied to a cell that uses them to make enzyme.



Which route will the radioactive amino acids take?

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

2 A fleshy section of an onion bulb was taken and placed in liquid **P**.
The diagram below shows the cells from the onion bulb after half an hour.



Which of the following is most likely to be liquid **P**?

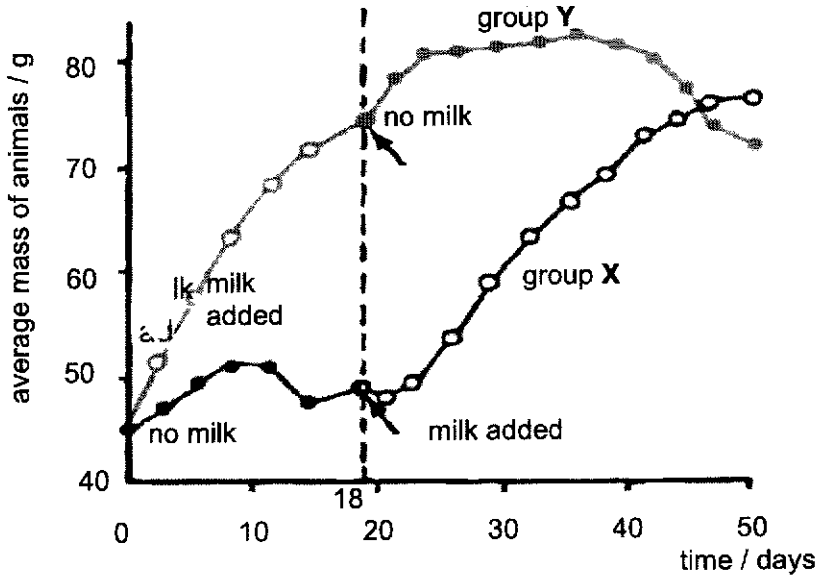
A concentrated sugar solution
B dilute sugar solution
C distilled water
D oil

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3 According to the 'lock and key' hypothesis, which is the lock and which is the key for the enzyme lipase?

	key	lock
A	fatty acids	lipids
B	lipase	lipids
C	lipase	fatty acids
D	lipids	lipase

4 In the early 1900s, Frederick Hopkins divided young rats from the same litter into two groups, **X** and **Y**. He fed all rats with protein, sugar, starch, fat, mineral salts and water, but the rats in group **Y** received an additional 3 ml of milk each day. After 18 days, group **X** was given the milk instead of group **Y**. The results of the experiment are shown in the graph below.



Using information provided from the graph, what was the aim of the experiment?

A To show that milk contains lactose that is essential for the growth of rats.

B To show that milk contains substances that are essential for the growth of rats.

C To show that milk is more important than protein, carbohydrates, fat, mineral salts and water for the growth of rats.

D To show that protein, carbohydrates, fat, mineral salts and water are essential for the growth of rats..

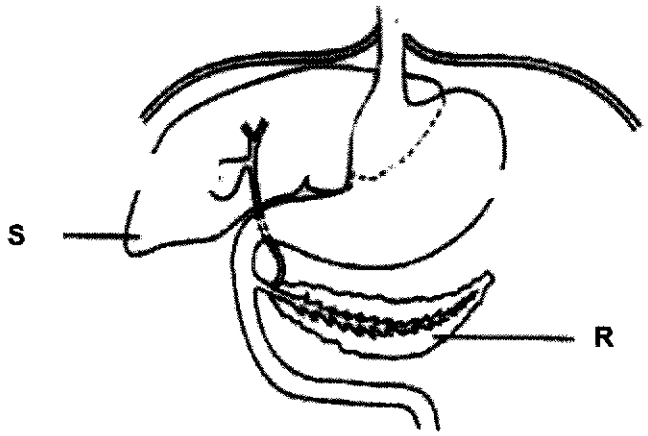
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5 In the human body, large molecules are synthesized from from small molecules.

Which row is correct for the small molocules required for synthesis of glycogen, lipids and proteins?

	glycogen	lipids	proteins
A	amino acids	glucose	glycerol and fatty acids
B	glycerol and amino acids	fatty acids	glucose
C	glycerol and fatty acids	glycerol and amino acids	fatty acids
D	glucose	glycerol and fatty acids	amino acids

For Questions **6** and **7**, refer to the following diagram of the alimentary canal



6 If the duct connecting structure **R** to the alimentary canal becomes blocked, which of the following would be the most likely consequence?

A decrease protein digestion
B decrease bile production
C increase blood glucose level
D increase carbohydrate digestion

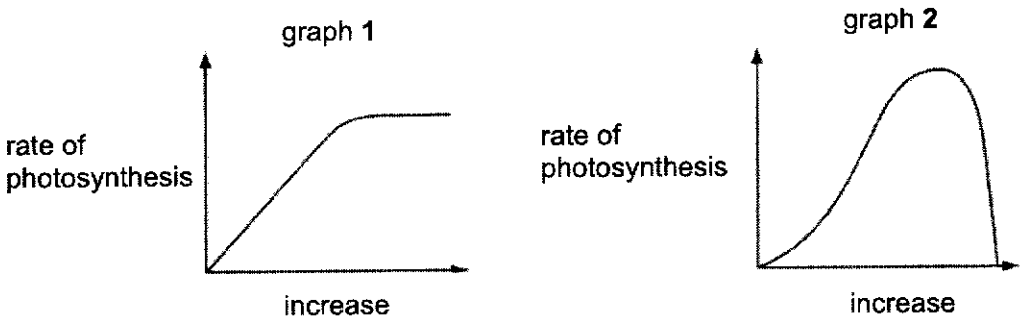
7 As a result of a serious infection, structure **S** of a patient had to be removed via surgery.

Which of the following would be the likely consequence?

A Lipids cannot be digested.
B Production of bile will be affected.
C Release of bile cannot be regulated.
D Fatty food substances can no longer be digested.

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8 The graphs show how two different conditions affect the rate of photosynthesis.

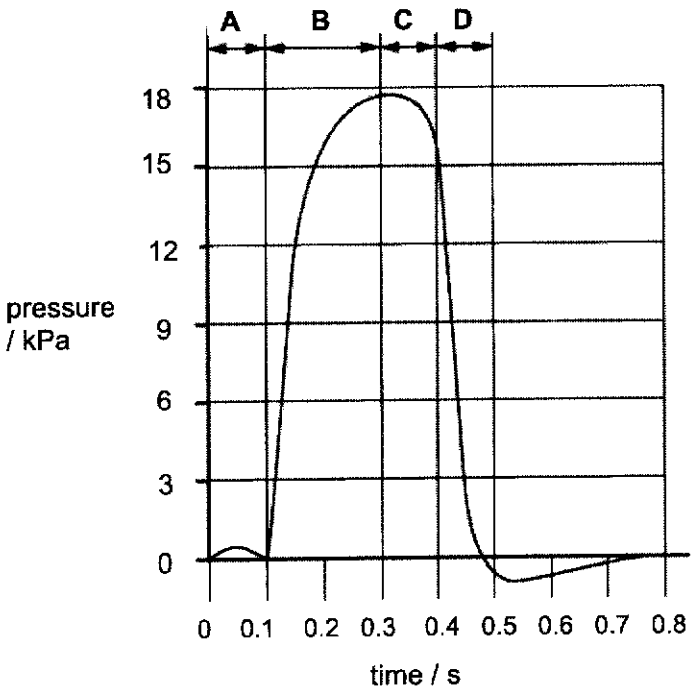


Which conditions are represented in graphs **1** and **2**?

	graph **1**	graph **2**
A	carbon dioxide concentration	light intensity
B	carbon dioxide concentration	temperature
C	temperature	carbon dioxide concentration
D	temperature	light intensity

9 The graph shows changes in the blood pressure in the left ventricle of the heart.

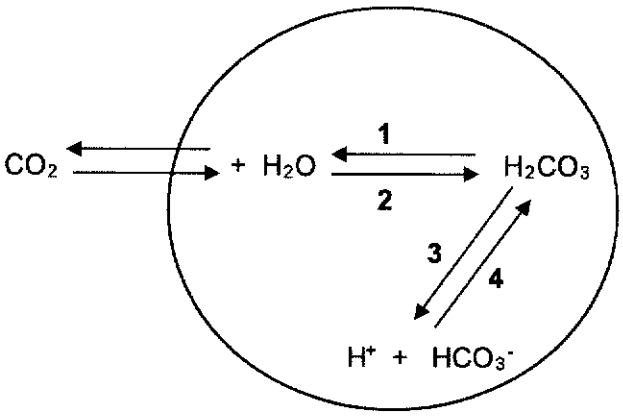
During which period is the left atrium contracting?



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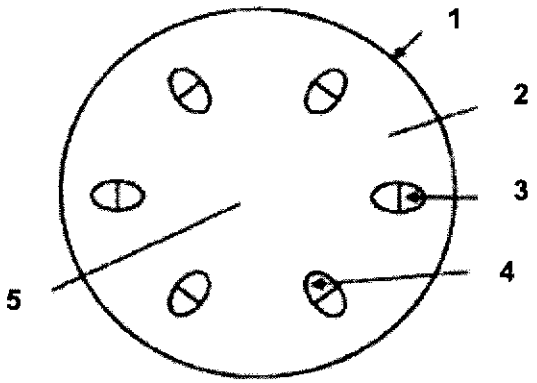
10 The diagram shows the reactions involved in the conversion between carbon dioxide and hydrogencarbonate ions in the blood.



Which numbered reaction(s) involve carbonic anhydrase?

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

11 In an experiment, two plants were placed in bright sunlight. Plant **X** had its leaves exposed to radioactive carbon dioxide while plant **Y** was watered with radioactive water. The diagram below shows the typical cross-section of a stem.



Which labelled parts of plants **X** and **Y** would test positive for radioactivity after 48 hours?

	plant **X**	plant **Y**
A	**1**	**5**
B	**2**	**5**
C	**3**	**4**
D	**4**	**3**

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12 What could increase the rate of water uptake by a shoot?

A covering the shoot with a black plastic bag
B covering the shoot with a clear plastic bag
C removing the leaves from the shoot
D shining a bright light onto the shoot

13 Some effects of smoking are listed.

1 paralyses cilia
2 increases heart rate
3 increases mucus production
4 is additive
5 reduces the amount of oxygen in the blood

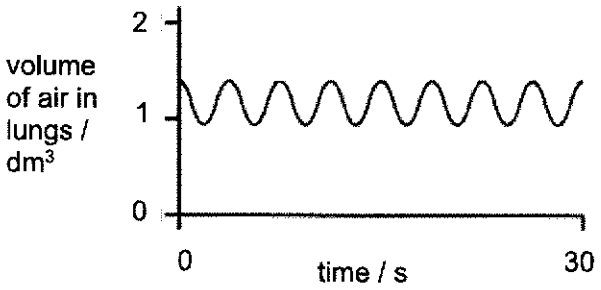
What effects are caused by nicotine?

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

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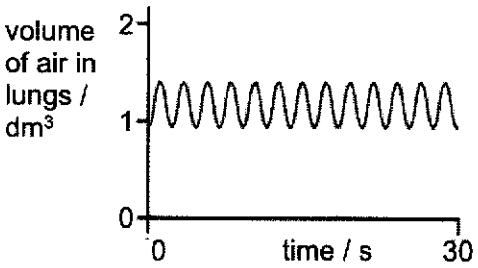
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14 The graph shows changes in the volume of air in the lungs of a person at rest, over a period of 30 seconds.

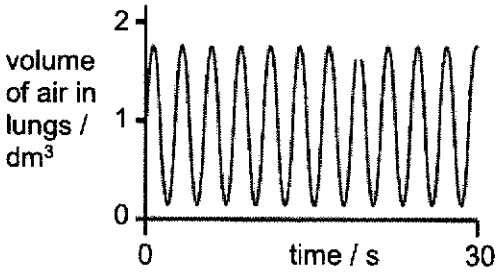


Which graph shows changes in the volume of air in the lungs of the same person immediately after he/ she has done five minutes of vigorous exercise??

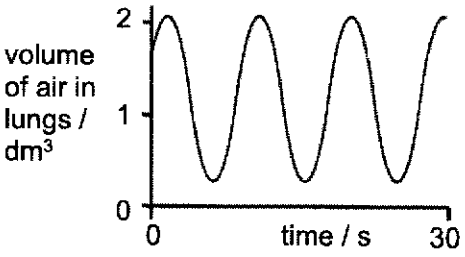
A



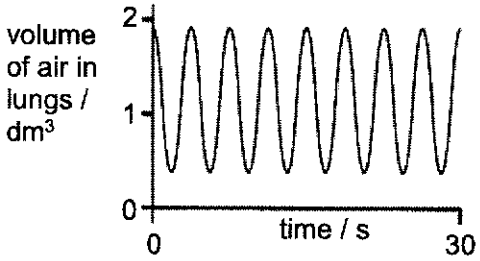
C



B



D



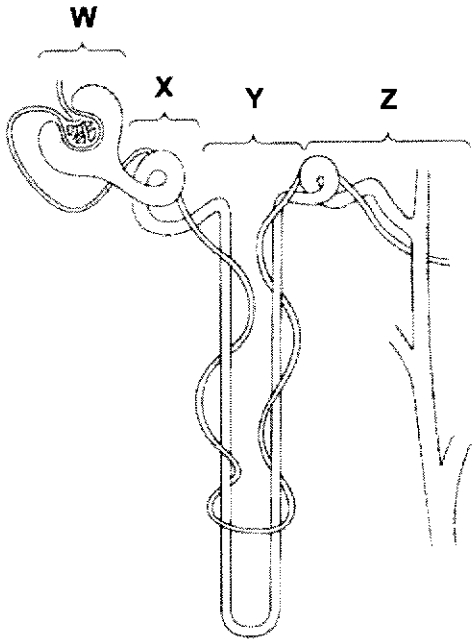
15 Which row states the end products, of aerobic and anaerobic respiration in muscles correctly?

	aerobic respiration	anaerobic respiration
A	carbon dioxide and water	carbon dioxide only
B	carbon dioxide and water	lactic acid only
C	carbon dioxide only	lactic acid and carbon dioxide
D	lactic acid only	carbon dioxide and water

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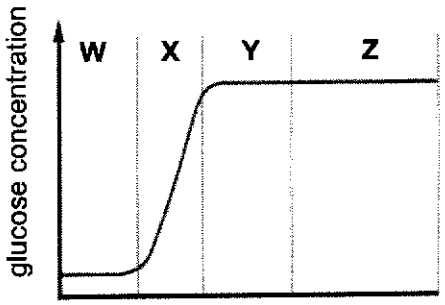
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16 The diagram shows a nephron and associated blood vessels.

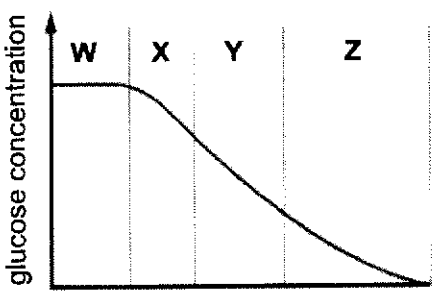


Which graph shows the concentration of glucose present in each part of the kidney tubule?

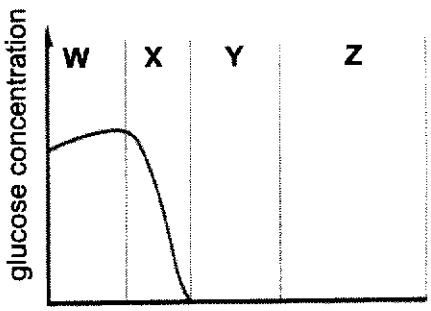
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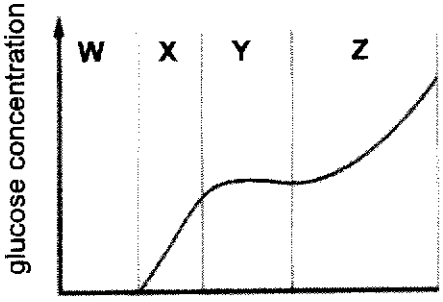
C



B

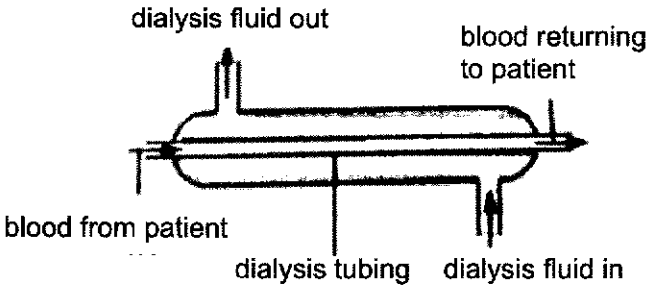


D



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17 An engineer has been asked to improve the efficiency of the dialysis machine shown below.



He has made the following list of recommendations:

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

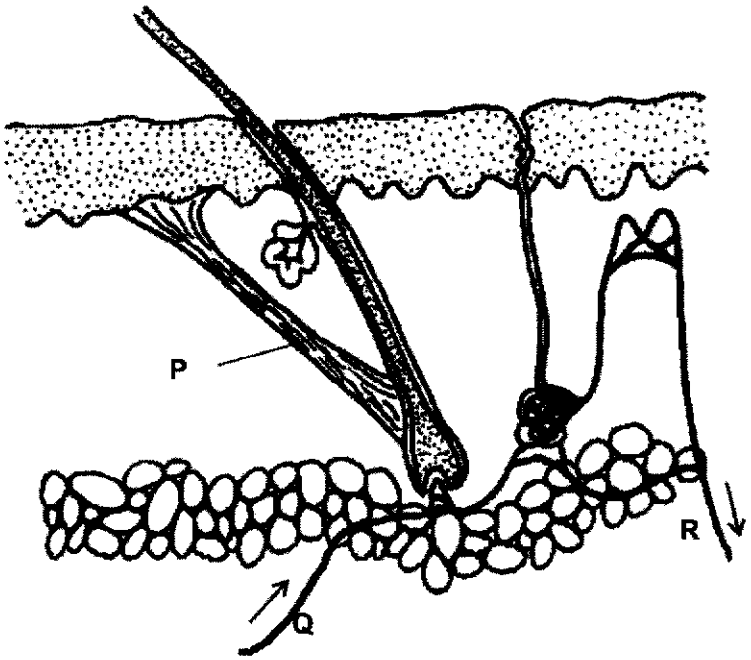
Which of the following recommendations is correct?

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

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18 The diagram shows a section through the human skin.



Which of the following changes occur when body temperature rises?

	concentration of carbon dioxide	concentration of urea	concentration of salt	P
A	higher at **R** than at **Q**	same at **Q** and **R**	lower at **R** than at **Q**	relaxes
B	higher at **R** than at **Q**	lower at **R** than at **Q**	lower at **R** than at **Q**	relaxes
C	lower at **R** than at **Q**	same at **Q** and **R**	higher at **R** than at **Q**	contracts
D	same at **Q** and **R**	same at **Q** and **R**	same at **Q** and **R**	relaxes

19 Which factors are controlled by homeostasis?

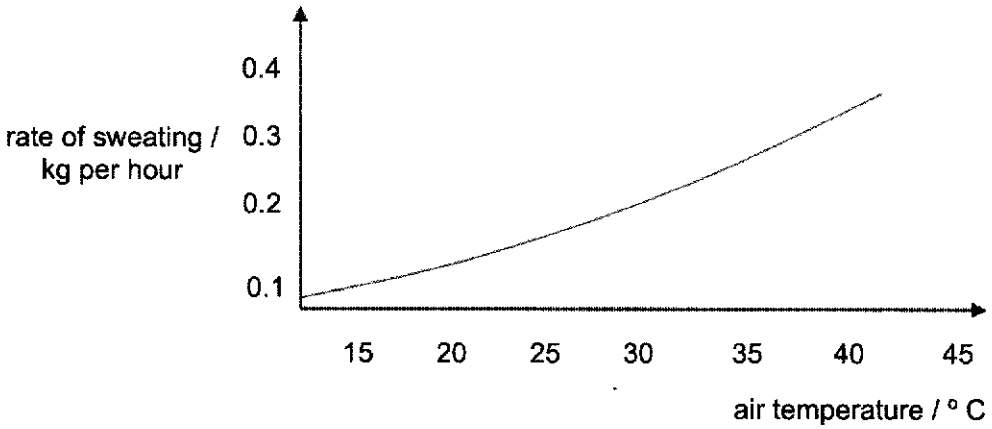
	glucose concentration in blood	water content in ileum	temperature in the stomach	pH in the duodenum
A	✓	✓	×	✓
B	✓	×	✓	✓
C	✓	×	✓	×
D	×	✓	✓	×

key ✓ = controlled by homeostasis
× = not controlled by homeostasis

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20 The graph shows the rate of sweating at different air temperatures for a mammal which has a body temperature of 38 °C.



Which of the following describes the mammal's internal body temperature as air temperature rises to 40 °C?

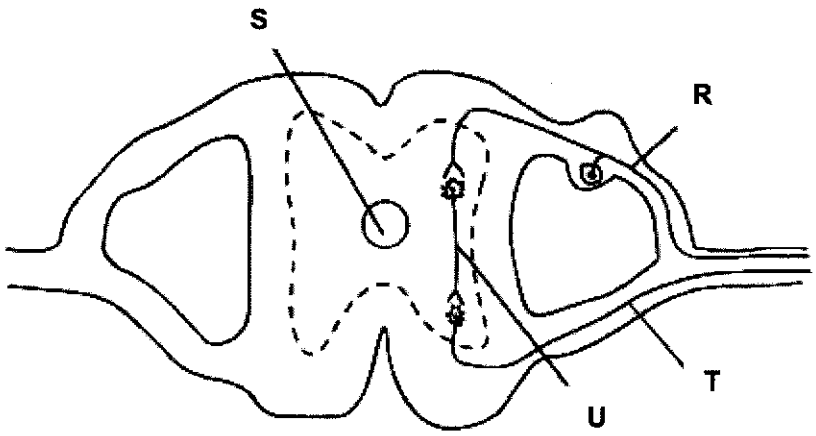
A Its body temperature will decrease to 36 °C.

B Its body temperature will decrease to 37 °C.

C Its body temperature will be maintained at 38 °C.

D Its body temperature will increase to 40 °C.

For Questions **21** and **22**, refer to the diagram which shows a transverse cross-section of the spinal cord with spinal nerves.



21 Which of the following represents the correct pathway of a reflex action?

A effector → **R** → **U** → **T** → receptor

B effector → **T** → **U** → **R** → receptor

C receptor → **T** → **U** → **R** → effector

D receptor → **R** → **U** → **T** → effector

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22 If neurone **U** is severed and the person's hand touches a hot object, which of the following would happen?

A The person cannot feel the sensation of pain.

B Pain receptors cannot be stimulated to produce nerve impulses.

C The person is still able to consciously withdraw hand from the hot object.

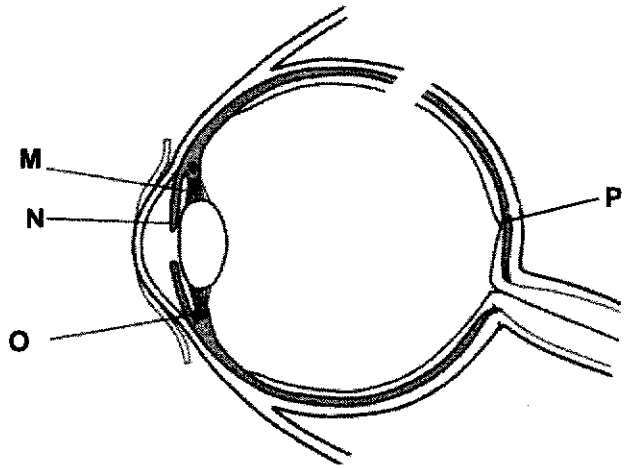
D The motor neurone is still able to receive nerve impulses from the pain receptors.

23 A man stands 10 metres away from a sign and can see it clearly. He walks towards the sign and stops 0.5 metres from it.

Which changes occur in his eyes so that the sign is still in focus?

	ciliary muscles	suspensory ligaments	lens becomes
A	contract	becomes taut	less convex
B	contract	slacken	more convex
C	relax	slacken	less convex
D	relax	becomes taut	more convex

24 The diagram below shows a cross-section of a human eye.



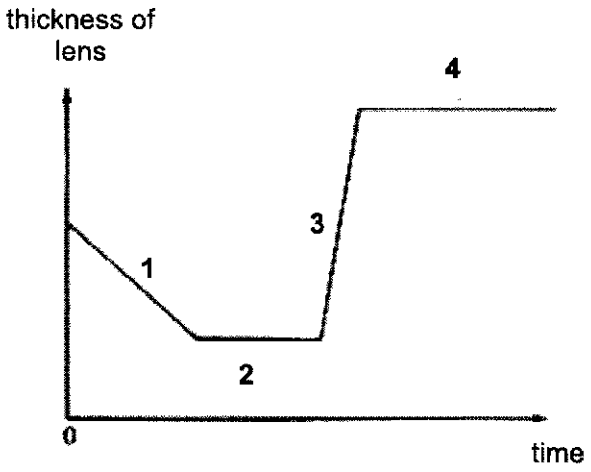
Which labelled structures can be considered as effectors?

A **N** and **O** only **B** **M** and **N** only **C** **O** and **P** only **D** **M**, **N** and **P** only

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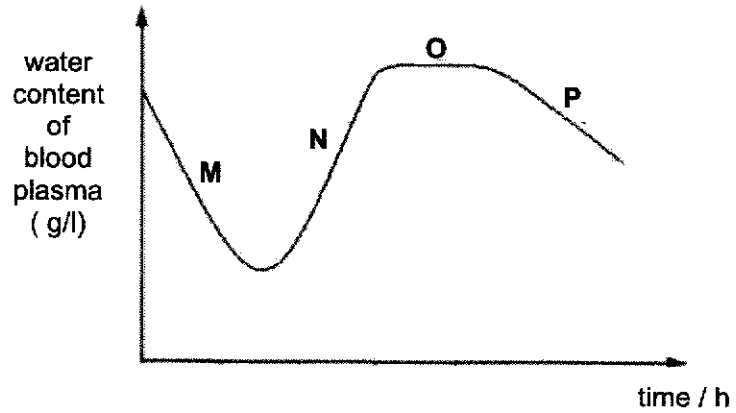
25 The graph below shows the changes in the thickness of the lens when a man looked at an object which either moved toward/away from him or remained stationary.



In which stage was the object moving away from the observer?

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

26 The graph shows the effect of antidiuretic hormone (ADH) on the regulation of water content in blood plasma.



Which part/s of the graph show/s the effects of increased ADH secretion?

A **M** only **B** **M** and **P** **C** **N** only **D** **N** and **O**

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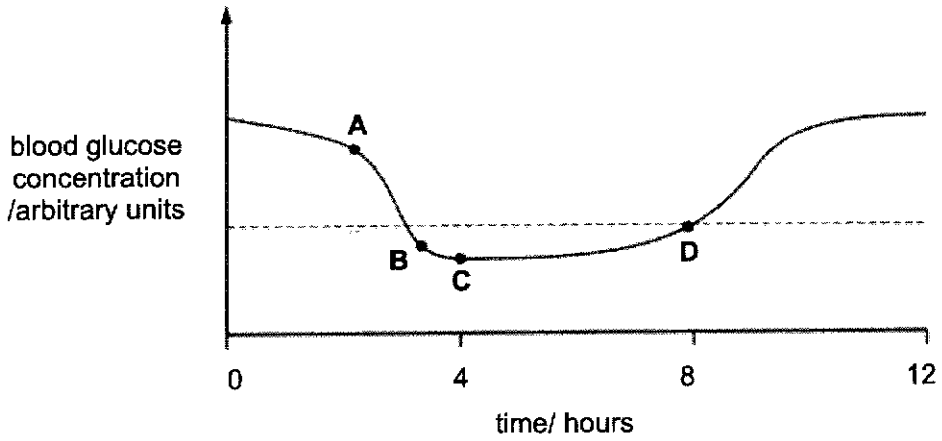
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27 How is the concentration of glucose in the blood regulated?

	blood glucose concentration	pancreas stimulated to produce	liver converts	blood glucose concentration	pancreas reduces secretion of
A	fall	glucagon	glycogen to glucose	rise	glucagon
B	fall	insulin	glucagon to glucose	rise	insulin
C	rise	glucagon	glucose to glycogen	fall	glucagon
D	rise	insulin	glycogen to glucose	fall	insulin

28 A person with diabetes mellitus is receiving treatment with insulin injections. The graph shows how this person's blood glucose concentration changed during part of one day.

At what point was an insulin injection given?



29 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, and insects were allowed to visit all the flowers freely.

Which group of flowers, **A**, **B**, **C** or **D**, would be most successfully cross-pollinated?

groups of flowers	stigma	anthers	petals
A	left intact	left intact	removed
B	left intact	removed	left intact
C	removed	left intact	left intact
D	removed	removed	removed

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30 The following data regarding two different plant species was obtained.

plant	average diameter of pollen grain /mm	average mass of pollen grain /mm	texture of pollen grain
X	15	200	smooth, dry
Y	45	1800	spiky, sticky

The following conclusions were made from the data above.

1 Plant **X** is more likely to be cross-pollinated.
2 Plant **Y** is more likely to be self-pollinated.
3 Plant **X** is more likely to have stigmas which have a larger surface area than those of plant **Y**.
4 Plant **Y** is more likely to produce a larger number of pollen per unit time to achieve the same efficiency of pollination as plant **X**.

Which conclusion(s) is/are valid?

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

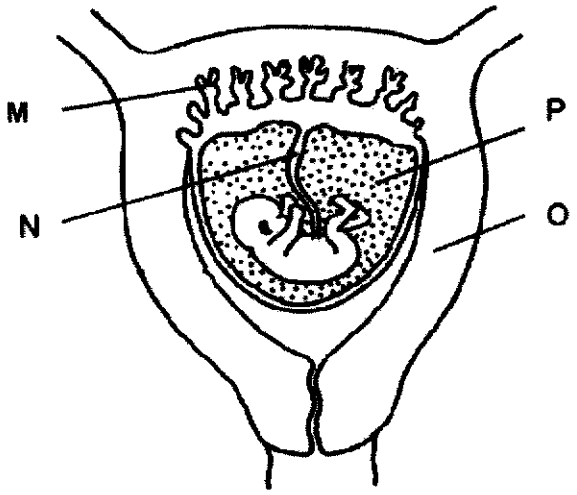
31 A plant has 20 chromosomes in its leaf cells. The plant reproduces both sexually and asexually.

What is the correct number of chromosomes in the gametes and in the cells used for asexual reproduction?

	number of chromosomes	
	gametes	cells used for asexual reproduction
A	10	10
B	10	20
C	20	10
D	20	20

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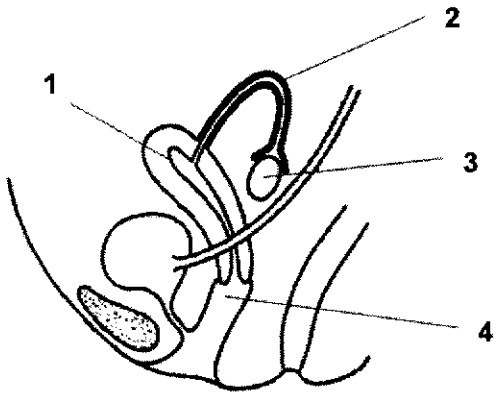
32 The diagram shows part of the womb of a pregnant woman.



Which of the following statements is correct?

A Progesterone is needed to maintain structure **M**.
B Structure **O** only protects the foetus from fluctuations in temperature.
C Structure **P** contains the gaseous water products of the foetus.
D The artery in **N** transports glucose and amino acids to the foetus.

33 The diagram below shows the side view of the female reproductive system.



At which labelled parts do the following processes take place?

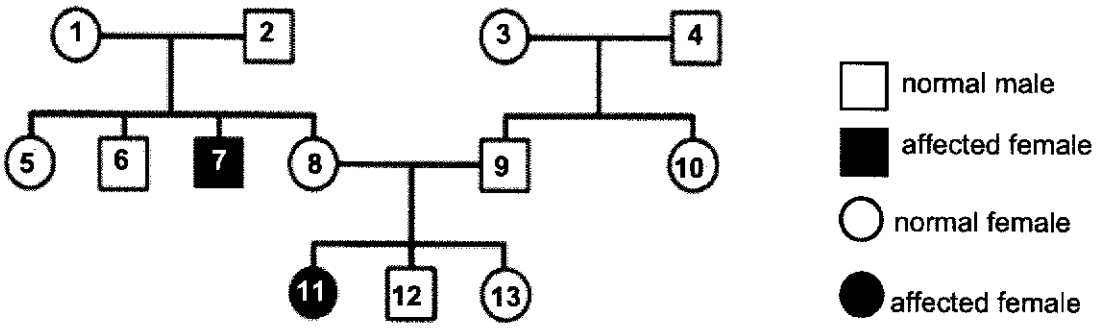
	fertilization	implantation	sperms deposition
A	**1**	**4**	**2**
B	**2**	**1**	**4**
C	**2**	**3**	**4**
D	**3**	**2**	**1**

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34 Phenylketonuria (PKU) is a condition where the affected individual is unable to produce the enzyme phenylalanine hydroxylase. If left untreated, it can lead to intellectual disability, seizures, and other serious medical problems. PKU is inherited as an autosomal recessive condition.

The chart below shows a family where two of the members have PKU.



Which of the following members are carriers of the PKU gene?

A **2** and **8**
B **3** and **10**
C **4** and **11**
D **7** and **12**

35 Tay Sachs disease, which usually causes death in young children by the age of four, is caused by an abnormal allele of a single gene.

Which one of the following is the most likely reason why this disease has persisted in the human population?

A It is caused by a dominant allele that can be passed on more successfully.
B It is caused by a recessive allele that does not display its effect in carriers.
C The disease can be transmitted to other individuals via means of fluid exchange.
D The victims pass on their genes to subsequent generations.

36 In a conversation, Eileen and Eddie made four statements about themselves.

	Eddie	Eileen
1	I am male.	I am female.
2	I am 172 cm tall.	I am 157 cm tall.
3	I am not very good at maths.	I am good at maths.
4	My blood group is B.	My blood group is O.

Identify the statements that describe characteristics consistent with discontinuous variation?

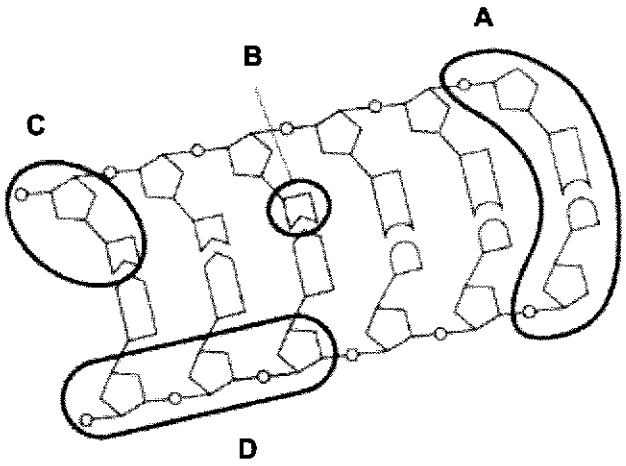
A **1** and **2** **B** **1** and **4** **C** **2** and **3** **D** **3** and **4**

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37 The diagram shows part of a DNA molecule.

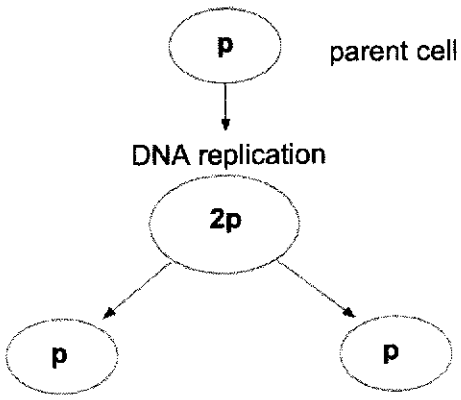
Which part is a nucleotide?



38 A polypeptide consists of 50 amino acids. How many bases should the mRNA consist of to produce this polypeptide?

A 50 **B** 100 **C** 150 **D** 500

39 The diagram shows a cell dividing. The letter **p** on the diagram represents the number of chromosomes.



Which of the following shows the type of cell division taking place and the type of cells produced by this division?

	type of cell division	type of cells produced
A	mitosis	haploid
B	meiosis	diploid
C	mitosis	diploid
D	meiosis	haploid

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40 The statements describe the events during the mitotic cell cycle.

1 Chromosomes migrate to opposite poles of the spindle.
2 Chromosomes arrange themselves at the equator of the spindle.
3 Chromosomes condense and the nuclear membrane disappears.
4 Centromeres divide.

What is the correct order of these events in the mitotic cell cycle?

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

END OF PAPER

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Name and Index Number: ( )	Class:

SENG KANG SECONDARY SCHOOL
PRELIMINARY EXAMINATION

BIOLOGY (REVISED) 6093/02

Secondary 4 Express

2 Sept 2020

Paper 2 Theory

1 hour 45 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your index number and name on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
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 in the spaces provided.

Section B
Answer all **three** questions, the last question is in the form either/or.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question

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

For Examiner's use	
Section A	**/ 50**
1	/ 6
2	/ 5
3	/ 7
4	/ 4
5	/ 7
6	/ 9
7	/ 7
8	/ 5
Section B	**/ 30**
9	/ 10
10	/ 10
11	/ 10
Total	**/ 80**
Total %	**/ 100**

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Section A

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

1 A student set up the following apparatus as shown in Fig 1.1 below.

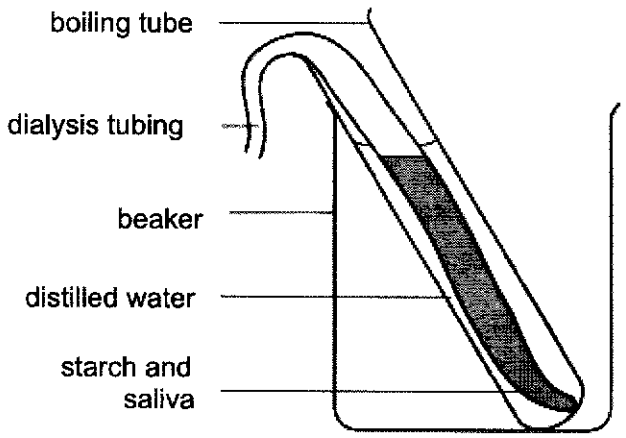


Fig. 1.1

(a) Explain what results you would expect when the distilled water was tested for the presence of starch and glucose

(i) immediately after the Visking tubing was placed into the boiling tube;

.....

.....

..... [2]

(ii) twenty minutes after the Visking tubing was placed into the boiling tube.

.....

.....

..... [2]

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(b) The apparatus is sometimes described as a model gut.

Which structures of the mammalian digestive system do the following parts of the apparatus represent?

(i) visking tubing

..... [1]

(ii) distilled water

..... [1]

2 Students investigated the digestion of lipids in milk by lipase. They set up three test tubes.

In tube **A**, milk was incubated with lipase only.

In tube **B**, milk was incubated with lipase and bile salts.

In tube **C**, milk was incubated with bile salts only.

Their results are shown in the Table 2.1.

Table 2.1

time /minutes	mean pH		
	A milk and lipase only	**B** milk, lipase and bile salts	**C** milk and bile salts only
0	8.5	8.5	8.5
10	8.0	7.7	8.5
20	7.6	7.0	8.5
30	7.3	6.5	8.5
40	7.0	6.5	8.5
50	6.5	6.5	8.5
60	6.5	6.5	8.5

(a) The pH changed in test tube **A**. Explain why.

.....

.....

..... [2]

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(b) The rate at which the pH fell in tube **A** was different from the rate at which the pH fell in tube **B**.

Explain the difference in rate.

.....

.....

..... [2]

(c) Explain the purpose of test tube **C**.

.....

..... [1]

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3 The rates of oxygen production in two plants, **X** and **Y**, were measured at different light intensities. One of the plants grows in shady conditions and the other plant grows in sunny conditions. The graph in Fig. 3.1 below shows the results for plant **X**.

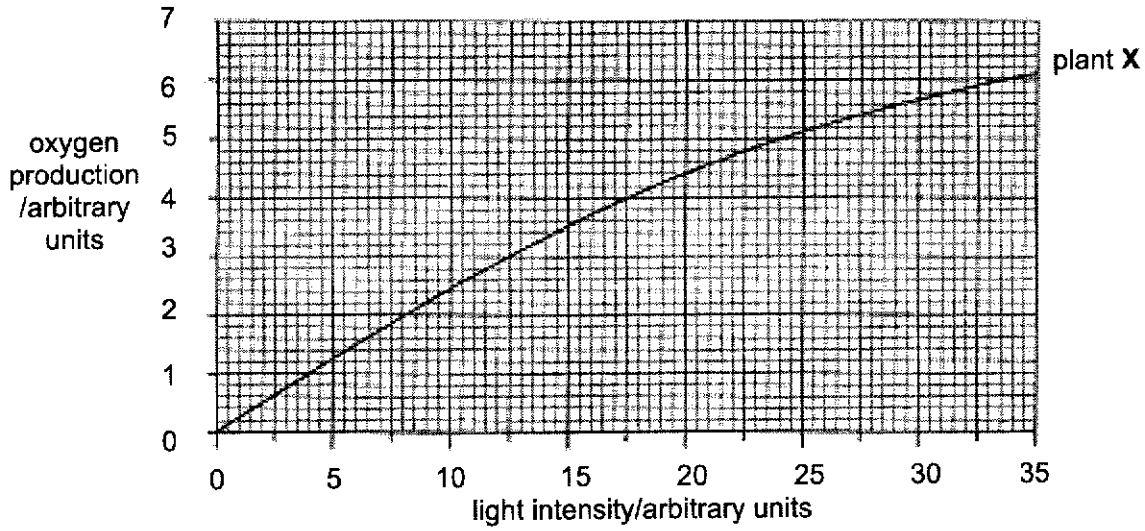


Fig. 3.1

Table 3.1 shows the results for plant **Y**.

Table 3.1

light intensity /arbitrary units	oxygen production /arbitrary units
0	0.0
5	2.1
10	2.9
15	3.3
20	3.5
25	3.6
30	3.6
35	3.6

(a) On Fig. 3.1, plot a best fit line for the results for plant **Y**. [1]

(b) Describe the differences in the oxygen production between plant **X** and **Y**.

.....

.....

.....

.....

..... [3]

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(b) Which of the two plants grows in the shade?
Explain your answer.

.....

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.....

.....

..... [3]

4 Fig. 4.1 shows the changes in blood pressure, velocity and cross sectional area of the blood vessels of the systemic circulation as blood flows and returns to the heart.

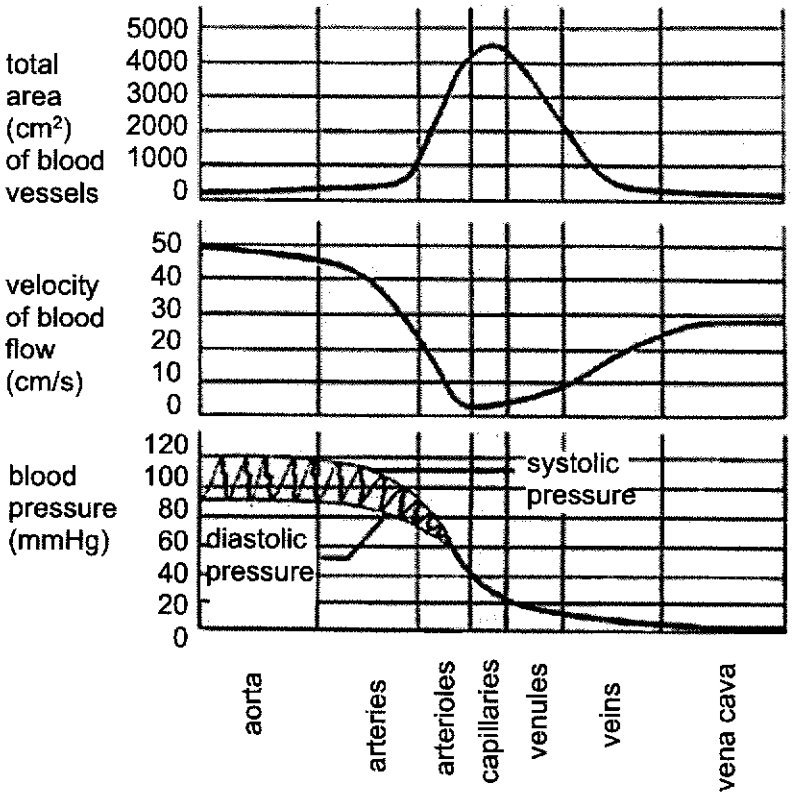


Fig. 4.1

(a) Describe the relationship between the velocity of blood and the total cross sectional area of the blood vessels.

.....

..... [1]

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(b) Relate the importance of the rate of blood flow in the capillaries to its function.

.....

..... [1]

(c) Suggest how the aorta is able to withstand the fluctuations in blood pressure.

.....

..... [1]

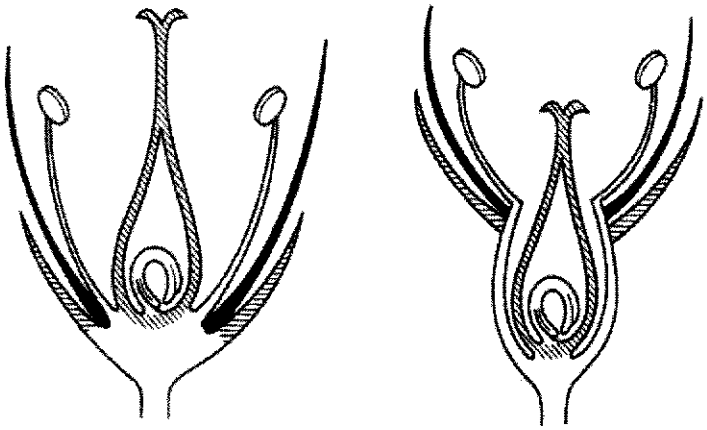
(d) Suggest how a cut in an artery can be distinguished from a cut in a vein if a person has been injured and bleeding.

.....

..... [1]

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5 Fig. 5.1 shows vertical section of two flowers **A** and **B**.



flower **A** flower **B**

Fig. 5.1

(a) With reference to Fig. 5.1, state two differences between flower **A** and **B**.

1 .....

.....

2 .....

..... [2]

(b) One of these flower may be self-pollinated.
State with reason, which of the two flower types would be self-pollinated.

flower .....

reason .....

..... [2]

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(c) In some species of plant, some plants have only male flowers while the rest have only female flowers.
Explain the advantages of this to the species.

.....

.....

.....

.....

..... [3]

6 A woman's menstrual cycle usually lasts 28 days. The graph and diagram in Fig 6.1 shows changes in a woman's hormone levels and some effects which took place over 38 days.

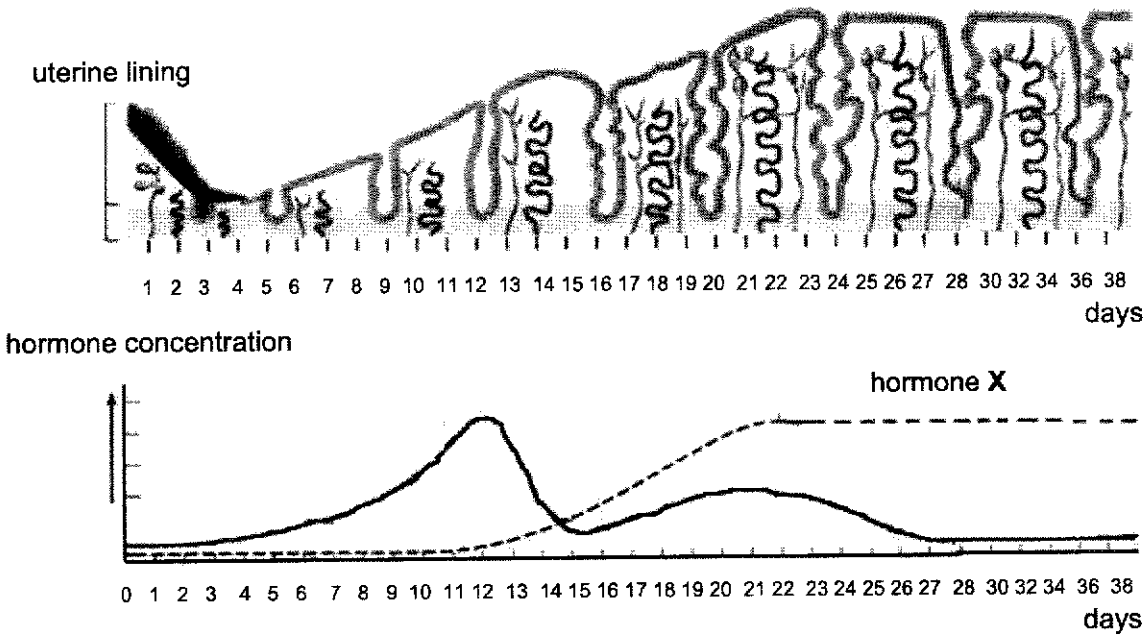


Fig. 6.1

(a) Use information in Fig. 6.1 and your own knowledge to answer the following questions.

(i) Name hormone **X**.

..... [1]

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(ii) Compare the concentration of hormone **X** and thickness of uterine lining in this woman with a normal 28 days menstrual cycle. State a reason for this difference and relate it to the function of hormone **X**.

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..... [3]

(b) Fig. 6.2 shows a developing foetus inside another woman's body.

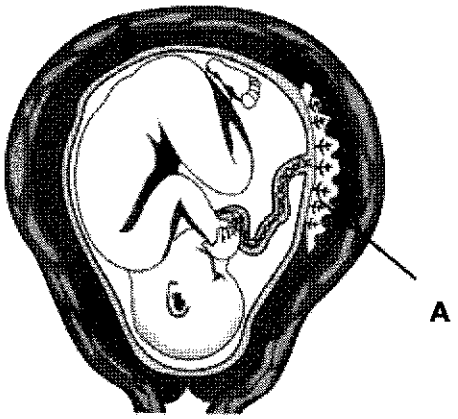


Fig. 6.2

(i) Identify **A**.

..... [1]

(ii) State one function of **A**.

.....

..... [1]

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(c) A clinical test was carried out to take out some cells at **A**. The chromosomes of the foetus are to be examined under microscope.
Fig. 6.3 is a karyotype of the foetus which shows the number and visual appearance of the chromosomes.



Fig. 6.3

(i) With reference to Fig. 6.3, state the sex of the foetus and explain how you obtain your answer.

.....

..... [2]

(ii) State the abnormality of this foetus.

..... [1]

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7 Fig. 7.1 shows some events of a cell cycle taking place in an animal cell. The events are not in the correct sequence.

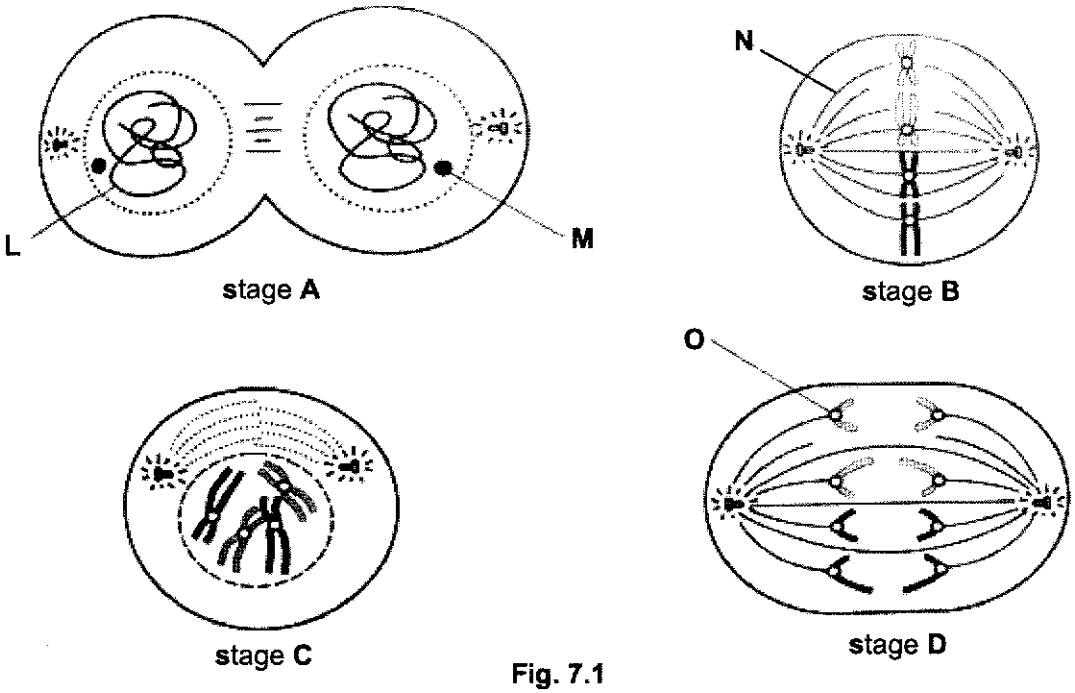


Fig. 7.1

(a) (i) Name structures **L**, **M**, **N** and **O**.

L ..... **N** .....

M ..... **O** ..... [2]

(ii) Name the stages, **A**, **B**, **C** and **D**.

A ..... **C** .....

B ..... **D** ..... [2]

(b) Explain why during a cell cycle, it is important for the amount of DNA to be doubled.

.....

..... [1]

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(c) State two differences between the daughter cells produced during mitosis and meiosis.

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..... [2]

8 Fig. 8.1 shows represents part of a DNA molecule

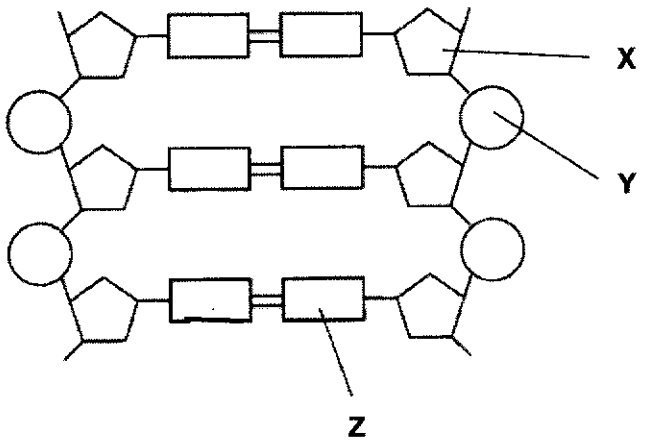


Fig. 8.1

(a) Name the structures **X**, **Y** and **Z**.

X ..... **Z** .....

Y ..... [2]

(b) Name the process which makes copies of the DNA template.

..... [1]

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(c) One of the strands of the DNA template has the following sequence of bases:

TACTTTTGGACCGAAA.

What is the complementary sequence of the opposite strand of the DNA template?

..... [1]

(d) A sample of DNA was analysed. 28% of the nucleotides contained thymine. Calculate the percentage of nucleotides which contained cytosine. Show your working

[2]

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Section B

Answer **all** the questions in this section in the spaces provided. Question **11** is in the form either/or.

9 Fig. 9.1 shows the changes in the blood glucose concentration over a day of an untreated diabetic individual and that of a healthy individual. Both of them take the same meals and exercise. Blood glucose was measured in both individuals every hour. At mealtimes, the measurements were made just before the meal.

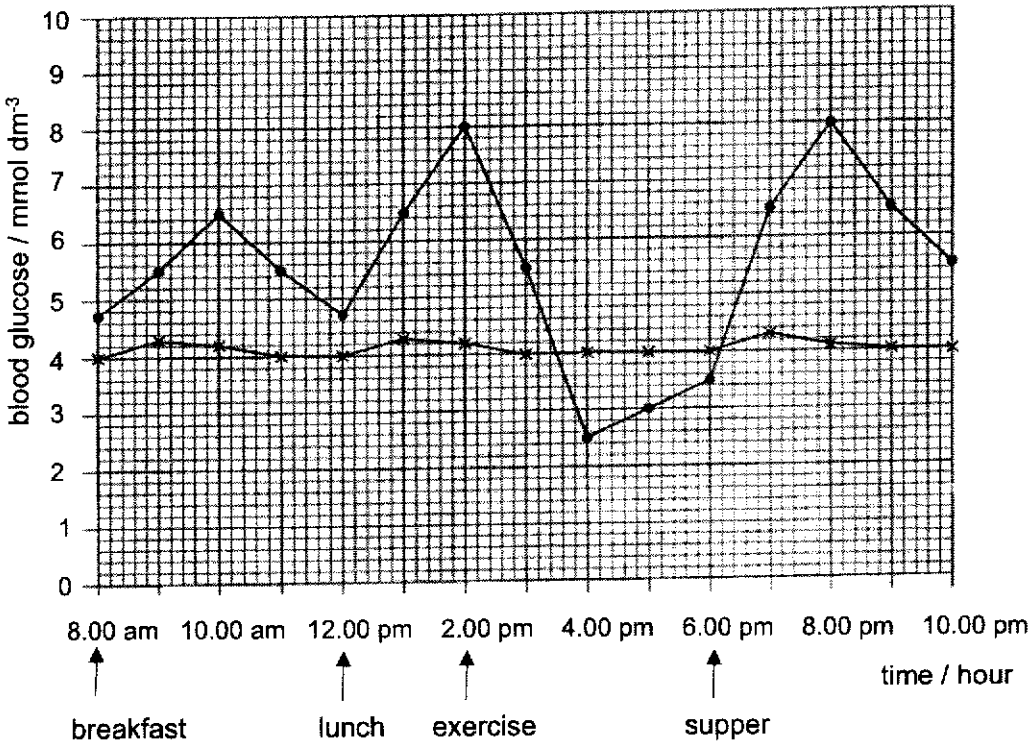


Fig. 9.1

(a) With reference to Fig. 9.1, account for the differences in blood glucose concentration at 10 am.

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..... [6]

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(b) Explain why, following exercise at 2.00 pm, the blood glucose in the diabetic person dropped.

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..... [3]

(c) Suggest a possible cause of the increase in blood glucose concentration of the diabetic person at 4.00 pm.

.....

..... [1]

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10 Fig. 10.1 shows a family tree and the blood group phenotype of each individual.

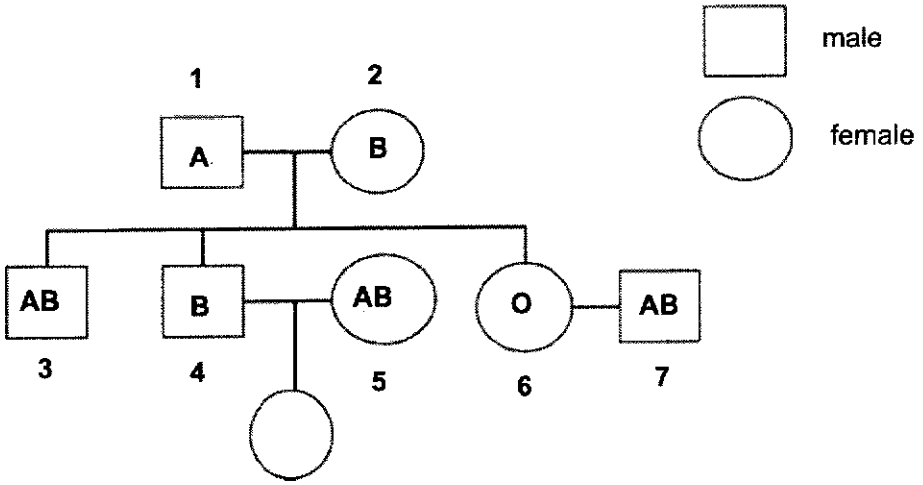


Fig. 10.1

(a) List the alleles involved in the inheritance of ABO blood groups.

..... [1]

(b) State and explain the genotype of individual **1**.

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(c) Use a genetic diagram to explain the chances of a child born to individual **4** and **5** being a girl of blood group **B**.

[6]

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11 Either

With the understanding of DNA structure and protein synthesis in animal and plant cells, scientists are able to develop and produce transgenic organisms.

(a) Describe what is meant by transgenic organism and give an example of such an organism.

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..... [3]

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(b) Fig. 11.1 shows a technique used in genetic engineering.

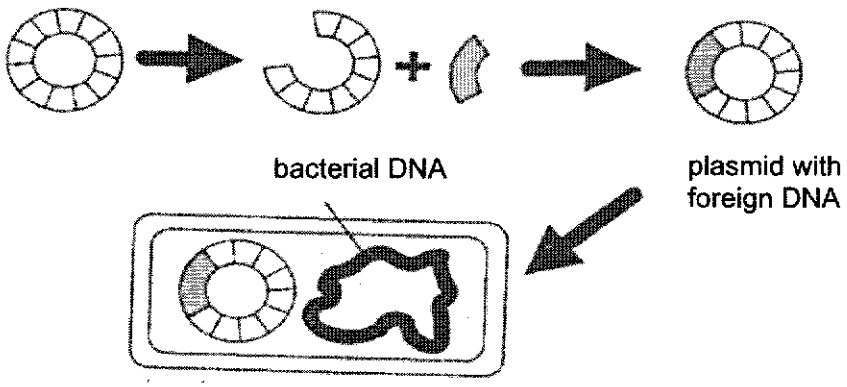


Fig. 11.1

With reference to Fig.11.1 explain how genetic engineering can be used to produce a named product that can be beneficial to humans.

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..... [7]

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11 **Or** An organ in the human body plays a role in both excretion and homeostasis. Identify this organ and describe the role it plays in

(a) homeostasis;

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..... [5]

(b) Excretion.

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..... [5]

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SENG KANG SECONDARY SCHOOL
PRELIMINARY EXAMINATION

BIOLOGY (REVISED) 6093/01

Secondary 4 Express __ Sept 2020

Paper 1 Multiple Choice 1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

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

There are **forty** questions in 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 Multiple Choice 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 question paper.
The use of an approved scientific calculator is expected, where appropriate.

Parent's / Guardian's Signature: .....

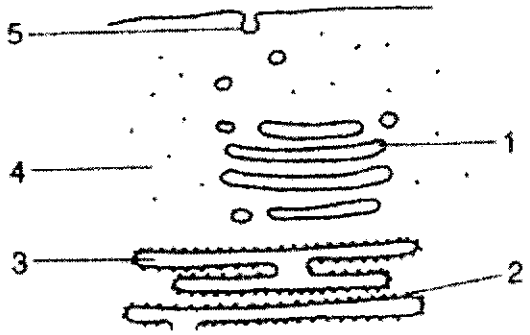
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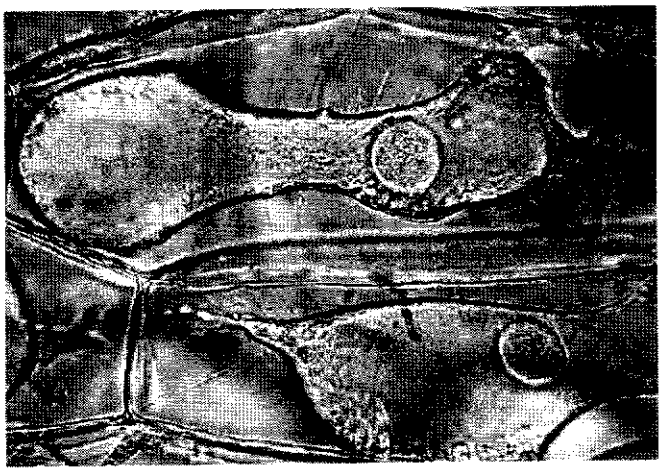
1 Radioactive amino acids are supplied to a cell that uses them to make enzyme.



Which route will the radioactive amino acid take?

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

2 A fleshy section of an onion bulb was taken and placed in liquid **P**.
The diagram below shows the cells from the onion bulb after half an hour.



Which of the following is most likely to be liquid **P**?

A oil
B distilled water
C dilute sugar solution
D concentrated sugar solution

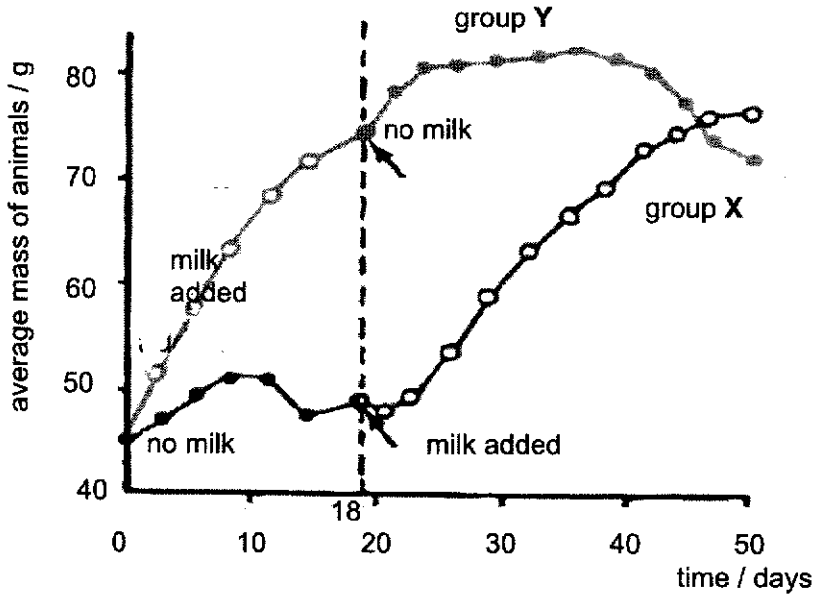
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3 According to the 'lock and key' hypothesis, which is the lock and which is the key for the enzyme lipase?

	key	lock
A	fatty acids	lipids
B	lipase	lipids
C	lipase	fatty acids
D	lipids	lipase

4 In the early 1900s, Frederick Hopkins divided young rats from the same litter into two groups, **X** and **Y**. He fed all rats with protein, sugar, starch, fat, mineral salts and water, but the rats in group **Y** received an additional 3 ml of milk each day. After 18 days, group **X** was given the milk instead of group **Y**. The results of the experiment are shown in the graph below.



Using information provided from the graph, what was the aim of the experiment?

A To show that milk contains lactose that is essential for the growth of rats.

B To show that milk contains substances that are essential for the growth of rats.

C To show that protein, carbohydrates, fat, mineral salts and water are essential for the growth of rats.

D To show that milk is more important than protein, carbohydrates, fat, mineral salts and water for the growth of rats.

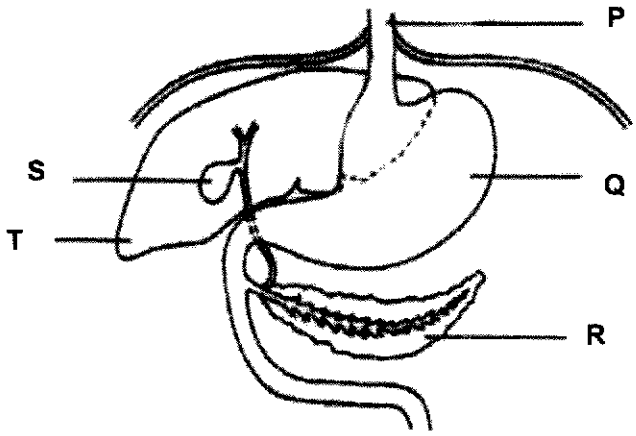
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5 In the human body, large molecules are synthesized from from small molecules.

Which row is correct for the small molocules required for synthesis of glycogen, lipids and proteins?

	glycogen	lipids	proteins
A	amino acids	glucose	glycerol and fatty acids
B	glycerol and amino acids	fatty acids	glucose
C	glycerol and fatty acids	glycerol and amino acids	fatty acids
D	glucose	glycerol and fatty acids	amino acids

For Questions **6** and **7**, refer to the following diagram of the alimentary canal



6 If the duct connecting structure **R** to the alimentary canal becomes blocked, which of the following would be the most likely consequence?

A decrease protein digestion
B decrease bile production
C increase blood glucose level
D increase carbohydrate digestion

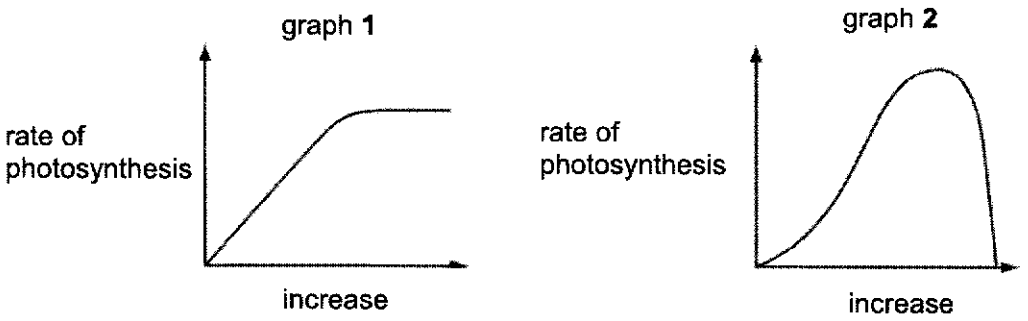
7 As a result of a serious infection, structure **T** of a patient had to be removed via surgery.

Which of the following would be the likely consequence?

A Lipids cannot be digested.
B Production of bile will be affected.
C Release of bile cannot be regulated.
D Fatty food substances can no longer be digested.

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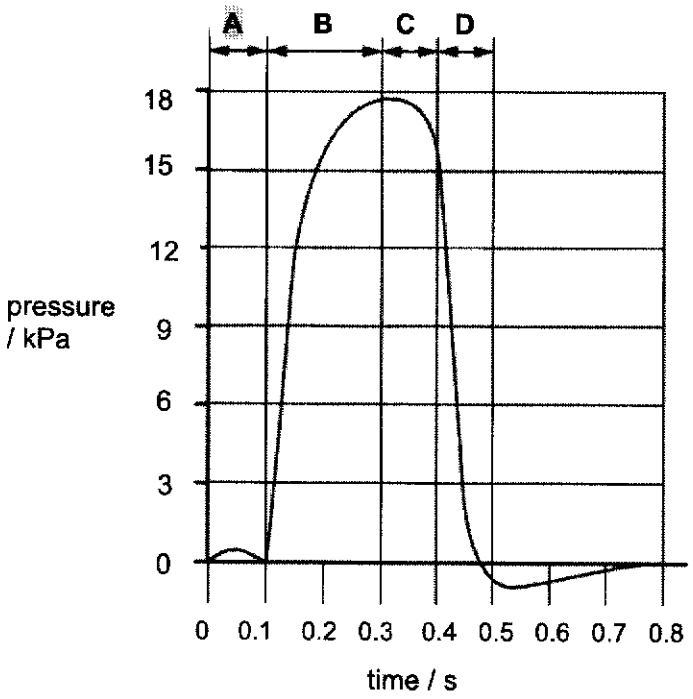
8 The graphs show how two different conditions affect the rate of photosynthesis.



Which conditions are represented in graphs **1** and **2**?

	graph **1**	graph **2**
A	carbon dioxide concentration	light intensity
B	carbon dioxide concentration	temperature
C	temperature	carbon dioxide concentration
D	temperature	light intensity

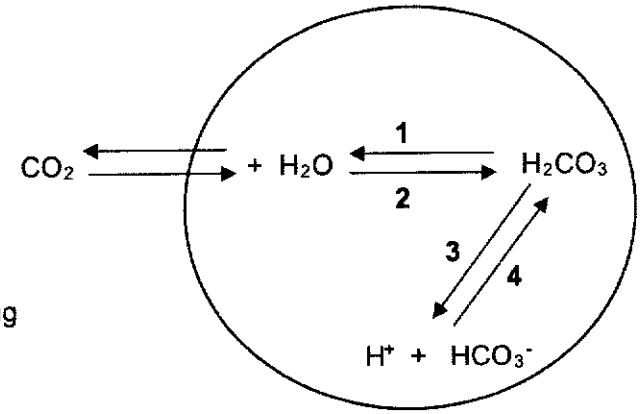
9 The graph shows changes in the blood pressure in the left ventricle of the heart.
During which period is the left atrium contracting?



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10 The diagram shows the reactions involved in the conversion between carbon dioxide and hydrogencarbonate ions in the blood.



Which numbered reaction(s) involve carbonic anhydrase?

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

11 Some effects of smoking are listed.

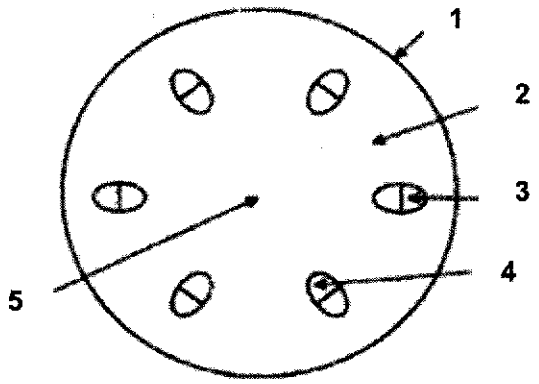
1 paralyses cilia
2 increases heart rate
3 increases mucus production
4 is additive
5 reduces the amount of oxygen in the blood

What effects are caused by nicotine?

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

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12 In an experiment, two plants were placed in bright sunlight. Plant **X** had its leaves exposed to radioactive carbon dioxide while plant **Y** was watered with radioactive water. The diagram below shows the typical cross-section of a stem.



Which labelled parts of plants **X** and **Y** would test positive for radioactivity after 48 hours?

	plant **X**	plant **Y**
A	**1**	**5**
B	**2**	**5**
C	**3**	**4**
D	**4**	**3**

13 What could increase the rate of water uptake by a shoot?

A covering the shoot with a black plastic bag

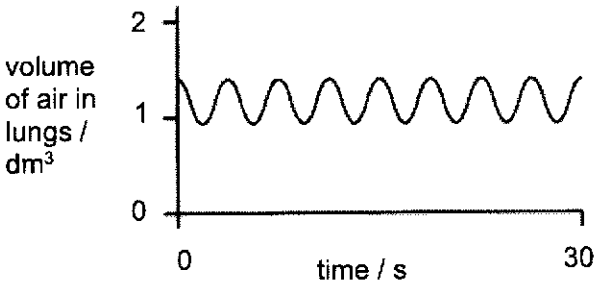
B covering the shoot with a clear plastic bag

C removing the leaves from the shoot

D shining a bright light onto the shoot

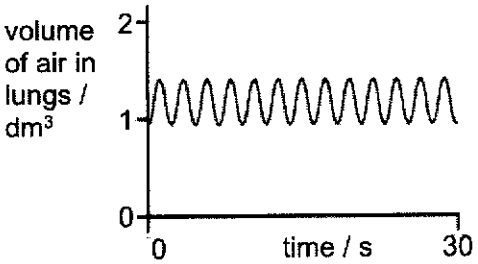
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14 The graph shows changes in the volume of air in the lungs of a person at rest, over a period of 30 seconds.

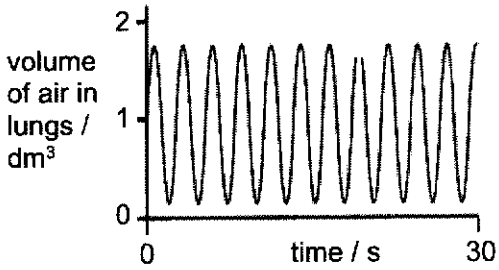


Which graph shows changes in the volume of air in the lungs of the same person immediately after he/ she has done five minutes of vigorous exercise??

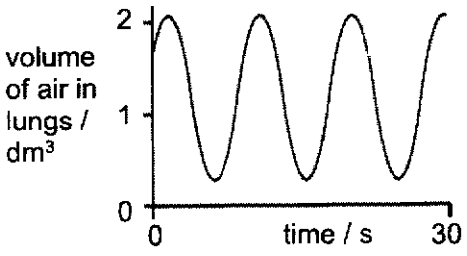
A



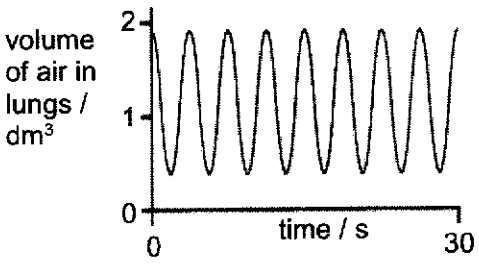
C



B



D



15 Which row states the end products, other than energy, of aerobic and anaerobic respiration in muscles correctly?

	aerobic respiration	anaerobic respiration
A	carbon dioxide and water	carbon dioxide only
B	carbon dioxide and water	lactic acid only
C	carbon dioxide only	lactic acid and carbon dioxide
D	lactic acid only	carbon dioxide and water

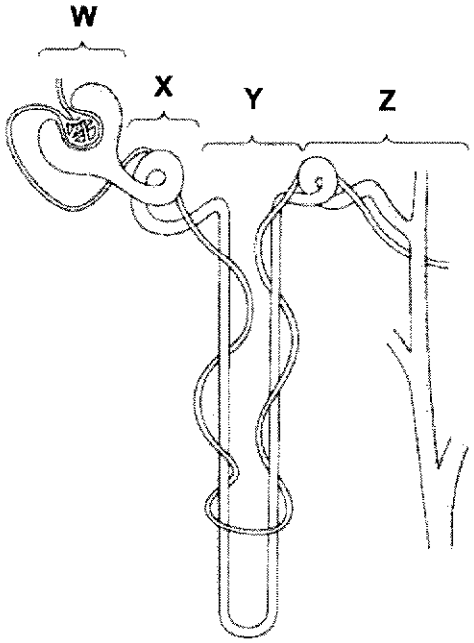
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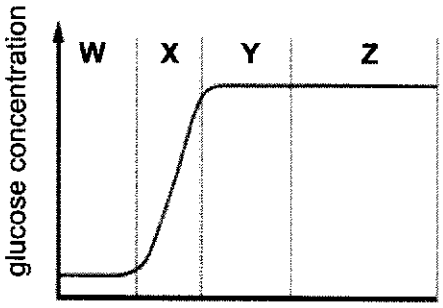
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16 The diagram shows a nephron and associated blood vessels.

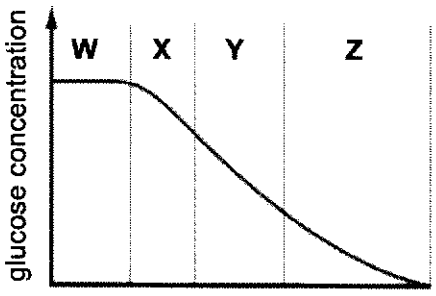


Which graph shows the concentration of glucose present in each part of the kidney tubule?

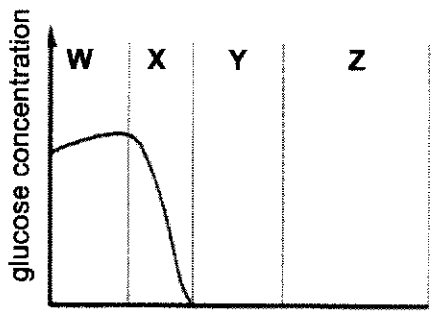
A



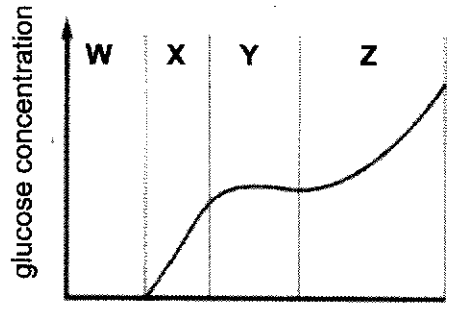
C



B

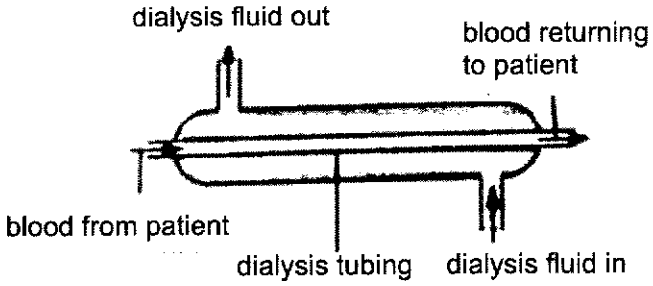


D



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17 An engineer has been asked to improve the efficiency of the dialysis machine shown below.



He has made the following list of recommendations:

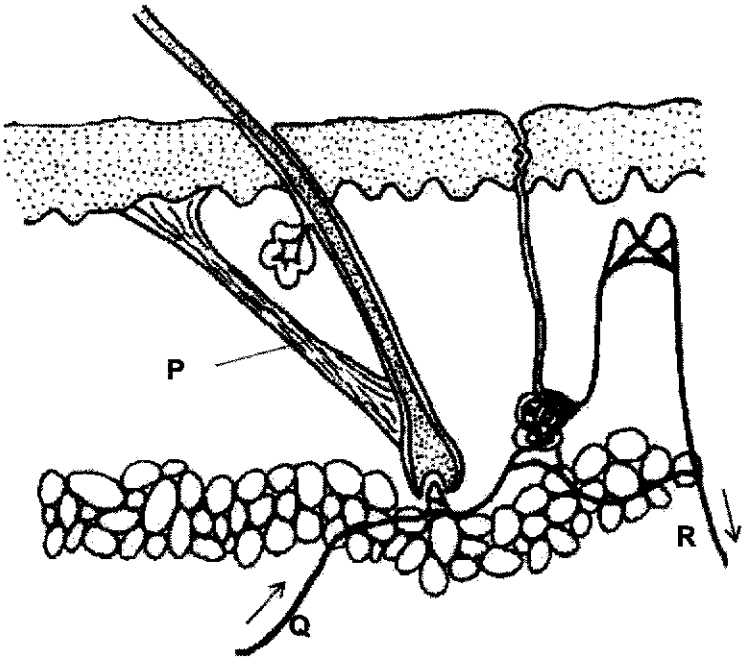
1 increase the rate of efficiency at which dialysis fluid is replaced.
2 increase the length of the dialysis tubing by coiling it
3 increase the rate which blood flows into the dialysis tubing
4 increase the thickness of the dialysis tubing

Which of the following recommendations is correct?

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

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18 The diagram shows a section through the human skin.



Which of the following changes occur when body temperature rises?

	concentration of carbon dioxide	concentration of urea	concentration of salt	P
A	higher at **R** than at **Q**	same at **Q** and **R**	lower at **R** than at **Q**	relaxes
B	higher at **R** than at **Q**	lower at **R** than at **Q**	lower at **R** than at **Q**	relaxes
C	lower at **R** than at **Q**	same at **Q** and **R**	higher at **Q** than at **R**	lies flat
D	same at **Q** and **R**	same at **Q** and **R**	same at **Q** and **R**	relaxes

19 Which factors are controlled by homeostasis?

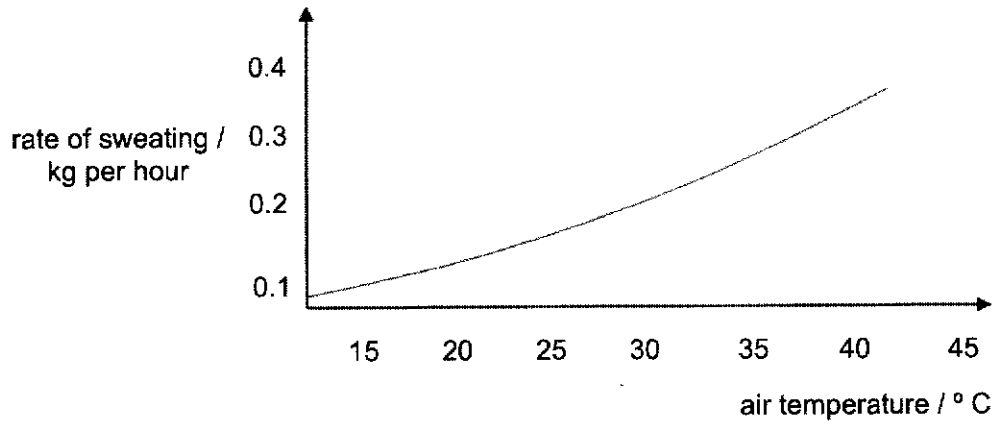
	glucose concentration in blood	water content in ileum	temperature in the stomach	pH in the duodenum
A	✓	✓	×	✓
B	✓	×	✓	✓
C	✓	×	✓	×
D	×	✓	✓	×

key ✓ = controlled by homeostasis
× = not controlled by homeostasis

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20 The graph shows the rate of sweating at different air temperatures for a mammal which has a body temperature of 38 °C.



Which of the following describes the mammal's internal body temperature as air temperature rises to 40 °C?

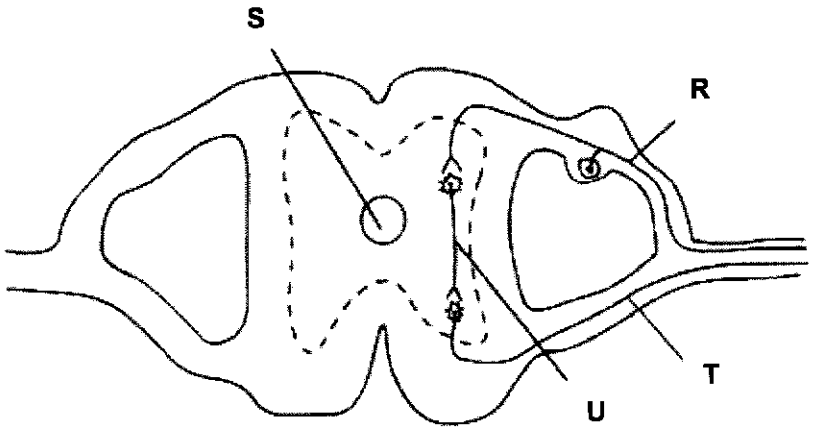
A Its temperature will decrease to 36 °C.

B Its temperature will decrease to 37 °C.

C Its temperature will be maintained at 38 °C.

D Its temperature will increase to 40 °C.

For Questions **21** and **22**, refer to the diagram which shows a transverse cross-section of the spinal cord with spinal nerves.



21 Which of the following represents the correct pathway of a reflex action?

A effector → **R** → **U** → **T** → receptor

B effector → **T** → **U** → **R** → receptor

C receptor → **T** → **U** → **R** → effector

D receptor → **R** → **U** → **T** → effector

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22 If neurone **U** is severed and the person's hand touches a hot object, which of the following would happen?

A The person cannot feel the sensation of pain.

B Pain receptors cannot be stimulated to produce nerve impulses.

C The person is still able to consciously withdraw hand from the hot object.

D The motor neurone is still able to receive nerve impulses from the pain receptors.

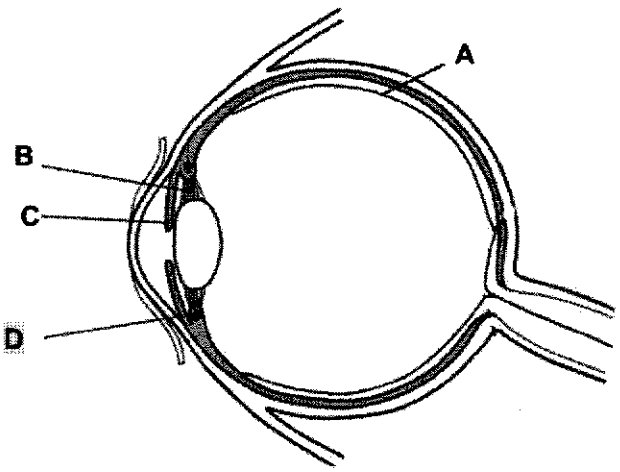
23 A man stands 10 metres away from a sign and can see it clearly. He walks towards the sign and stops 0.5 metres from it.

Which changes occur in his eyes so that the sign is still in focus?

	ciliary muscles	suspensory ligaments	lens becomes
A	contract	slacken	more convex
B	contract	becomes taut	less convex
C	relax	slacken	less convex
D	relax	becomes taut	more convex

24 The diagram below shows a cross-section of a human eye.

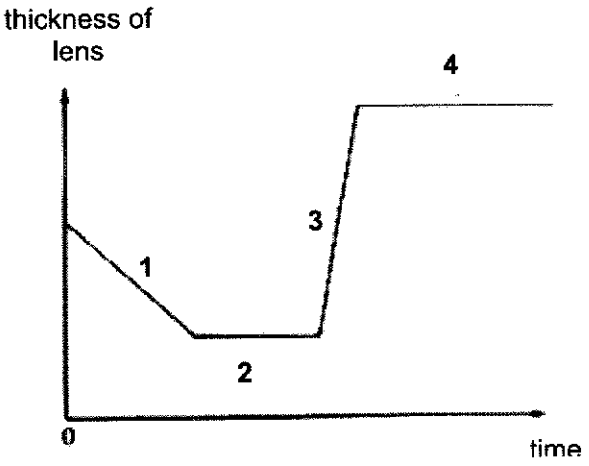
Which structure contains muscles which contract to produce a focused image on the retina?



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25 The graph below shows the changes in the thickness of the lens when a man looked at an object which either moved toward/away from him or remained stationary.



In which stage was the object moving away from the observer?

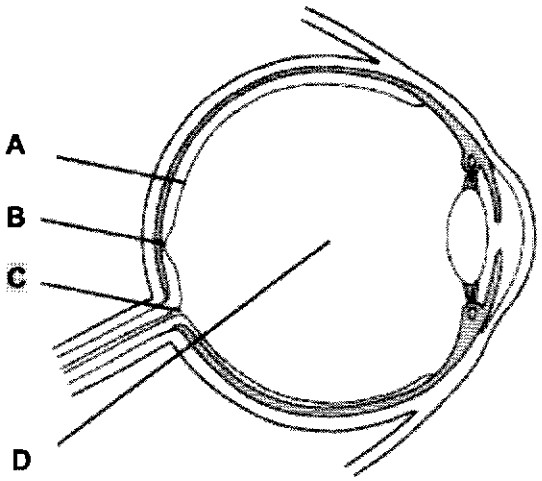
A 1 **B** 2 **C** 3 **D** 4

26 A student draws a dot and a cross as shown.



With his right eye closed, the student looks hard at the cross with his left eye. He brings the drawing towards him until the dot disappears.

On which point inside his eye does the image of the dot fall, when it disappears?



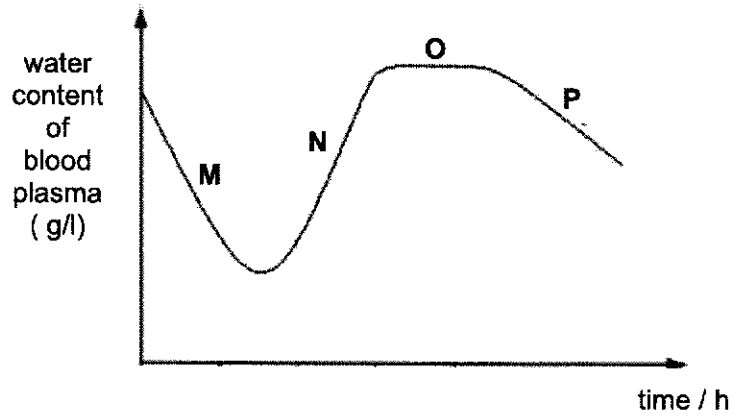
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27 How is the concentration of glucose in the blood regulated?

	blood glucose concentration	pancreas stimulated to produce	liver converts	blood glucose concentration	pancreas reduces secretion of
A	fall	glucagon	glycogen to glucose	rise	glucagon
B	fall	insulin	glucagon to glucose	rise	insulin
C	rise	glucagon	glucose to glucogen	fall	glucagon
D	rise	insulin	glycogen to glucose	fall	insulin

28 The graph shows the effect of antidiuretic hormone (ADH) on the regulation of water content in blood plasma.

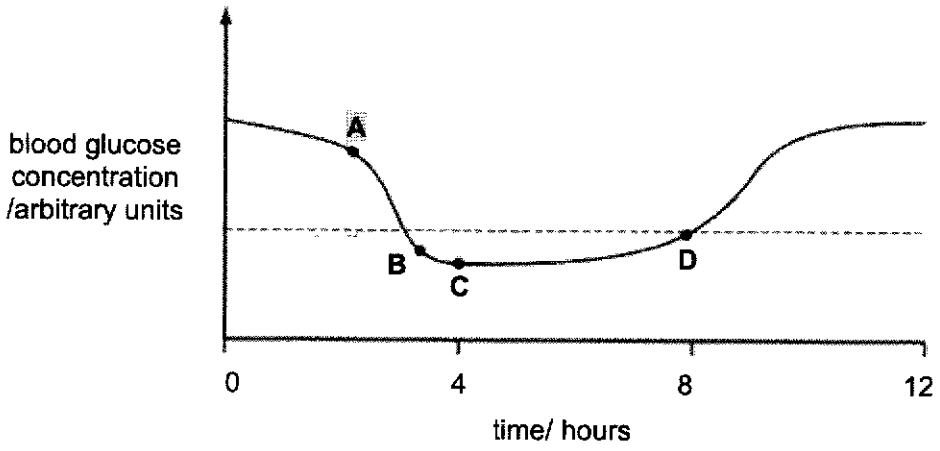


Which part/s of the graph show/s the effects of increased ADH secretion?

A **M** only **B** **M** and **P** **C** **N** only **D** **N** and **O**

29 A person with diabetes mellitus is receiving treatment with insulin injections. The graph shows how this person's blood glucose concentration changed during part of one day.

At what point was an insulin injection given?

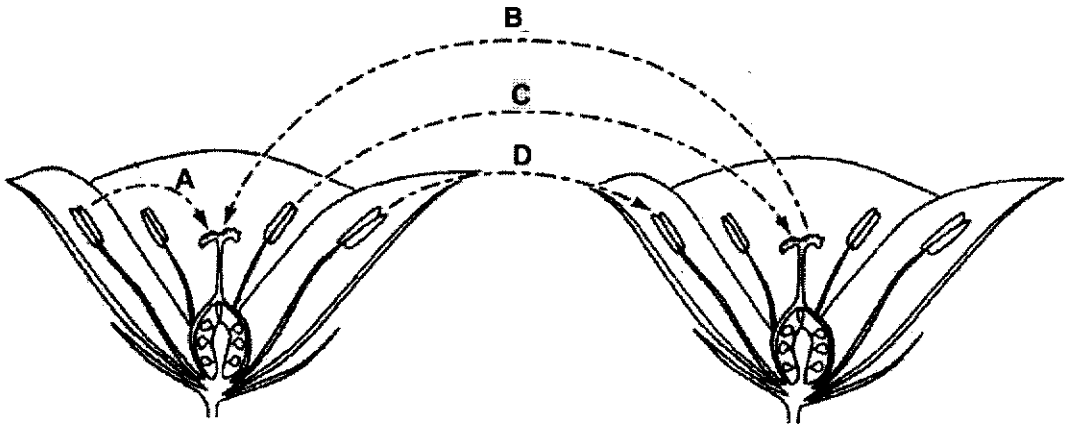


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30 The diagram shows two flowers of the same species.

Which arrow (**A**, **B**, **C** or **D**) represents cross-pollination?



31 The following data regarding two different plant species was obtained.

plant	average diameter of pollen grain /mm	average mass of pollen grain /mm	texture of pollen grain
X	15	200	smooth, dry
Y	45	1800	spiky, sticky

The following conclusions were made from the data above.

1 Plant **X** is more likely to be cross-pollinated.
2 Plant **Y** is more likely to be self-pollinated.
3 Plant **X** is more likely to have stigmas which have a larger surface area than those of plant **Y**.
4 Plant **Y** is more likely to produce a larger number of pollen per unit time to achieve the same efficiency of pollination as plant **X**.

Which conclusion(s) is/are valid?

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

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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, and insects were allowed to visit all the flowers freely.

Which group of flowers, **A**, **B**, **C** or **D**, would be most successfully cross-pollinated?

groups of flowers	stigma	anthers	petals
A	left intact	left intact	removed
B	left intact	removed	left intact
C	removed	left intact	left intact
D	removed	removed	removed

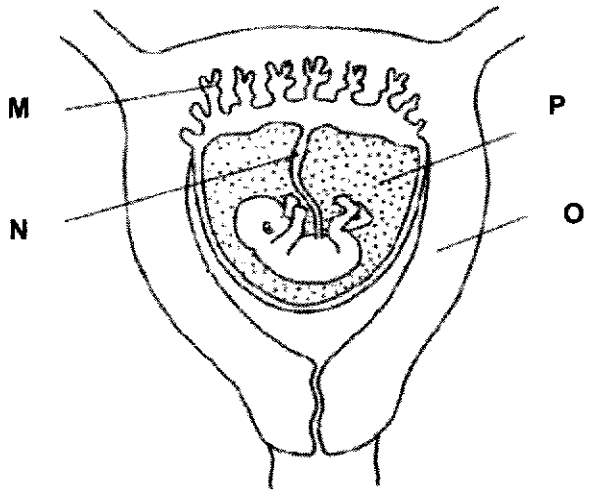
33 A plant has 20 chromosomes in its leaf cells. The plant reproduces both sexually and asexually.

What is the correct number of chromosomes in the gametes and in the cells used for asexual reproduction?

	number of chromosomes	
	gametes	cells used for asexual reproduction
A	10	10
B	10	20
C	20	10
D	20	20

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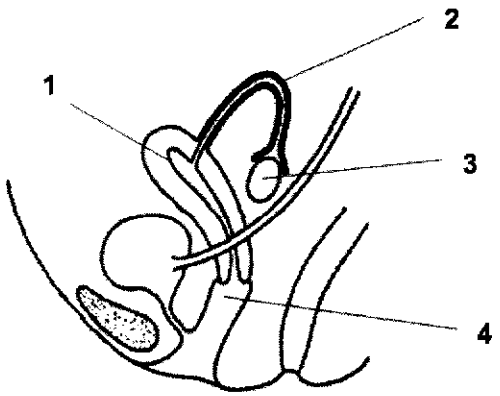
34 The diagram shows part of the womb of a pregnant woman.



Which of the following statements is correct?

A Progesterone is needed to maintain structure **M**.
B Structure **O** only protects the foetus from fluctuations in temperature.
C Structure **P** contains the gaseous water products of the foetus.
D The artery in **N** transports glucose and amino acids to the foetus.

35 The diagram below shows the side view of the female reproductive system.



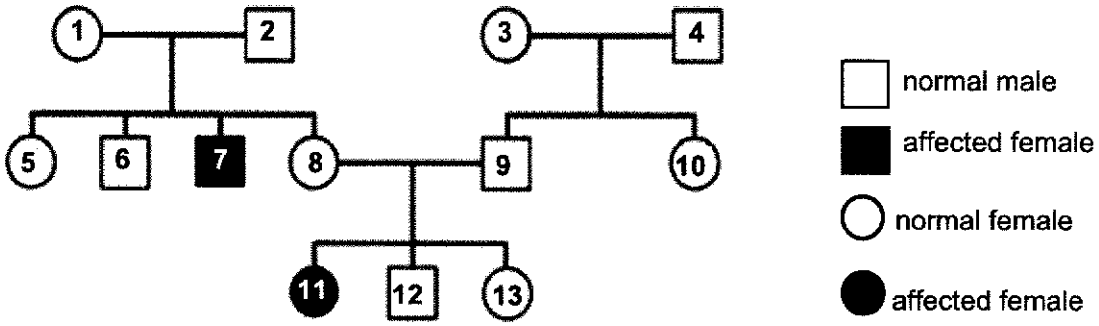
What process takes place at the labelled parts?

	fertilization	implantation	sperms deposition
A	1	4	2
B	2	1	4
C	2	3	4
D	3	2	1

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36 Phenylketonuria (PKU) is a condition where the affected individual is unable to produce the enzyme phenylalanine hydroxylase. If left untreated, it can lead to intellectual disability, seizures, and other serious medical problems. PKU is inherited as an autosomal recessive condition.

The chart below shows a family where two of the members have PKU.



Which of the following members are carriers of the PKU gene?

A **2** and **8**
B **3** and **10**
C **4** and **11**
D **7** and **12**

37 Tay Sachs disease, which usually causes death in young children by the age of four, is caused by an abnormal allele of a single gene.

Which one of the following is the most likely reason why this disease has persisted in the human population?

A It is caused by a dominant allele that can be passed on more successfully.
B It is caused by a recessive allele that does not display its effect in carriers.
C The disease can be transmitted to other individuals via means of fluid exchange.
D The victims pass on their genes to subsequent generations.

38 In a conversation, Eileen and Eddie made four statements about themselves.

	Eddie	Eileen
1	I am male.	I am female.
2	I am 172 cm tall.	I am 157 cm tall.
3	I am not very good at maths.	I am good at maths.
4	My blood group is B.	My blood group is O.

Identify the statements that describe characteristics consistent with discontinuous variation?

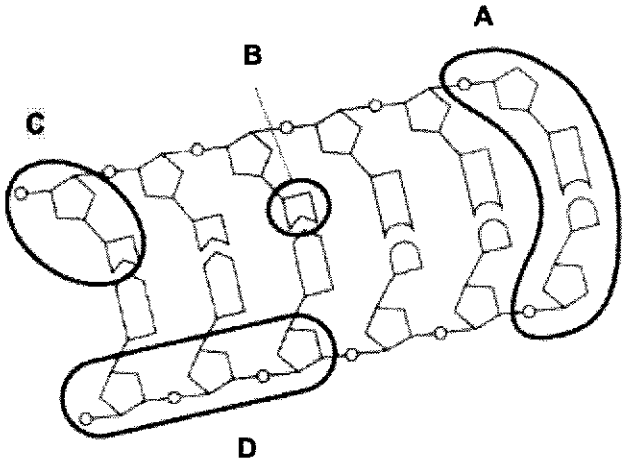
A **1** and **2** **B** **1** and **4** **C** **2** and **3** **D** **3** and **4**

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39 The diagram shows part of a DNA molecule.

Which part is a nucleotide?



40 The statements describe the events during the mitotic cell cycle.

1 Chromosomes migrate to opposite poles of the spindle.
2 Chromosomes arrange themselves at the equator of the spindle.
3 Chromosomes condense and the nuclear membrane disappears.
4 Centromeres divide.

What is the correct order of these events in the mitotic cell cycle?

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

END OF PAPER

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4E Biology Preliminary Exam 2020 ANSWER SCHEME

Paper 1 : Multiple Choice Questions (40 marks)

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

Paper 2 - SECTION A: Short Answer Questions (50 marks)

Answer all questions in the spaces provided.

1 **(a)** **(i)** Iodine solution would remain yellowish brown and Benedict's solution remain blue. [1]
It takes time for digestion to starch to occur./ time for diffusion to occur[1]
Or Starch and glucose is not present

(ii) Benedict's solution turn a brick red/orange precipitate while the iodine solution remains yellowish brown. [1]
Amylase in saliva would digest the starch into /glucose maltose which **small enough to diffuse** through the partially permeable membrane. [1]

(b) **(i)** Wall of small intestine/ileum/ villi of small intestine [1]

(ii) Blood / blood plasma / blood capillaries of villi [1]

2 **(a)** Fatty acids are produced during the digestion of lipids [1]

Fatty acids are acidic /is an acid [1], causing the fall in pH value

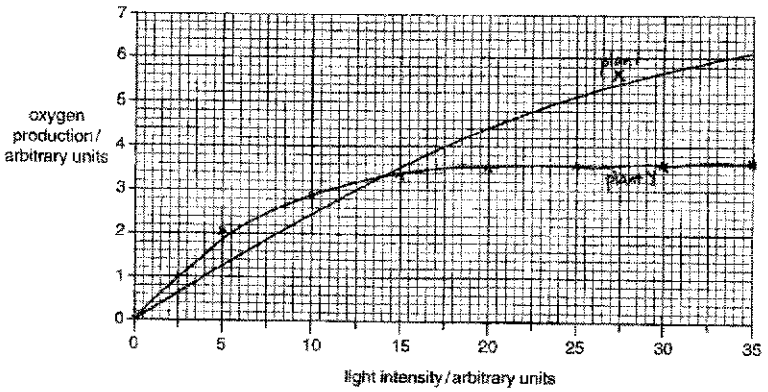
(b) Bile emulsifies lipids [1]

Increasing the surface area to volume ratio of lipid droplets thus, increasing the rate of digestion of lipids. [1]

(c) C is the control to show that bile salts do not digest lipids / lipase is responsible for the lowering of the pH of the reaction mixture. [1]

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3 (a)



Smooth curve drawn [1]

(b) Oxygen production is higher in plant Y at lower light intensities [1]

From the graph above it can be seen that oxygen production is higher in plant X at higher light intensities [1]

The rate of oxygen production for plant X increases with increase in light intensity [1]

(c) Plant Y [1]

The rate of photosynthesis is higher in Y at low light intensities [1]

The rate of oxygen production for plant Y becomes constant at high light intensity /after light intensity of 20 arbitrary units. [1]

4 (a) The velocity of the blood decreases as the total cross sectional area of the blood vessel increases. [1]

Accept vice versa

(b) The rate of blood flow in the capillaries is slow. [1]
This is to ensure sufficient time for diffusion of gases and nutrients between the blood plasma in the capillaries and the tissue cells [1]

R- diffusion of gases/gaseous exchange as this refers only to capillaries in the lungs

(c) Arteries have thick and elastic muscular wall which are able to withstand the fluctuations in blood pressure [1]

(d) A cut artery can be distinguished from a cut vein by looking for an uneven flow that reflects the pulse/ blood is spurting in arteries instead of oozing in veins. [1]

5 (a) In flower A, stigma is located above anther whereas in flower B, stigma is located below the anther. [1]

In flower A, ovary is located above the receptacle whereas in flower B, ovary is enclosed by the receptacle. [1]

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(b) **(i)** Flower B. [1]

Pollen grains from the anthers are able to fall directly onto the stigma as the anthers are located above the stigma. [1]

(c) There is greater/more genetic variation among the offsprings [1]
The seeds are more viable and are better adapted to changes in the environment. [1]
More resistant to diseases. [1]

5 **(a)** **(i)** Progesterone. [1]

(ii) The concentration of X remains high beyond day 28.[1]
X is needed to maintained the uterine lining to be thick and richly supplied with blood [1] for the implantation of the embryo . The woman may be pregnant [1]

(b) **(i)** A is placenta. [1]

(ii) Any one answer -1m
In placenta, nutrients (e.g glucose, amino acids, etc) and oxygen to diffuse from the maternal blood into fetal blood capillaries

antibodies to diffuse from the maternal blood into the fetal blood. The antibodies protect the embryo against certain diseases.

In placenta, metabolic wastes e.g urea, carbon dioxide) to diffuse from the fetal blood to the maternal blood

(c) **(i)** The child is a male/ boy [1]
It has a pair of XY sex chromosomes [1]

(ii) There is an extra chromosomes at 18th pair of chromosomes. [1]

7 **(a)** **(i)** L: Chromatin thread N: Spindle fibre

M: Nucleolus O: Centromere

2 correct- 1m

(ii) A: Telophase C: Prophase

B: Metaphase D: Anaphase

2 correct- 1m

(b) To ensure the number of chromosomes is maintained in the daughter cells/ daughter cell is also diploid/ daughter cell have same amount of DNA as parent cell. [1]

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(c) Any 2 – 2m

Mitosis	Meiosis
Daughter cells used in growth of organism or repair of tissue	Daughter cells develop nto gametes; involved in sexual reproduction
The daughter cells are diploid/ have the same number of chromosomes have parent cell	The daughter cells are haploid/ have half the number of chromosome as parent cell
Daughter cells are genetically identical to parent cell	Genetic variation occurs in the daughter cells/ Daughter cells are not genetically identical to parent cell

8 **(a)** X: deoxyribose Z: nitrogenous base

Y: phosphate group

2 correct- 1m, 3 correct—2m

(b) Transcription [1]

(c) ATGAAAACCTGGCTTT

(d) According to the rule of base pairing, adenine pair with thymine and cytosine pair with guanine in the ratio 1 : 1.

Percentage of cytosine and guanine = 100 – (28 +28) = 44%

Percentage of cytosine= 44/2 = 22 % [1]

Section B

9 **(a)** Blood glucose of the non-diabetic person was 4.2 mmol/dm^3 [1] , much lower [1] than that of the diabetic person which reached 6.5 mmol/dm^3. [1]

The healthy/non-diabetic person's pancreas/Islets of Langerhans cells produce insulin [1] which convert the excess glucose to glycogen,[1] for storage in the liver and muscles and the permeability of cell membrane to glucose increases

The diabetic was unable to do so as his pancreas was unable to produce insulin [1] . Hence it rises up to 6.5mmol/dm^3.

(b) Glucose is oxidized/used [1]during aerobic respiration [1] to release energy [1] used for muscular contractions during exercise.
Or

As a result, his blood glucose dropped from 8 mmol/dm^3 to 2.5 mmol/dm^3.

Or
He was unable to raise his blood glucose because there is no glycogen stored in his liver.

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(c) He may have had a soft drink/ sweets/ after exercise or tea at 4pm. [1]
Accept any reasonable answer.

10 **(a)** I^A, I^B, I^O all correct -1m

(b) I^A, I^O [1]

Individual 6 has blood group O is recessive [1] so she must received one I^O allele from individual 1. [1]

(c) Let I^A, I^B be the dominant allele for ABO blood group
Let I^O be the recessive allele for ABO blood group } minus 1m from overall

Parental phenotype Blood group O X Blood group AB

Genotype of parents $I^B I^O$ X I^A, I^B **[1]**

Gametes I^B I^O I^A I^B **[1]**

Offspring Genotype I^A, I^B I^B, I^B I^A, I^O I^B, I^O **[1]**
(correct crossing

offspring phenotype grp AB, grp B, grp A, grp B **[1]**

Phenotypic ratio Group AB : Group B : Grp A
1 : 2 1 **[1]**

From diagram the chance of getting blood group B is ½.
And chance of getting a boy is ½.
Hence, chance of getting a boy with blood group B is ½ x ½ = ¼. **[1]**

11 EITHER

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11 (a) A transgenic organism is a plant or animal that has a foreign gene [1] inserted into its DNA. [1]

Example : [1]
plant that has a pest resistant gene/ genetically modified food/ rice that can produce Vit A/ Bt corn (gene for *Bacillus thurigensis* toxin inserted into corn)

(b) Max 7 m

1.Obtain the human chromosome containing the insulin gene. [1]

2.Cut the gene using a restriction enzyme to produce sticky ends. [1]

3.Obtain a plasmid (bacterial DNA) from a bacterium. [1]

4Cut the plasmid with the same restriction enzyme to produce complementary sticky ends. [1]

5.The insulin gene is inserted into the plasmid using an enzyme DNA ligase. [1]

6.Mix the plasmid with E.coli bacteria. [1]

7.Apply temporary heat or electric shock to open up the cell membrane so that the plasmid can enter the bacterium. [1]

8. Put the bacterium in a fermenter to grow and insulin will be produced by the gene. [1]

11 OR

Excretory organs can be kidney/skin/ liver/lungs but both a) and b) must be the same organ.

11 (a) Kidney [1] plays a part in osmoregulation this maintaining constant water potential of the blood.

When blood plasma water potential decreases below normal, the pituitary gland secretes more ADH [1] into bloodstream to increase the permeability of the cells in the walls of the collecting duct.[1]

More water is reabsorbed [1] and decreases the volume of urine produced [1] and returned the blood water potential back to normal.

Or
Kidney [1] plays a part in osmoregulation this maintaining constant water potential of the blood.

When water potential in blood plasma increases above normal, the pituitary gland secretes less ADH [1] so cells in the walls of the collecting duct are less permeable to water [1] and amount of water reabsorbed by the kidney tubules decreases. [1]

A greater volume of water [1] in urine is produced and removed out of the body hence decreasing the water potential back to normal.

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(b) Kidney prevents metabolic waste substances and toxic materials to accumulate in the body. [1]

At the glomerulus, there is hydrostatic blood pressure due to the wider afferent arteriole and narrower efferent arteriole [1],

hence ultrafiltration takes place where small molecules like glucose and urea pass [1] through the partially permeable from the glomerular blood capillaries into the Bowman's capsule.

Selective reabsorption of useful substances such as mineral ions, salts, glucose and water occurs at the kidney tubules. [1]

The unwanted excretory products such as urea and excess water collect at the collecting duct are pass out via the urethra as urine. [1]

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