YUYING SECONDARY SCHOOL
PRELIMINARY EXAMINATION
Secondary 4

NAME			
CLASS		**REG. NO**	

BIOLOGY 6093/1

Paper 1 **22 August 2024**

1 hour

Additional Materials: Multiple Choice Answer Sheet **Setter: Mr Darren Kung**

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class and register number on this question booklet and the separate Answer Sheet.

There are **forty** questions on this paper. Answer **all** questions.
For each question there are four possible answers **A, B, C** and **D**.
Choose the one you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved calculator is expected, where appropriate.

40

For Examiner's Use	
Total	

This document consists of **14** printed pages.

1 Which organelle is **not** correctly paired with its cellular function?

	organelle	function
A	endoplasmic reticulum	transports proteins to the Golgi body
B	Golgi body	stores proteins and carbohydrates
C	mitochondrion	releases energy
D	ribosome	joins amino acids together

2 Which statement about the muscle cells is **incorrect**?

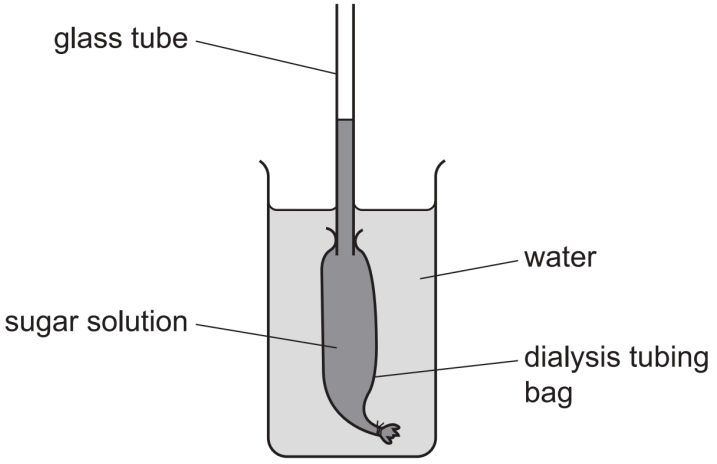
A They contain few mitochondria.

B They contain many nuclei.

C They contract and relax to produce movement.

D They have contractile protein fibres.

3 The diagram shows an experiment demonstrating osmosis using a dialysis tubing bag.



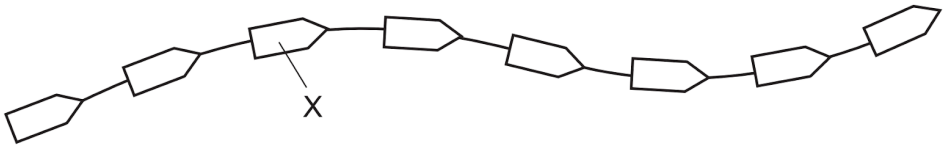
After 30 minutes, the level of the liquid in the glass tube goes .....1..... because the water had a .....2..... water potential than the sugar solution.

Which words correctly complete the statement?

	1	2

A	down	lower
B	down	higher
C	up	lower
D	up	higher

4 The diagram shows part of a protein molecule.



What does X represent?

A amino acid

B fatty acid

C glycerol

D sugar

5 Which food-testing solution shows a positive result when it turns from blue to purple?

A Benedict's solution

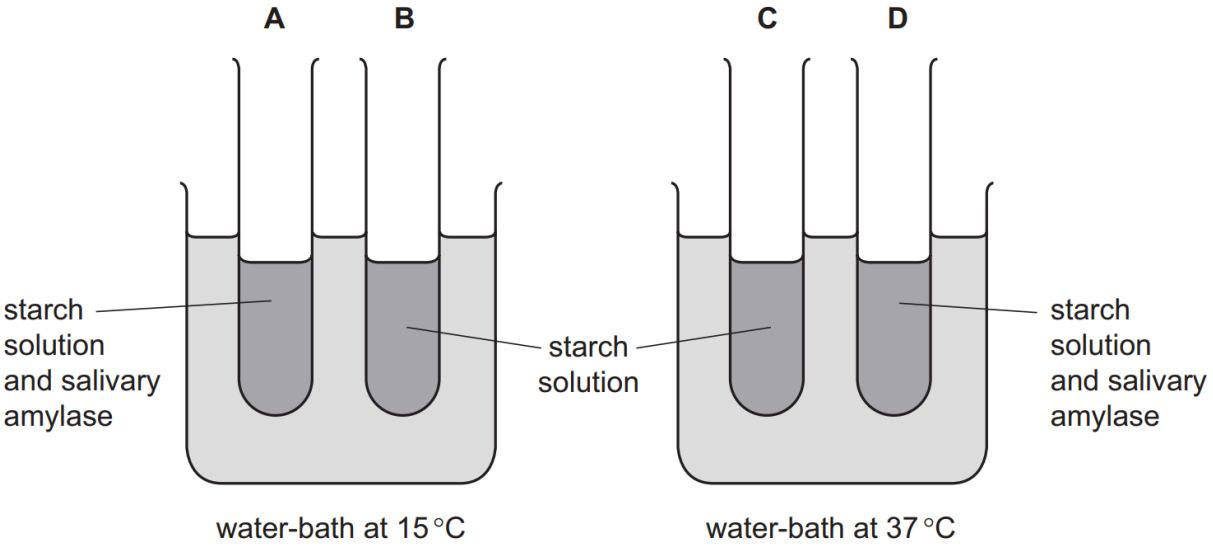
B biuret solution

C ethanol

D iodine solution

6 The apparatus shown is used for an experiment on starch digestion.

Which test-tube contains the most sugar after 20 minutes?



7 Which of the following is **not** an effect of alcohol consumption on the body?

A brain damage

B decreased reaction time

C decreased self-control

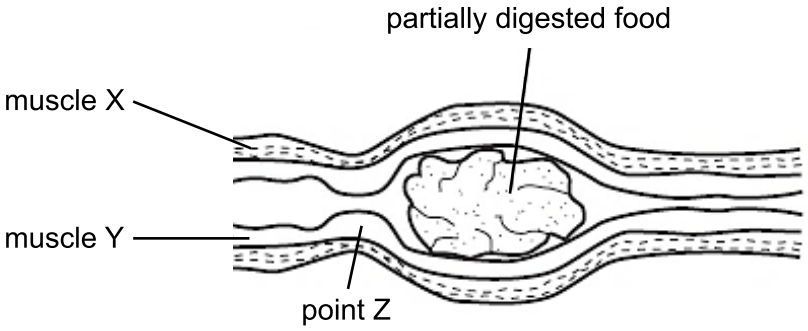
D liver disease

8 Which row correctly indicates the structural properties of a villus that allow the rate of absorption in the small intestine to increase?

	rich network of capillaries	folding of the cell membrane	thick surface epithelium
A	✓	✓	✓
B	✓	✓	×
C	✓	×	✓
D	×	✓	×

key
= yes
= no

9 The diagram shows a section of the alimentary canal pushing along partially digested food.



Muscle Y is contracting at point Z.

Which row correctly identifies the muscles and direction of movement of the partially digested food?

	muscle X	muscle Y	direction of movement
A	circular	longitudinal	left to right
B	circular	longitudinal	right to left
C	longitudinal	circular	left to right
D	longitudinal	circular	right to left

10 Which statements describe how the structures in the circulatory system function?

1 has a muscular pump to push blood into vessels

2 valves ensure one-way blood flow

3 veins to take blood away from the heart

4 has vessels to return blood to the heart

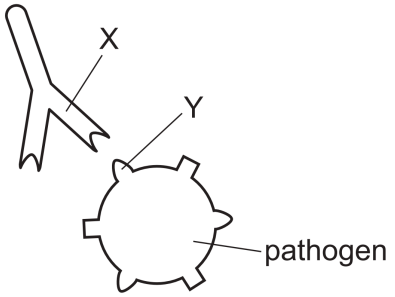
A 1, 2 and 3

B 1, 2 and 4

C 1, 3 and 4

D 2, 3 and 4

11 The diagram shows one of the mechanisms used by the immune system to destroy a pathogen that enters the body.

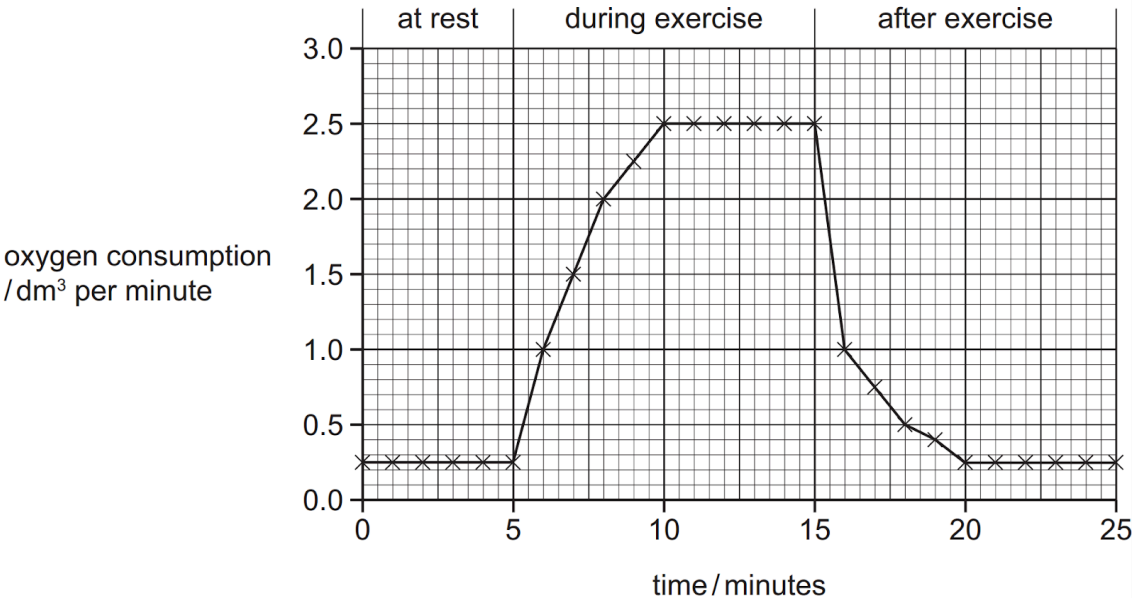


Which row describes the structures involved?

	structure X	X is made by	structure Y
A	antigen	lymphocytes	antibody
B	antigen	phagocytes	antibody
C	antibody	lymphocytes	antigen
D	antibody	phagocytes	antigen

12 A student measured his oxygen consumption before, during and after exercise.

The results are shown in the graph.



At which time is the oxygen debt being removed?

A 5–10 minutes

B 5–15 minutes

C 15–20 minutes

D 20–25 minutes

13 During inspiration, the processes listed take place.

P volume of the chest cavity increases

Q air rushes into the lungs

R pressure in the lungs decreases

S external intercostal muscles contract

T diaphragm moves down, ribs move upwards and outwards

What is the correct sequence for these processes?

A Q → P → S → R → T

B S → T → P → R → Q

C Q → P → S → T → R

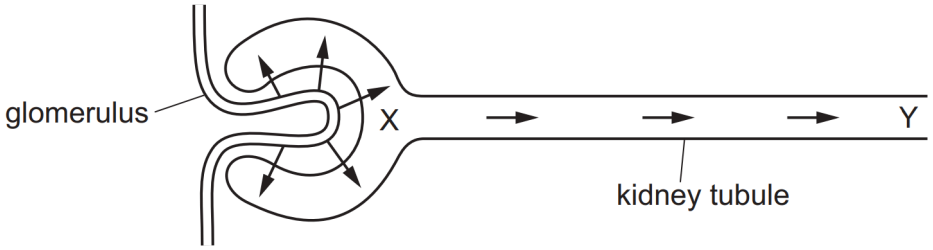
D S → Q → R → P → T

14 Which row describes the functions of the bladder, kidneys and liver?

	production of urea	excretion of urea	storage of urine
A	liver	bladder	kidneys
B	bladder	kidneys	liver

C	liver	kidneys	bladder
D	kidneys	liver	bladder

15 Which statement correctly explains the difference in amino acid concentration in the kidney tubule between X and Y?



A Amino acid concentration is higher at X than at Y because amino acids move out of the kidney tubule by osmosis.

B Amino acid concentration is higher at X than at Y because amino acids have been actively transported out of the kidney tubule.

C Amino acid concentration is higher at Y than at X because amino acids diffuse into the kidney tubule.

D Amino acid concentration is higher at Y than at X because amino acids have been actively transported into the kidney tubule.

16 Which row shows where glucose will be found in the body of a healthy human after eating a meal?

	renal artery	renal vein	glomerulus	nephron	ureter
A	yes	no	yes	yes	yes
B	yes	yes	no	no	no
C	yes	yes	yes	yes	no
D	no	yes	no	no	yes

17 Which statement best describes dialysis fluid entering a dialysis machine?

A It has a higher concentration of urea than the blood entering the dialysis machine.

B It has a higher concentration of urea than the blood leaving the dialysis machine.

C It has a lower concentration of urea than the blood entering the dialysis machine.

D It has a lower concentration of urea than the blood leaving the dialysis machine.

18 At which part of the kidney tubule does anti-diuretic hormone (ADH) have its effect and what effect does it have?

	part	effect

A	glomerulus	less water reabsorbed
B	glomerulus	more water reabsorbed
C	collecting duct	less water reabsorbed
D	collecting duct	more water reabsorbed

19 Which changes occur in an eye when it focuses on distant objects?

	ciliary muscle	lens	suspensory ligaments
A	contracts	thicker	slacken
B	relaxes	thinner	tighten
C	contracts	thicker	tighten
D	relaxes	thinner	slacken

20 A boy accidentally touches a very hot object and immediately takes his hand away.

What is the effector in this reflex action?

A a heat receptor in his hand

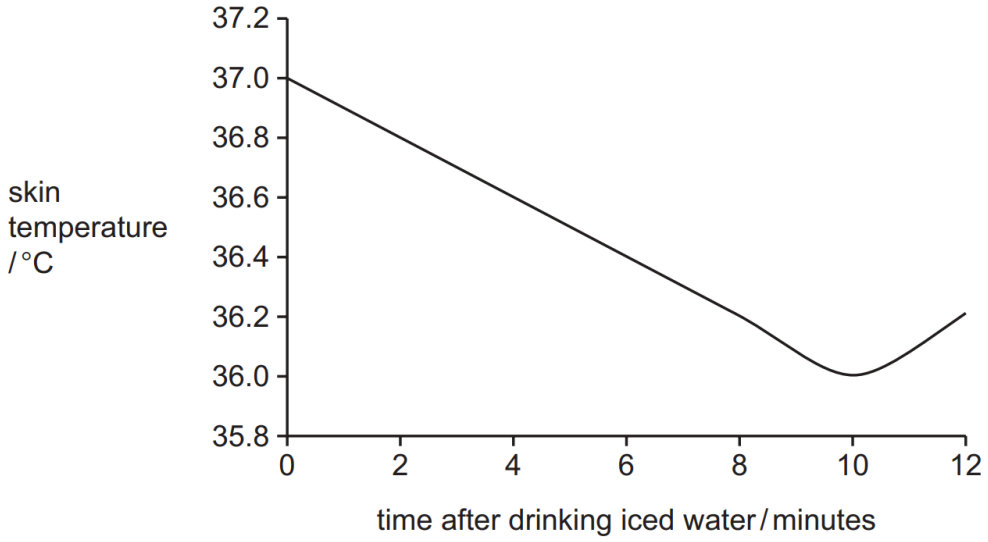
B a motor neurone

C a muscle in his arm

D the spinal cord

21 A scientist investigated the effect of drinking iced water on skin temperature. She drank a large volume of iced water and monitored the temperature of her skin.

The results are shown on the graph.



Which explanation of the change in skin temperature during the first 10 minutes is correct?

A Vasoconstriction occurred, increasing blood flow to the skin.

B Vasoconstriction occurred, reducing blood flow to the skin.

C Vasodilation occurred, increasing blood flow to the skin.

D Vasodilation occurred, reducing blood flow to the skin.

22 Which is a common symptom of both influenza and pneumococcal disease?

A cough

B nausea

C runny nose

D skin rash

23 Which of the following is present in a virus but **not** in a bacterium?

A cell wall

B nucleus

C protein coat

D ribosome

24 Which row shows structures that are present in **both** palisade mesophyll cells and root hair cells?

	cell wall	chloroplasts	cytoplasm	vacuole
A	✓	✓	×	×

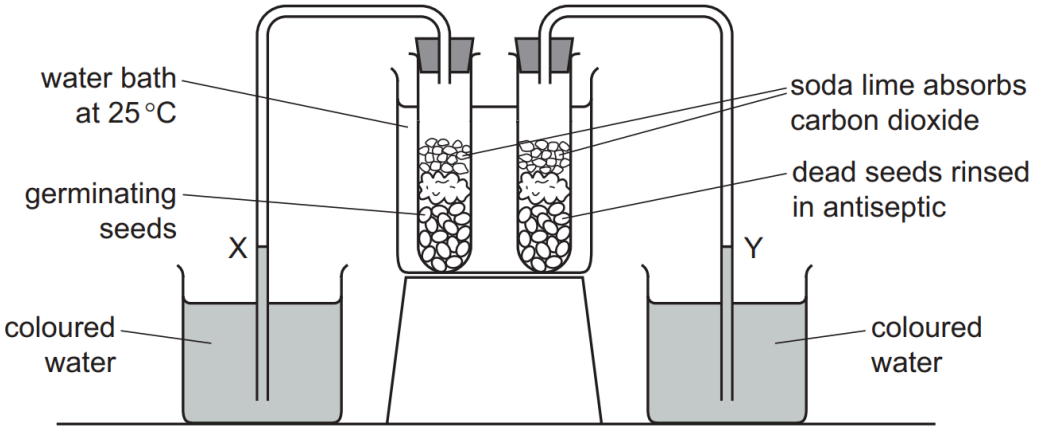
key

= present

= absent

B	×	✓	×	✓
C	×	×	✓	✓
D	✓	×	✓	✓

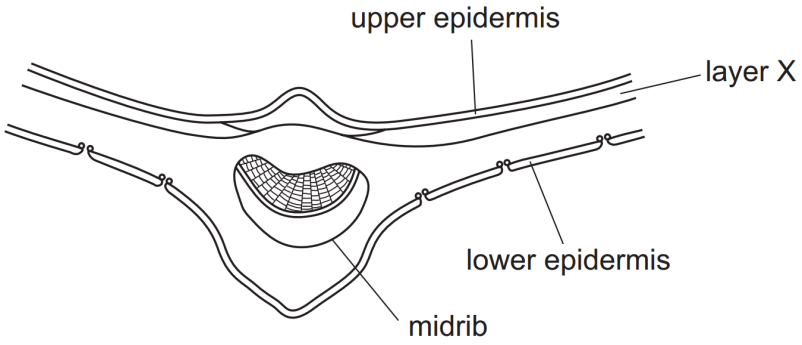
25 An experiment is set up to investigate the uptake of oxygen by germinating seeds.



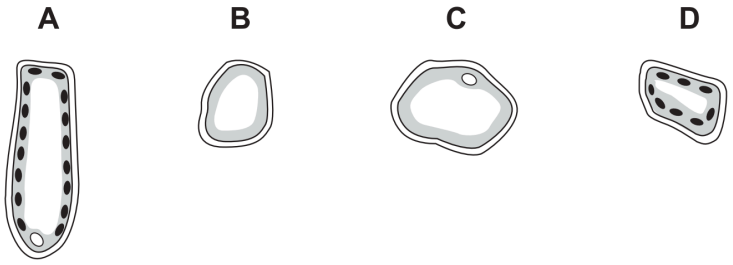
What happens to the levels of the coloured water at X and Y?

	X	Y
A	falls	rises
B	falls	unchanged
C	rises	falls
D	rises	unchanged

26 The diagram shows a cross-section of part of a leaf.

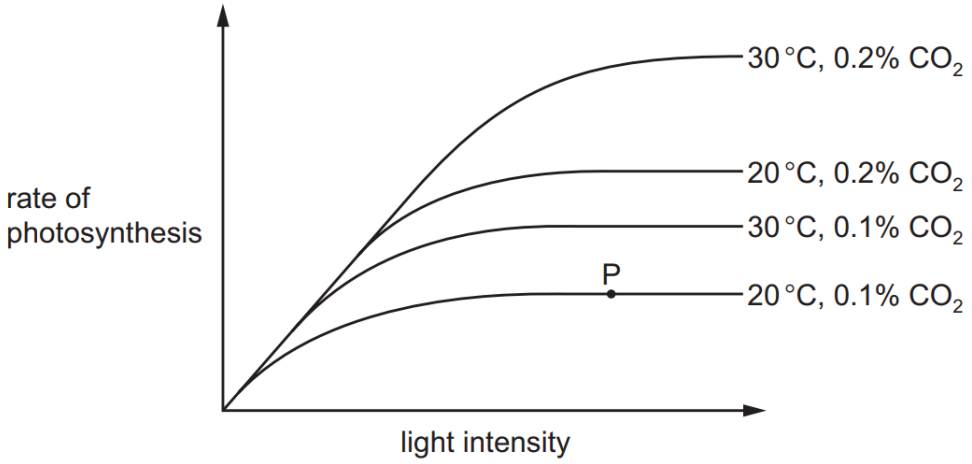


Which type of cell is found in layer X?



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

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



What limits the rate of photosynthesis at point P?

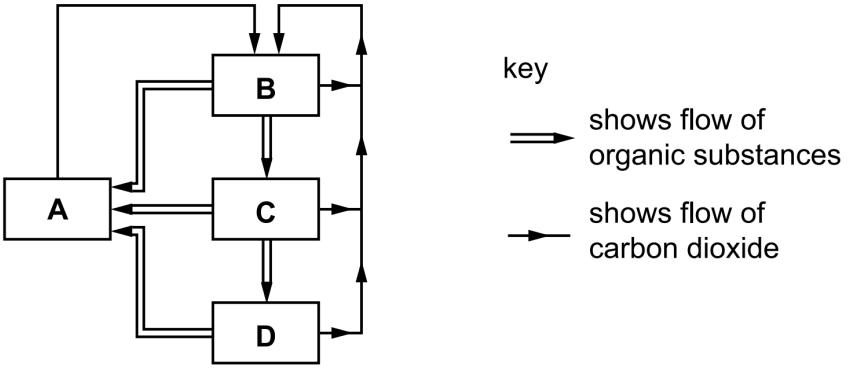
	light intensity	carbon dioxide concentration	temperature
A	✓	✓	×
B	✓	×	×
C	×	✓	✓
D	×	×	✓

key
= yes
= no

28 The diagram represents the flow of substances within a balanced ecosystem.

The boxes are various trophic levels.

Which box represents decomposers?



29 150 MJ of energy enters a consumer through its food.

Which row shows what happens to this energy?

	energy used in tissue growth / MJ	energy lost to the environment / MJ
A	10	140
B	15	135
C	30	120
D	60	90

30 When a river is polluted by fertilisers, the following processes may occur.

1 growth of decomposers

2 growth of surface producers

3 death of submerged producers

What is the correct sequence for these processes?

A 1 → 2 → 3

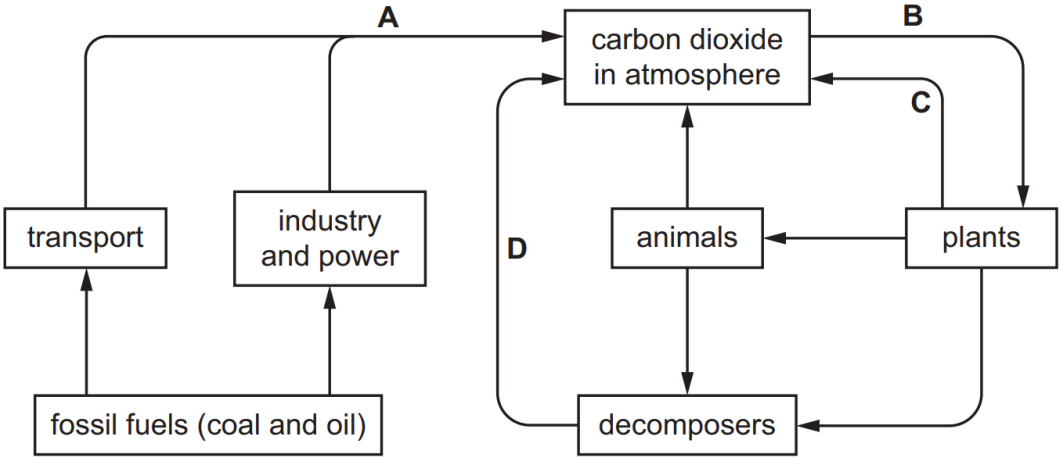
B 1 → 3 → 2

C 2 → 1 → 3

D 2 → 3 → 1

31 The diagram shows part of the carbon cycle.

Which process reduces the carbon dioxide content of the atmosphere?



32 Which human activity contributes most to global warming?

A air pollution by insecticides

B reducing global meat production

C emissions from burning fossil fuels

D water pollution by sewage

33 The structure of DNA involves two strands coiled together to form a double helix.

Which pairing of bases between the two strands is correct?

A A and G

B A and T

C C and A

D C and T

34 Which statement describes human male gametes?

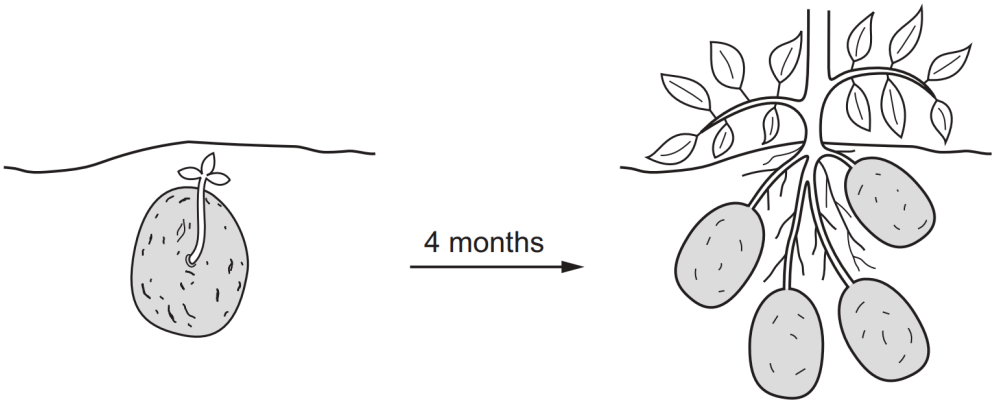
A large, few and non-motile

B large, numerous and motile

C small, few and non-motile

D small, numerous and motile

35 Potatoes are stem tubers. A tuber can be placed in the ground to grow into another plant, which can grow many more tubers.



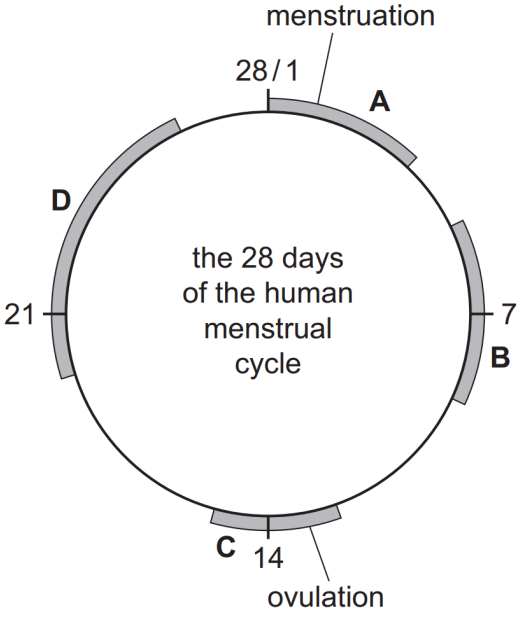
The diploid number of the potato plant is 24.

How many chromosomes will there be in the cells of the stem, the leaf and the pollen?

	stem	leaf	pollen
A	24	24	12
B	24	12	48
C	48	12	24
D	48	48	12

36 The diagram shows some events of the menstrual cycle.

In which shaded zone of the cycle would progesterone levels be the highest?



37 Which set of conditions is necessary for substances to be transferred across the placenta so that the fetus develops successfully?

	substance	concentration in fetal blood flowing to the placenta	concentration in maternal blood in placenta
A	amino acids	low	high
B	carbon dioxide	low	high
C	glucose	high	low
D	vitamins	high	low

38 Which parents could produce offspring with blood group O?

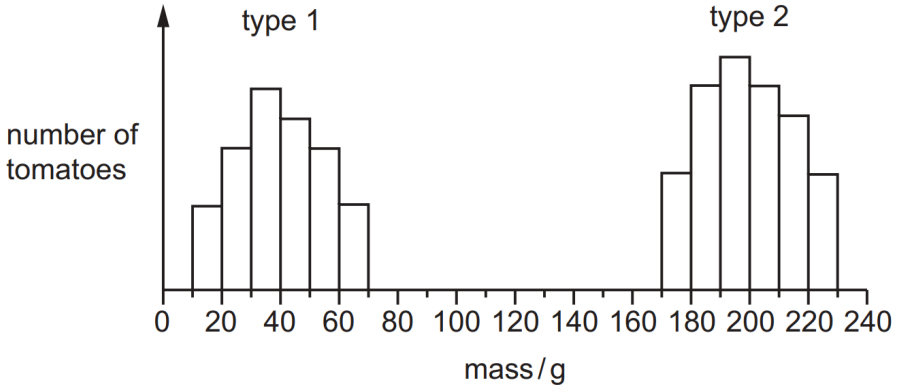
A heterozygous father with blood group A and heterozygous mother with blood group B

B heterozygous father with blood group A and homozygous mother with blood group B

C homozygous father with blood group A and heterozygous mother with blood group B

D homozygous father with blood group A and homozygous mother with blood group O

39 The graph shows the masses of two different types of tomatoes.



What can be concluded from the graph?

A Genes do not affect the mass of tomatoes.

B Type 1 tomatoes show continuous variation.

C Type 2 tomatoes are sometimes smaller than type 1 tomatoes.

D Type 2 tomatoes show discontinuous variation.

40 In areas of the world where the disease malaria is present, the sickle-cell allele is more common. What is the reason for this?

A Both diseases are caused by the same allele.

B Heterozygous individuals with the sickle-cell allele are less likely to have malaria.

C Heterozygous individuals with the sickle-cell allele are more likely to have malaria.

D These are parts of the world with many diseases.

END OF PAPER

YUYING SECONDARY SCHOOL

PRELIMINARY EXAMINATION
Secondary 4

NAME			
CLASS		**REG. NO**	

BIOLOGY 6093/2

Paper 2

23 August 2024

1 hour 45 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

Setter: Mr Darren Kung

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number 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 on the Question Paper.

Section B
Answer **one** question in the spaces provided on the Question Paper.

The use of an approved calculator is expected, where appropriate.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Total	

80

This document consists of **20** printed pages.

Section A

Answer **all** the questions in this section.
The total mark for this section is 70.

1 **(a)** A researcher investigated the effect of temperature on two different biological washing powders, **A** and **B**.

Two identical pieces of clothing were stained with the same type of food.

The researcher timed how long each washing powder took to remove the stains, at different temperatures.

Fig. 1.1 is a graph of the results.

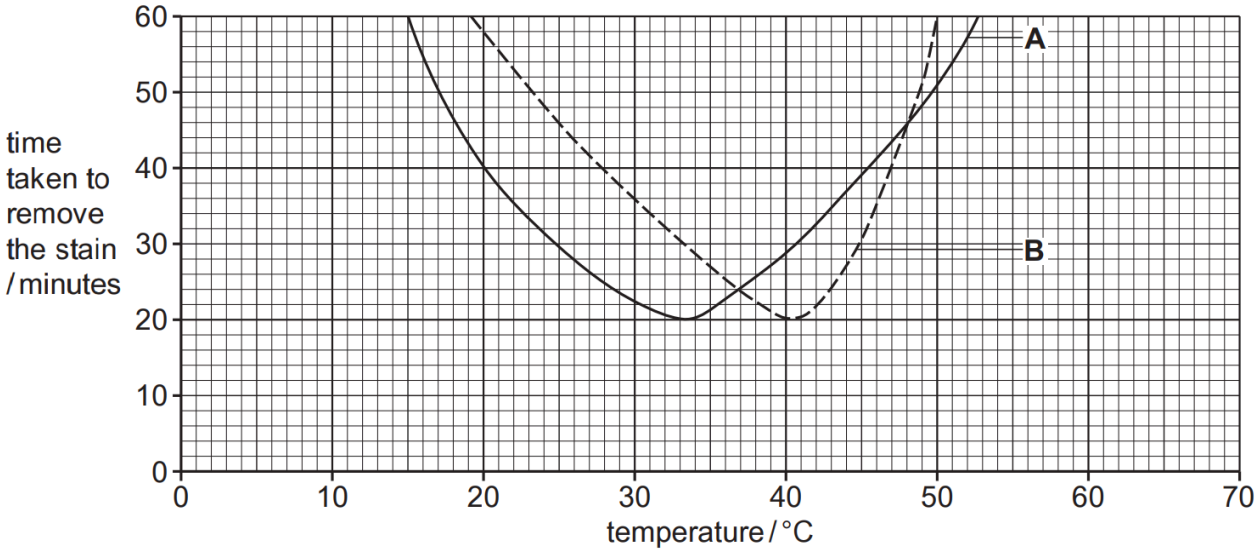


Fig. 1.1

(i) Determine the time taken for washing powder **A** to remove the stain at 20 °C.

…….. minutes [1]

(ii) Describe **and** explain the effectiveness of washing powder **B** between 20 °C and 40 °C.

……..

……..

……..

……..

……..

……..

……..

…… [4]

(iii) A student stated some conclusions for the results shown in Fig. 1.1.

Tick (✓) **two** boxes that show two correct conclusions for the results shown in Fig. 1.1.

Washing powders **A** and **B** do not work at 50 °C.	
Washing powders **A** and **B** have the same activity at 37 °C.	
Washing powder **A** can remove the stain in 15 minutes.	
Washing powder **A** is more effective at lower temperatures than washing powder **B**.	
Washing powder **B** is active over a greater range of temperatures than washing powder **A**.	

[2]

(b) Fig. 1.2 is a diagram showing the action of an enzyme.

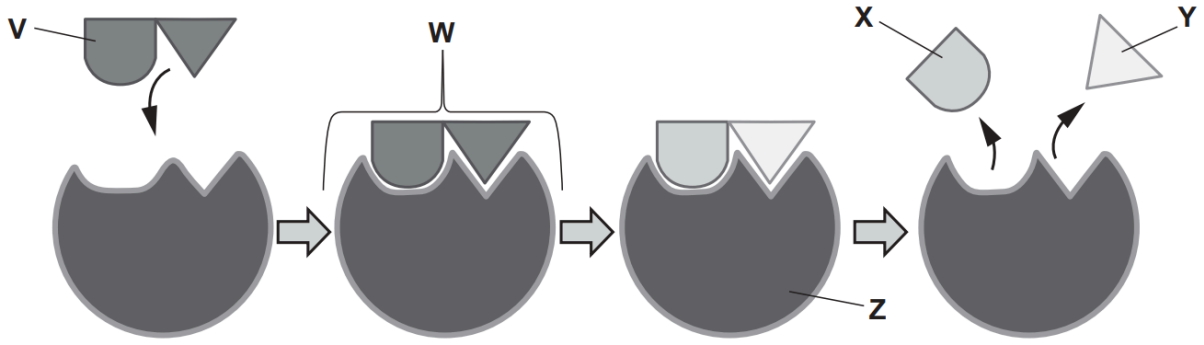


Fig. 1.2

State the letter or letters from Fig. 1.2 that represent(s) the:

substrate ……

enzyme ……..

[2]

[Total: 9]

2 **(a)** Fig. 2.1 is a photomicrograph of a sample of human blood.

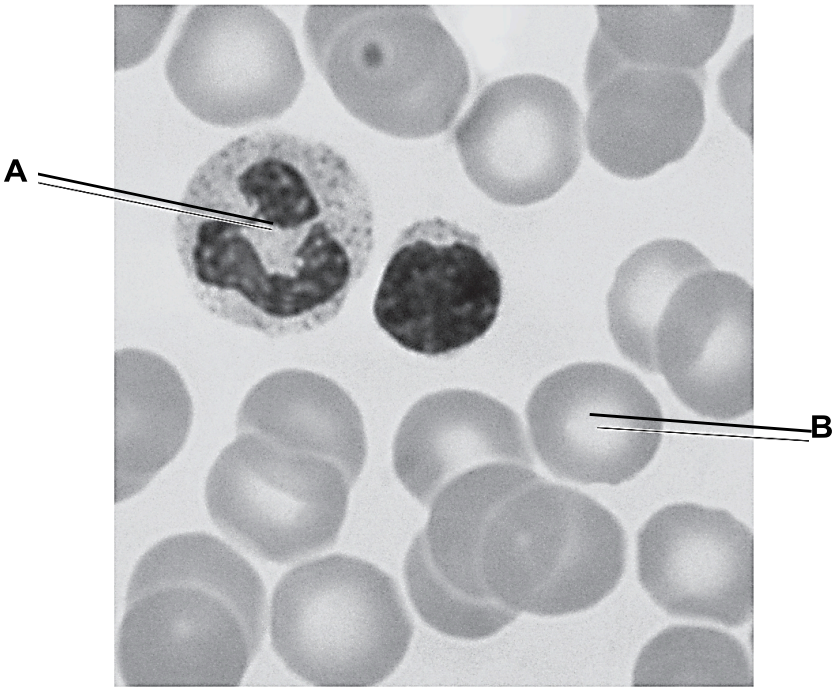


Fig. 2.1

Identify and describe the functions of the cells labelled **A and B** in Fig. 2.1.

cell **A** ……..

……

……

……

cell **B** ……..

……

……

……
[4]

(b) Fig. 2.2 is a diagram of a section through the heart of a mammal. The arrows show the direction of blood flow through the heart and blood vessels.

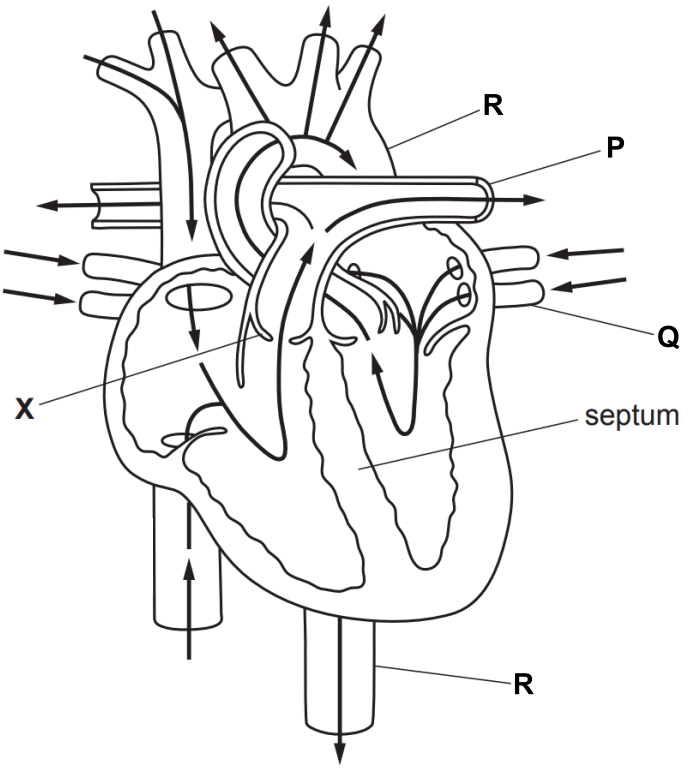


Fig. 2.2

(i) Name structures **P**, **Q** and **R**.

P ……

Q ……

R ……

[3]

(ii) Identify the structure labelled **X** in Fig. 2.2 **and** describe what happens to it during the cardiac cycle, making reference to the structures of the heart involved.

……..

……..

……..

……..

……..

…… [3]

[Total: 10]

3 **(a)** Fig. 3.1 is a photomicrograph of some cells lining the trachea.

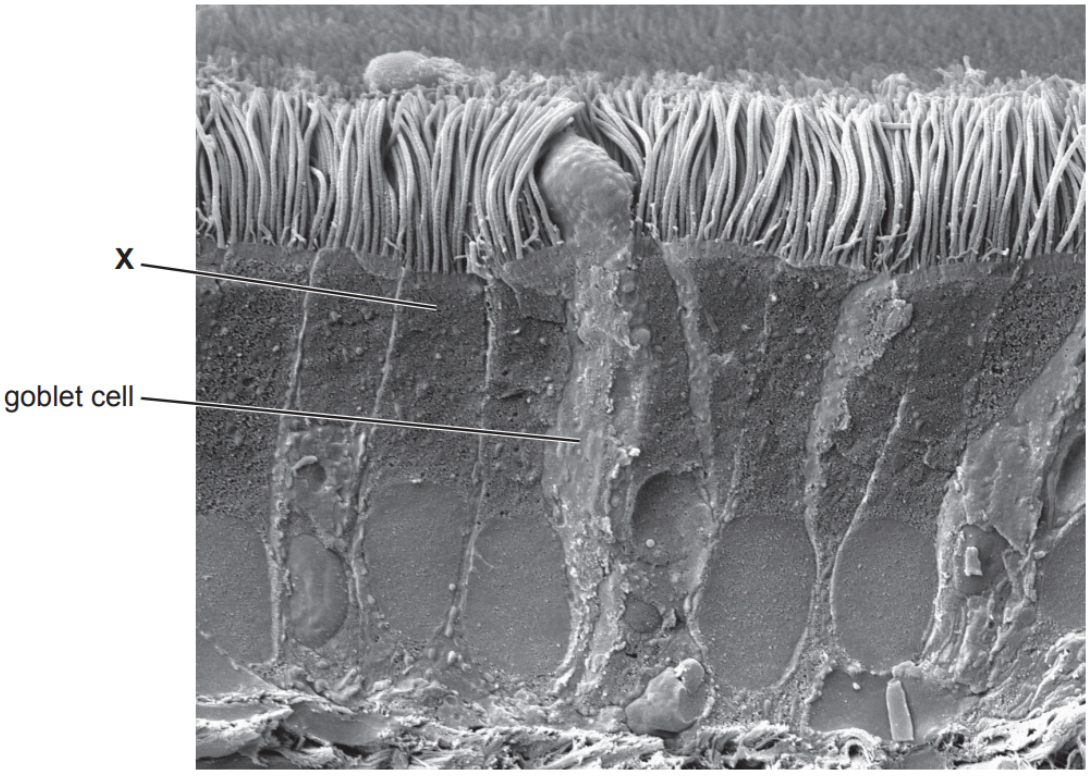


Fig. 3.1

(i) The goblet cell is responsible for the production of mucus.

Explain how the goblet cell and the cell labelled **X** in Fig. 3.1 work together to perform their function in the trachea.

……..

……..

……..

……..

……..

…… [3]

(ii) Explain how cigarette smoke may affect the functioning of the cells mentioned in **(i)** and how it would affect a smoker's health.

……..

……..

……..

..... [2]

(b) A scientist monitored the changes in the pH in muscles before, during and after two minutes of vigorous exercise. The changes in pH are due to the production of lactic acid. The results are as shown in Fig. 3.2

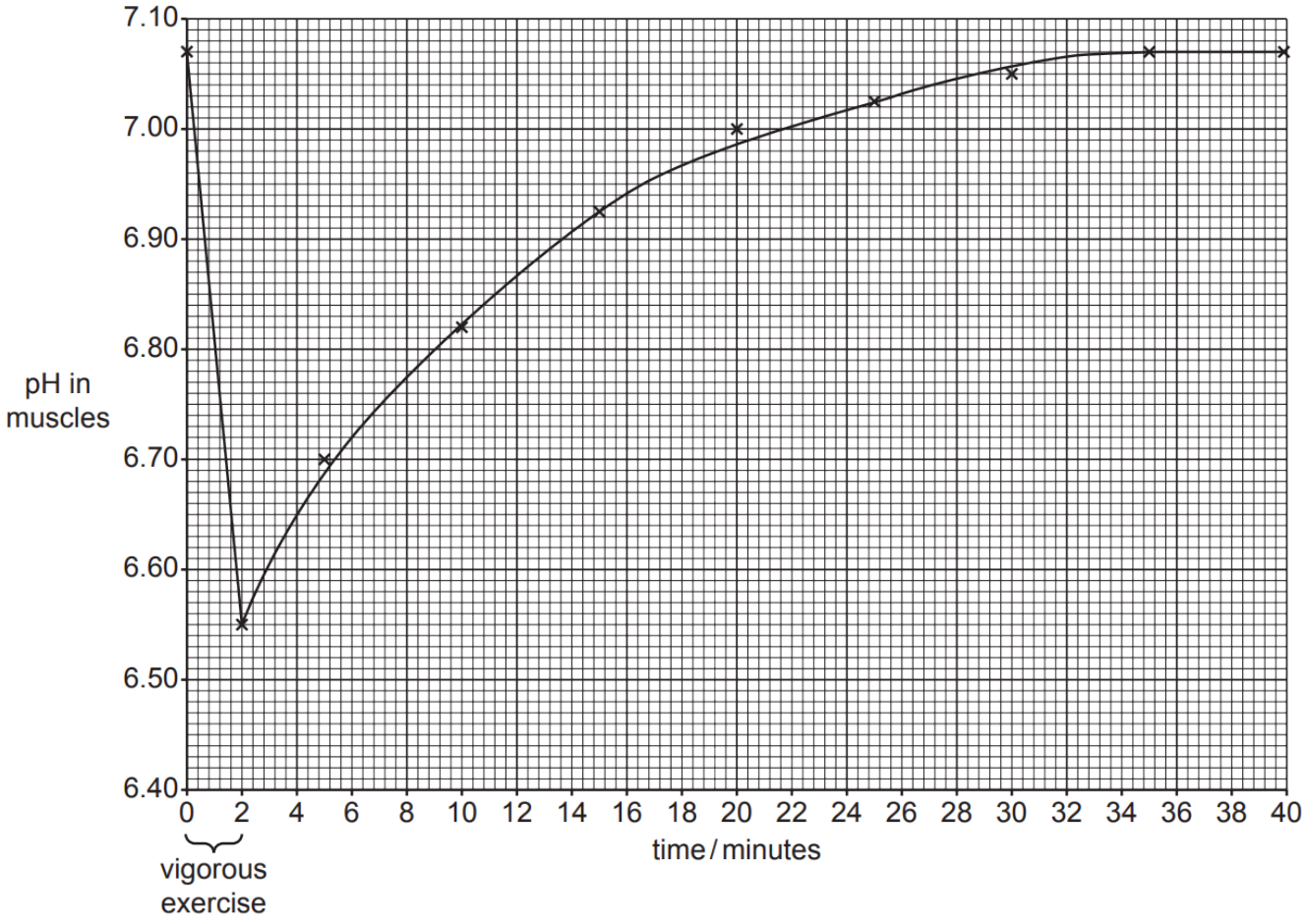


Fig. 3.2

Describe **and** explain the results shown in Fig. 3.2.

.....

.....

.....

.....

.....

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.....

.....

.....

.....
[5]

[Total: 10]

4 Insulin is a hormone that regulates the concentration of glucose in the blood.

(a) Describe what is meant by the term hormone.

.....

.....

.....

.....
[3]

(b) Persons **A** and **B** were monitored to see how well they could control their blood glucose concentration.

They did not eat or drink anything other than water for eight hours before the monitoring began. They then drank a glucose solution 30 minutes after monitoring began.

Blood samples were taken at 30-minute intervals and tested for glucose concentration.

The results are shown in Fig. 4.1.

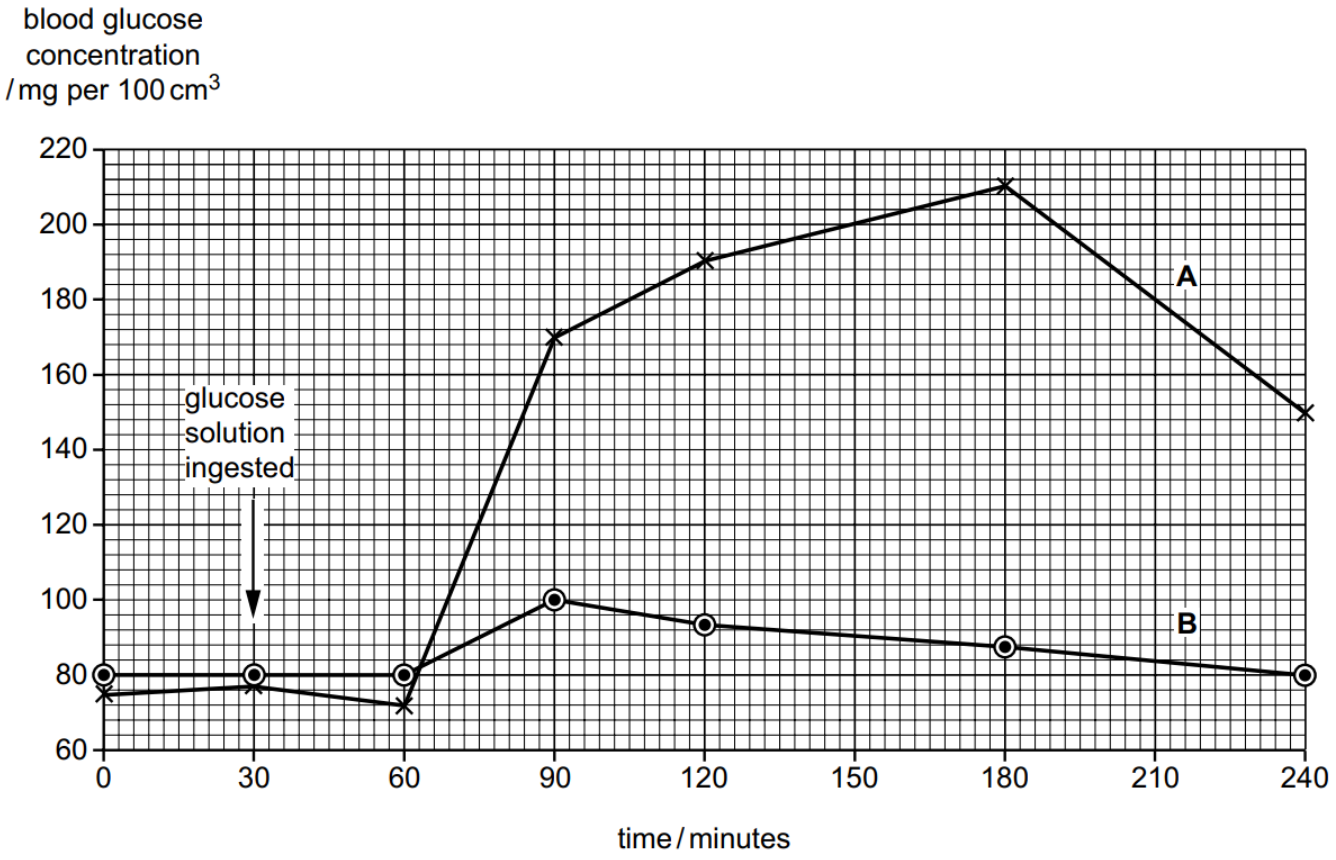


Fig. 4.1

(i) Calculate the percentage increase in the blood glucose concentration in person **A** between 60 and 90 minutes.

……% [2]

(ii) Using Fig. 4.1, describe **and** compare the response of person **A** with the response of person **B** after the ingestion of glucose.

……..

……..

……..

……..

……..

……..

……..

……..

……..

…… [3]

(iii) Using Fig. 4.1, describe **and** explain the response of person **B** after 90 minutes.

……..

……..

……..

……..

……..

……..

……..

…… [3]

[Total: 11]

5 Cystic fibrosis is a disease caused by a mutation in the genes. One of the symptoms of cystic fibrosis is the build-up of thick, sticky mucus on various organ membranes.

(a) The bile and pancreatic ducts are among the regions affected by cystic fibrosis.

Suggest **and** explain the effects this disease would have on digestion.

……

……

……

……

……

……

[3]

(b) Fig. 5.1 shows the pedigree diagram of a family that has two people who have cystic fibrosis.

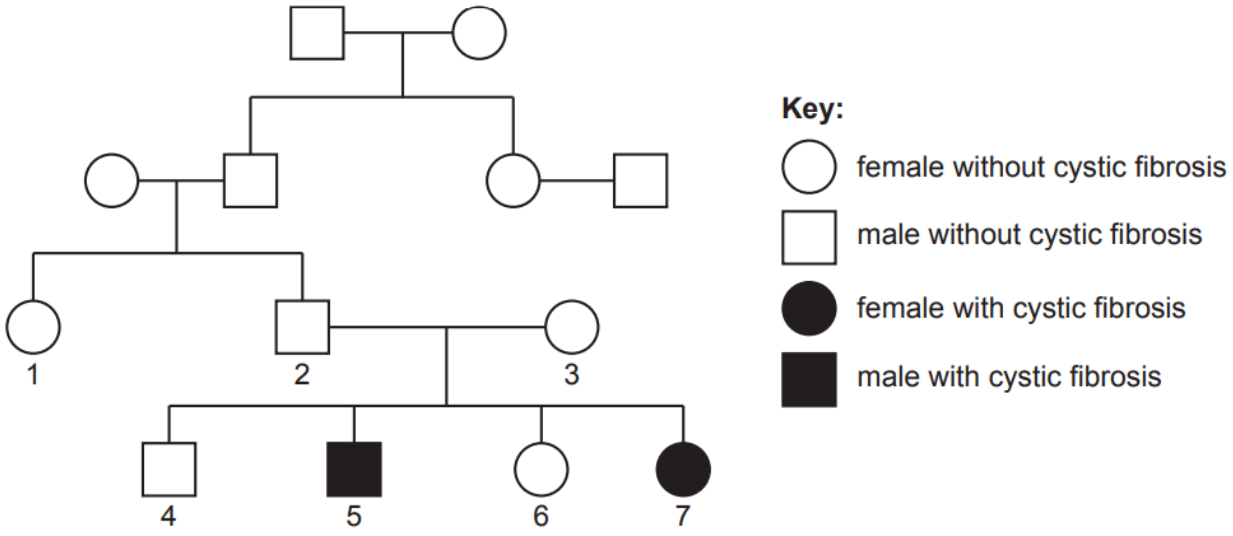


Fig. 5.1

(i) The allele that causes cystic fibrosis is a recessive allele.

Describe **and** explain the evidence shown in Fig. 5.1 that cystic fibrosis is caused by a recessive allele.

……..

……..

……..

……..

…… [2]

(ii) Person 5 has a child with a woman who is heterozygous for cystic fibrosis.

Complete the genetic diagram to predict the probability of person 5 and the heterozygous woman having a child with cystic fibrosis.

Use the symbol **A** for the dominant allele and **a** for the recessive allele.

	father	x	mother
genotype of parents	……		……

gametes	……	……	……	……

genotype of offspring	……	……	……	……
phenotype of offspring	……	……	……	……
	……	……	……	……

probability of having a child with cystic fibrosis …….

[5]

[Total: 10]

6 A student investigated osmosis in potato plant cells.

He immersed cubes of potato tissue in water and different concentrations of sucrose solution for 30 minutes.

The masses of the potato cubes were measured before and after immersion. The percentage changes in mass were calculated.

Table 6.1 shows the results.

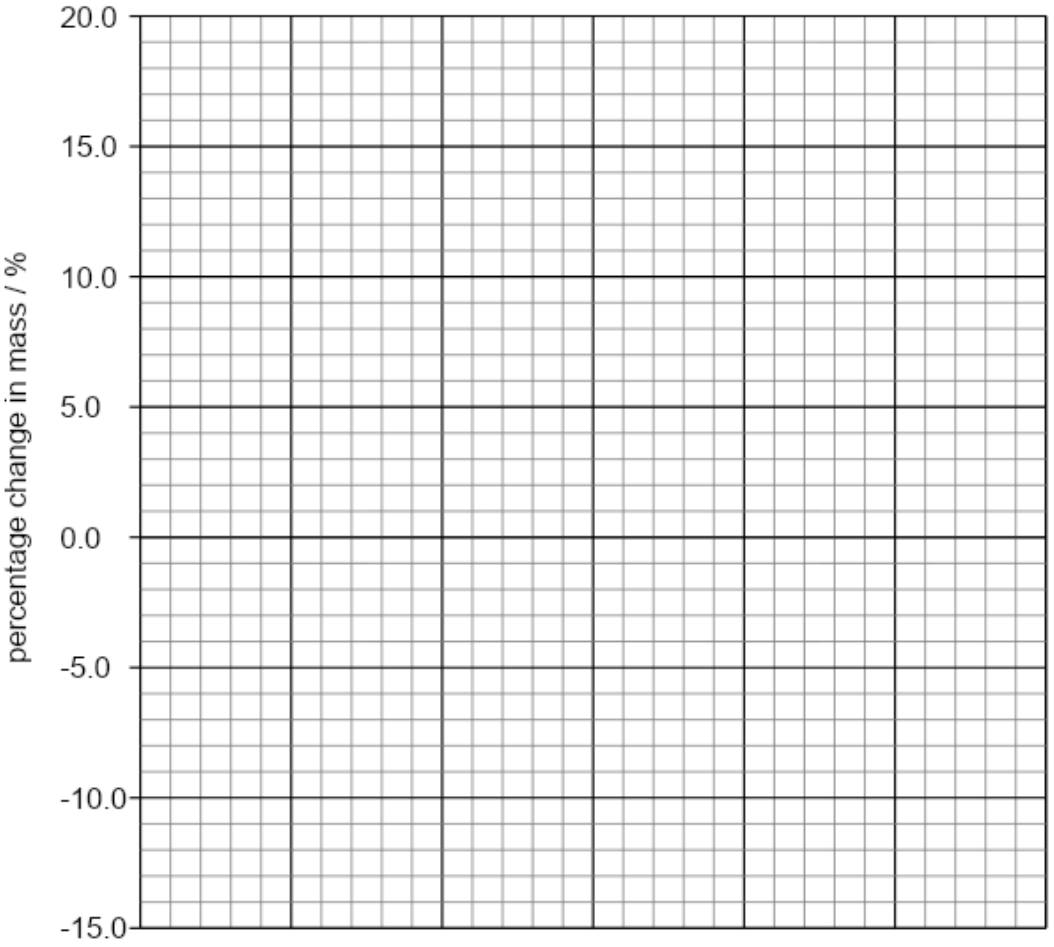
Table 6.1

concentration of sucrose solution / mol dm^{-3}	mass of potato cube before immersion / g	mass of potato cube after immersion / g	percentage change in mass / %
0.0	1.32	1.50	13.6
0.2	1.34	1.49	11.2
0.4	1.30	1.34	3.1
0.6	1.33	1.28	-3.8
0.8	1.26	1.13	-10.3
1.0	1.28	1.11	

(a) (i) Using the information in Table 6.1, calculate the percentage change in mass at 1.00 mol dm^{-3}. Show your working clearly.

…… % [2]

(ii) Plot a graph of the data from Table 6.1, including your answer from **(i)**, in the grid below.



[4]

(iii) Using your graph, determine the concentration of sucrose present in the potato cube.

…… mol dm^{-3} [1]

(b) Describe **and** explain the expected appearance of a cell from a potato cube that has been immersed in 0.2 mol dm^{-3} sucrose solution for 30 minutes.

……

……

……

……

……
[2]

(c) Describe how the process of active transport differs from the process of osmosis.

……

……

……

……

……

……

……
[3]

[Total: 12]

7 Fig. 7.1 shows part of a food web in a river.

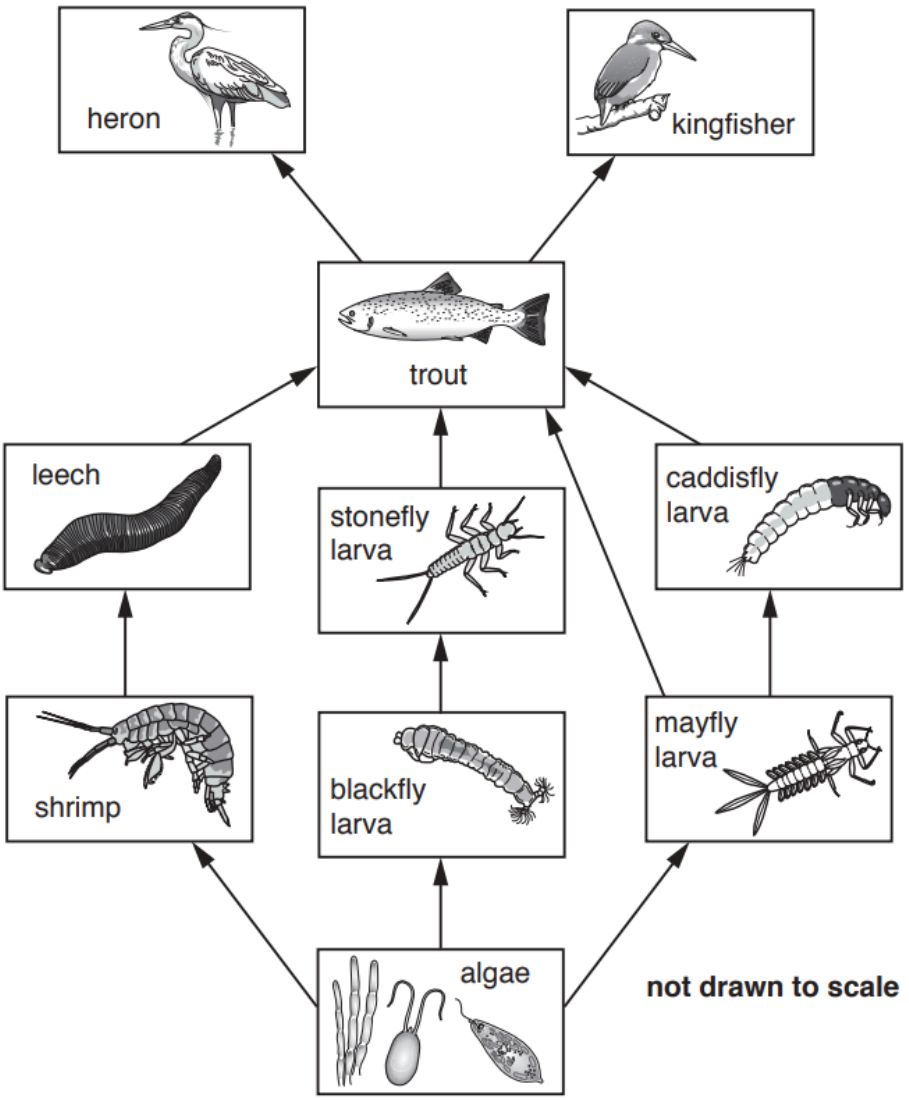


Fig. 7.1

(a) (i) Use the information from Fig. 7.1 to complete Table 7.1.

Table 7.1

role in the food web	name of organism
a producer	
an organism that is both a secondary and a tertiary consumer	

[2]

(b) Several months ago, farms near the river have begun using insecticides on their crop plants.

Scientists have observed that the populations of herons and kingfishers have been decreasing at a very high rate.

(i) Explain why a higher proportion of herons and kingfishers have died compared to other organisms in the river.

……..

……..

……..

……..

……..

……..

……..

…… [3]

(ii) Predict **and** explain how the death of the birds will affect the populations of trout and caddisfly larva.

……..

……..

……..

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……..

……..

……..

…… [3]

[Total: 8]

Section B

Answer **one** question from this section.
The total mark for this section is 10.

8 Fig. 8.1 shows a diagram of a typical bacterium cell.

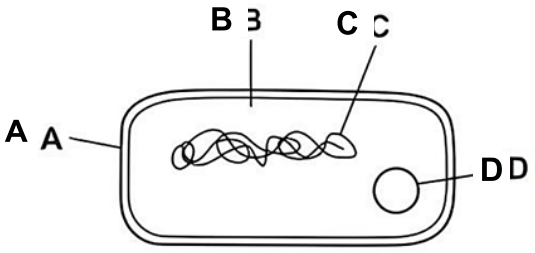

Fig. 8.1

(a) Use information from Fig. 8.1 to complete the table below.

description	part(s)
contains genetic material	
present in plant cells	

[2]

(b) Fig. 8.2 shows the process used to produce genetically modified plants.

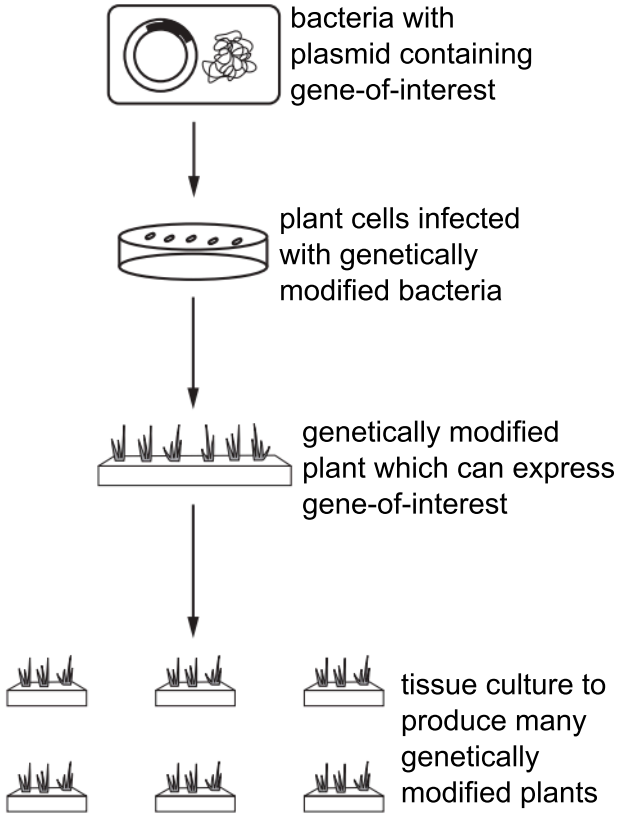

Fig. 8.2

(i) Suggest which type of reproduction tissue culture represents.

…… [1]

(ii) Describe how an antibiotic resistance gene can be inserted into bacteria to produce genetically modified plants with antibiotic resistance.

……..

……..

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……..

…… [5]

(iii) Explain why some people may be concerned about consuming genetically modified plants, such as those with antibiotic resistance, as a source of food.

……..

……..

……..

……..

…… [2]

[Total: 10]

9 **(a)** Define transpiration.

……

…… [1]

(b) Marram grass is a type of grass that is almost exclusively found in coastal regions. It has various adaptations that help it survive in dry environments.

Fig. 9.1 shows the cross-section of a whole marram grass leaf.

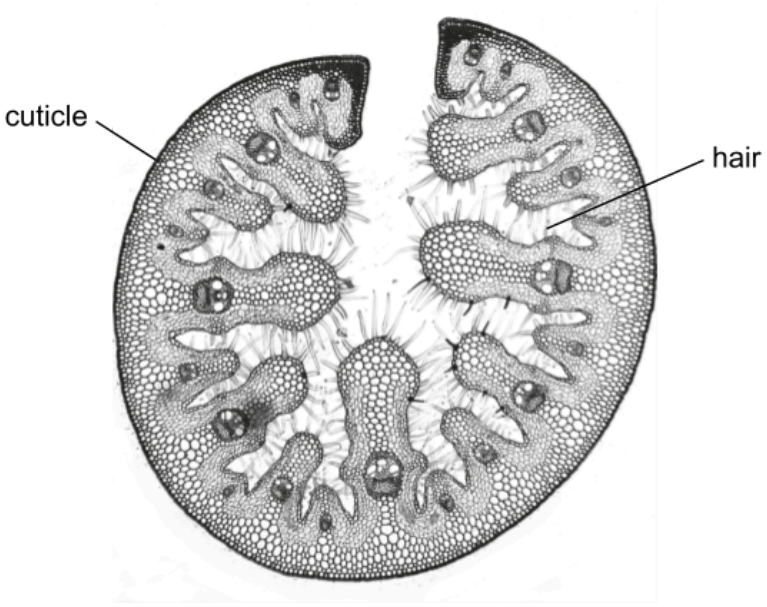

Fig. 9.1

With reference to the parts labelled and other observable features in Fig. 9.1, suggest **and** explain how adaptations of the marram grass help it survive in dry environments.

……

……

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……

……

…… [6]

(c) Fig. 9.2 is a diagram of the marram grass flower.

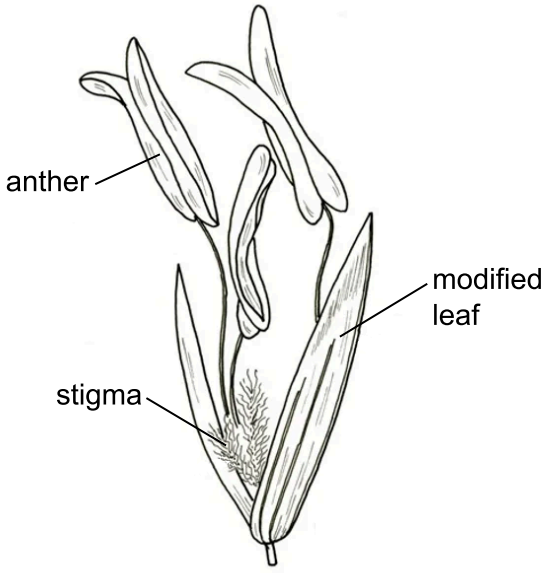


Fig. 9.2

Suggest if the marram grass flower relies on wind or insect pollination. Explain your answer using evidence from Fig. 9.2.

……

……

……

……

…… [3]

[Total: 10]

END OF PAPER

YYSS 2024 Sec 4 Biology Prelim Mark Scheme

Paper 1

1	2	3	4	5	6	7	8	9	10
B	A	D	A	B	D	B	B	C	B

11	12	13	14	15	16	17	18	19	20
C	C	B	C	B	C	C	D	B	C

21	22	23	24	25	26	27	28	29	30
B	A	C	D	D	A	C	A	B	D

31	32	33	34	35	36	37	38	39	40
B	C	B	D	A	D	A	A	B	B

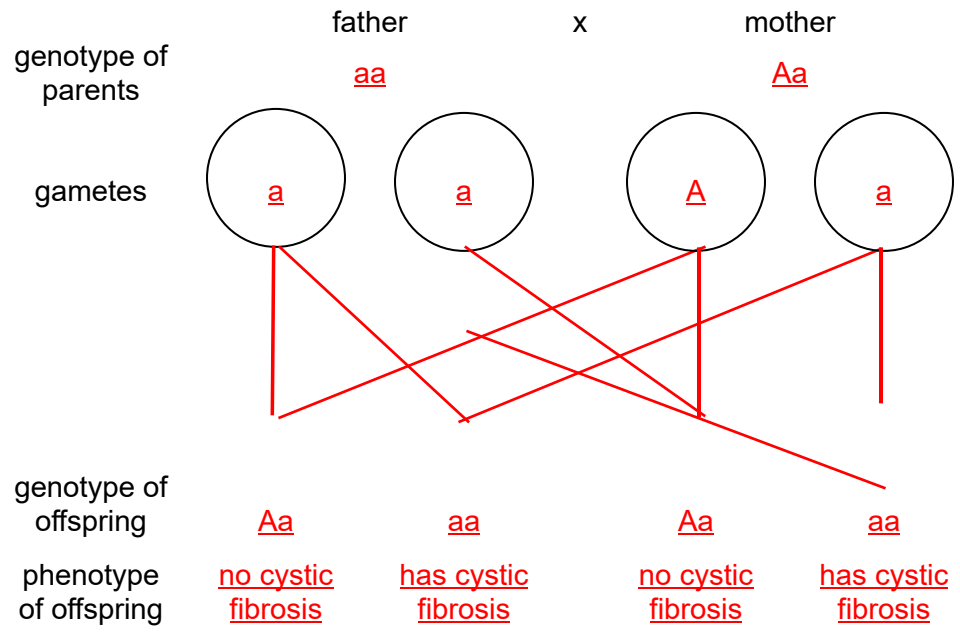
Paper 2

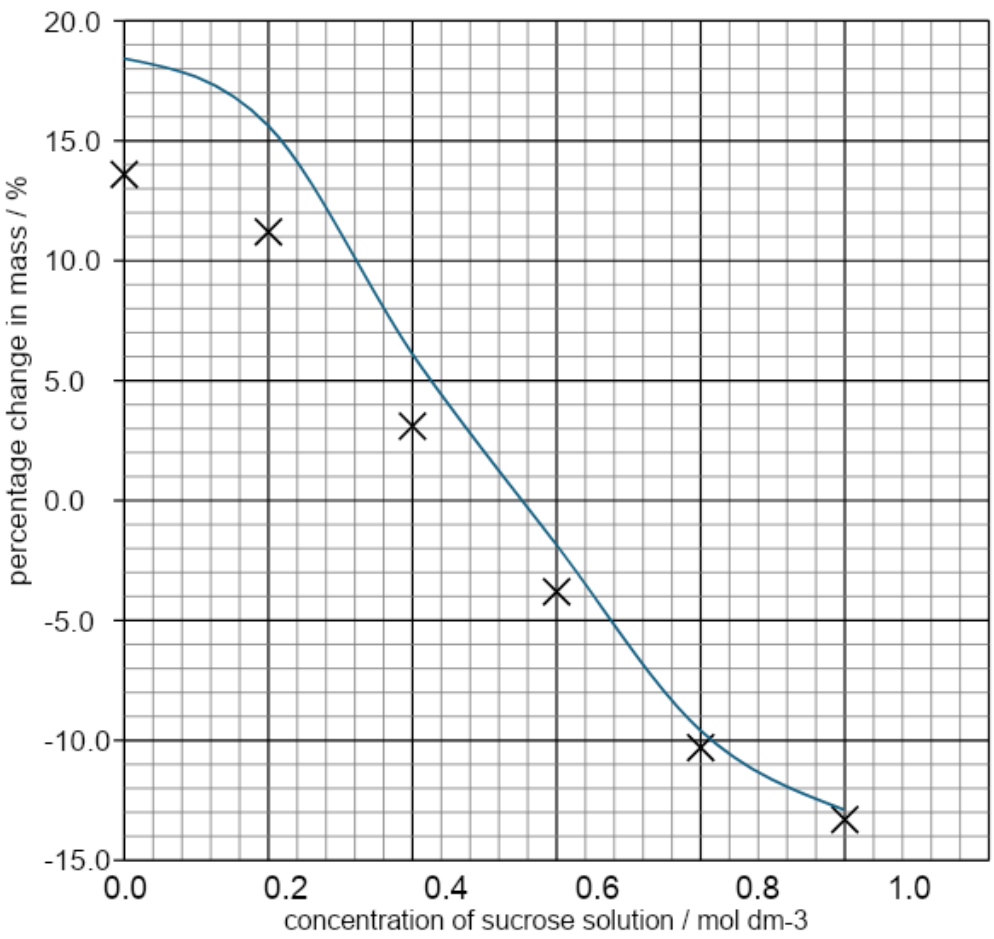
1ai	40 minutes	[1]
1aii	**Describe 1** – As temperature increased from 20°C to 40°C, the time taken for washing powder B to remove the stain decreased from 58 to 20. **Explain 1** – As temperature increased, the rate of effective collisions between the enzymes in the washing powder and substrates in the stain increased, resulting in a higher rate of enzyme-substrate complex formation and hence increased rate of reaction. Hence, the washing powder became more effective as temperature increased. **Describe 2** – At 40°C, the time taken for washing powder B to remove the stain was the lowest at 20 minutes. **Explain 2** – 40°C was the optimum temperature of the enzyme, hence rate of effective collisions between the enzymes of the washing powder and the substrates in the stain was the highest. Hence, the washing was the most effective at this temperature.	[1] [1] [1] [1]
1aiii		[1] ea

Washing powders **A** and **B** do not work at 50 °C.	
Washing powders **A** and **B** have the same activity at 37 °C.	✓
Washing powder **A** can remove the stain in 15 minutes.	
Washing powder **A** is more effective at lower temperatures than washing powder **B**.	✓
Washing powder **B** is active over a greater range of temperatures than washing powder **A**.	

1b	substrate – V enzyme – Z	[1] [1]
2a	cell **A** – phagocyte. It is responsible for engulfing foreign particles through phagocytosis. cell **B** – red blood cell. contains haemoglobin which binds to oxygen and transports it from the lungs to the rest of the body	[1] [1] [1] [1]
2bi	**P** – pulmonary artery **Q** – pulmonary vein **R** – aorta	[1] [1] [1]
2bii	**X** is the pulmonary valve. When the right ventricle contracts, the pulmonary valve opens, allowing blood to move from the right ventricle to the pulmonary artery. When the right ventricle begins to relax, the pulmonary valve closes, preventing the backflow of blood into the right ventricle.	[1] [1] [1]
3ai	Cell X has hair-like structures on the surface of the cell known as cilia. Mucus from the goblet cell trap dust and bacteria which enter the trachea. The cilia on cell X helps to sweep the mucus towards the pharynx to be removed from the trachea.	[1] [1] [1]
3aii	Cigarette smoker contains tar which paralyses cilia in found in the air passages, causing them to be unable to sweep mucus. This increases risk of the smoker developing chronic bronchitis/emphysema/causes breathing difficulties/chronic coughing.	[1] [1]
3b	**Describe 1** – pH in muscles decreased rapidly from pH 7.07 to 6.55 during the 2 minutes of exercise. **Explain 1** – When energy demand exceeds the energy supply from aerobic respiration, anaerobic respiration occurs at the same time to release more energy. Lactic acid is formed in the process, causing pH in the muscles to drop. At the same time, an oxygen debt is incurred. **Describe 2** – pH in muscles then gradually increased from 6.55 to 7.07 between 2 to 35 minutes, reaching back to the original pH before exercise. **Explain 2** – After exercise and during rest, lactic acid in transported to the liver, where lactic acid is removed from the blood, causing pH of blood to gradually increase back to normal	[1] [1] [1] [1] [1]
4a	**Any 3** A hormone is a chemical substance produced by an endocrine gland secreted directly into the bloodstream which carries it to one or more target organ to alter their activities	 [1] [1] [1]

	eventually destroyed in the liver.	[1]
4bi	Percentage increase = (170-72)/72 x 100% = 136%	[1] [1]
4bii	**Any 3** Both the blood glucose concentration of persons A and B began to increase 30 minutes after ingestion of the glucose solution. **(comparing trend)** Between 60-90min, blood glucose level of person A increased at a higher rate, from 72 to 170 mg per 100 cm^3, while blood glucose of person B increased at a gradual rate from 80 to 100 mg per 100 cm^3. **(comparing rate of increase)** While the peak blood glucose concentration of person A was 210 mg per 100 cm^3 at 180 minutes, the peak blood glucose concentration of person B was lower at 100 mg per 100 cm^3 at 90 minutes. **(comparing peak/fluctuation)** At 240 minutes, the blood glucose concentration of person A remained high at 150 mg per 100 cm^3, while the blood glucose concentration of person B recovered to normal levels of 80 mg per 100 cm^3. **(comparing end point)**	 [1] [1] [1] [1]
4biii	After 90 minutes, the blood glucose concentration of B gradually decreased from a peak of 100 mg per 100 cm^3 to the normal of 80 mg per 100 cm^3 at 240 minutes. When blood glucose concentration increases above the normal, the islets of Langerhans of the pancreas secrete more insulin into the bloodstream. Insulin stimulates liver and muscle cells to convert excess glucose into glycogen for storage, while also increases uptake of glucose in cells. This causes blood glucose level to return to normal levels.	[1] [1] [1]
5a	The build-up of mucus in the bile and pancreatic ducts may cause blockage, preventing/reducing secretions from the liver and pancreas from reaching the small intestine. Blocking of the bile duct prevents the release of bile into the small intestine. This results in lack of emulsification of fats prior to chemical digestion, which might lead to reduced rate of digestion of fats. Blocking of the pancreatic duct prevents the release of pancreatic enzymes such as amylase, lipase and trypsin (protease) in the small intestine, which might lead to reduced rate of digestion of starch, fats and proteins. (at least 2 enzymes named)	[1] [1] [1]
5bi	Individuals 2 and 3 both do not have cystic fibrosis, while having children with cystic fibrosis (5 and 7) This means that they must be heterozygous, each with only one copy of the recessive allele that causes cystic fibrosis. Or any reasonable explanation	[1] [1]

5bii	 probability of having a child with cystic fibrosis – 0.5 or 50%	[1] [1] [1] [1] [1]
6ai	percentage change in mass = (1.11-1.28)/1.28 x 100% = -13.3%	[1] [1]

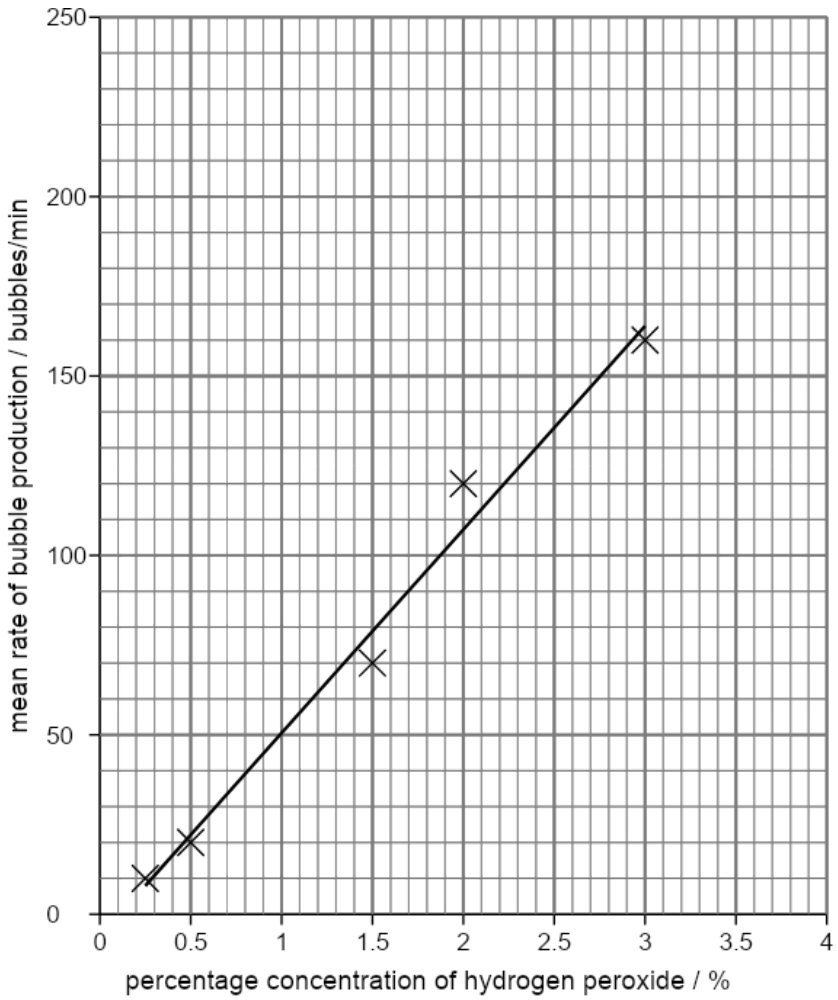
6aii	 scale [1], curve [1], axes [1], plot [1]	[4]
6aiii	0.49 mol dm^{-3} (based on graph)	[1]
6b	The cell will likely be <u>turgid</u>. Since the potato cube <u>cell has a lower water potential</u> than the 0.2 mol dm^{-3} sucrose solution, <u>water entered the cell via osmosis</u>.	[1] [1]
6c	Active transport is a process in which <u>energy is required</u>, while the process of osmosis <u>does not require any energy</u>. Active transport involves the movement of <u>any particle</u>, while osmosis only involves the <u>movement of only water molecules</u>. Active transport involves the movement of particles against its concentration gradient, while osmosis involves the <u>movement of particles down a water potential gradient</u>. Max 1m for stating of both definitions without any breakdown in comparisons.	[1] [1] [1]
7ai	producer – **algae** secondary and tertiary consumer - **trout**	[1] [1]
7bi	Insecticides are non-biodegradable and <u>accumulate in fatty tissues of organisms</u> that consume it over time. At low concentrations, the insecticides are not as harmful to the organisms.	[1]

	They are passed down the food chain, with the concentration of insecticides increasing every trophic level, becoming highly concentrated in the bodies of the final consumers such as the herons and kingfishers At such concentrations, they become deadly to the birds, causing them to die and leading to population decreases.	[1] [1]
7bii	The populations of trout are expected to increase greatly due to the lack of predators that control their population. The populations of caddisfly are expected to drop sharply due to predation by an increased population of trout Furthermore, as mayfly are also consumed by trout, the food supply of caddisfly will be further limited, leading to further stress on caddisfly population.	[1] [1] [1]
8a	contains genetic material – **C and D** present in plant cells – **A and B**	[1] [1]
8bi	asexual reproduction	[1]
8bii	The antibiotic resistance gene is isolated cut with a restriction enzyme. A plasmid is removed from a bacterium and is cut with the same restriction enzyme. The sticky ends produced are complementary to those of the antibiotic resistance gene. The antibiotic resistance gene and the cut plasmid bind by complementary base pairing between their sticky ends. DNA ligase seals the gene to the plasmid, forming a recombinant plasmid. The recombinant plasmid is inserted into bacterial cells, producing transgenic bacteria. The transgenic bacteria are then used to infect plant cells, which are subsequently cultured to produce genetically modified plants with the antibiotic resistance.	[1] [1] [1] [1] [1]
8biii	New proteins in genetically modified plants may cause allergies or harm to us, resulting in health complications. The genes coding for antibiotic resistance may accidentally be transferred into pathogenic bacteria, resulting in future difficulties in treating diseases.	[1] [1]
9a	Transpiration is the loss of water vapour from the aerial parts of a plant, mainly through the stomata of the leaves.	[1]
9b	The waxy and transparent cuticle layer helps to reduce loss of water through evaporation from the outer surfaces of the leaf. The transparent cuticle also allows sunlight to pass through it, so that it can reach the mesophyll cells of the leaf, allowing it to perform photosynthesis. The presence of large numbers of hairs on the inner surface of the leaf helps to trap air/create a humid internal environment,	[1] [1] [1]

	reducing the rate of diffusion of water vapour out of the plant via the stomata, lowering rate of transpiration. The curling of the leaf helps to reduce air movement against the inner side of the leaf, lowering rate of transpiration. The curling of the leaf also helps to reduce surface area of the leaf to sunlight, reducing the rate of transpiration and conserving water. OR any other reasonable answer	[1] [1] [1]
9c	Wind-pollination. Any 2 The flower has long (and pendulous) filaments and anthers which protrude out of the flower so that pollen can be blown out of the anther. It also has a stigma which is large and feathery, which can help to trap pollen that is blown in the wind. It has no petals, which are characteristic of wind-pollinated plants	[1] [2]

Paper 3

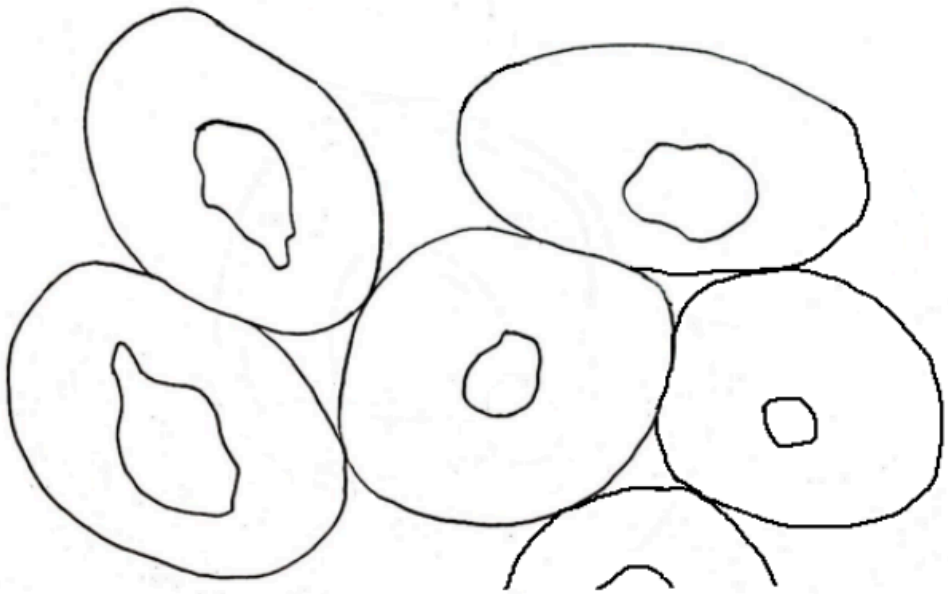
1a	Catalase is an enzyme with a specific 3D shape and has an active site which only hydrogen peroxide (has a shape that) is complementary to it. Others substances will not have a complementary shape to the active site of catalase, and will not be able to bind and be broken down by the enzyme.	[1] [1]
1b	<table><tr><th rowspan="2">percentage concentration of hydrogen peroxide / %</th><th colspan="3">number of bubbles in 30 sec</th><th rowspan="2">mean rate of bubble production / bubbles/min</th></tr><tr><th>count 1</th><th>count 2</th><th>count 3</th></tr><tr><td>3.0</td><td></td><td></td><td></td><td>160</td></tr><tr><td>2.0</td><td></td><td></td><td></td><td>120</td></tr><tr><td>1.5</td><td></td><td></td><td></td><td>70</td></tr><tr><td>0.5</td><td></td><td></td><td></td><td>20</td></tr><tr><td>0.25</td><td></td><td></td><td></td><td>10</td></tr></table>● Units in table ● All recorded numbers (including mean) should be in whole numbers ● All three repeats per concentration recorded	[6]

1c	 Scale [1], line [1], axes [1], plot [1]	[4]
1di	Ensure that each 10cm^3 syringe was <u>used for only one specific solution</u>, either water, 3% or 10% hydrogen peroxide solution. This ensures that there was <u>no contamination between the solutions</u>, which may have affected the accuracy of the concentrations of tubes 1-5. Ensure the volumes of solution drawn using the syringes were accurate by <u>reading syringe volumes at eye level</u>. This <u>prevents the presence of parallax error</u> and ensures that accurate volumes of solutions were added. Ensure that <u>no air bubbles were present in the syringes</u> when drawing the solutions by <u>making sure that the plunger was fully pressed down before drawing solutions</u>, and that the <u>tip of the syringe was fully submerged in the solution</u>. This ensures the volumes of solution drawn using the syringes were accurate.	Any 2 [2]
1dii	Stirring the yeast suspension <u>ensures that the concentration of yeast is consistent throughout the solution / is homogeneous</u> before adding it to the test-tube, <u>maintaining consistency across all readings</u>.	[1]

<table>
<tr><td>1ei</td><td>A clicker/counter can be used for counting bubbles at it helps with accurate tracking the number of bubbles evolved at high concentrations, reducing the risk of human error from manual counting.</td><td>[1]</td></tr>
<tr><td>1eii</td><td>Repeating the investigation helps to <u>account for the variability in the number bubbles produced</u> by the yeast suspension at the same concentration due to minor differences in conditions across repeats. Obtaining an average reading from performing repeats helps to ensure that the <u>results obtained are more reliable</u></td><td>[1]</td></tr>
<tr><td>1f</td><td>prediction – rate of bubble production will likely <u>gradually decrease over time before eventually reaching zero</u>.

explanation – The concentration of hydrogen peroxide will decrease over time as <u>hydrogen peroxide is broken down by catalase</u>. <u>As substrate concentration decreases, the rate of reaction decreases, leading to decreased rate of bubble production</u>. When all hydrogen peroxide is broken down, bubble production will stop.</td><td>[1]

[1]</td></tr>
<tr><td>1g</td><td>● Transfer 0.5 cm^3 of yeast suspension into the conical flask.
● Add 30 cm^3 of pH 3 buffer solution to the yeast suspension.
● Prepare the experimental setup as shown in Fig. 1.2
● Open the tap to release 10 cm^3 of 1.5% hydrogen peroxide into the conical flask
● Record the volume of gas collected in the syringe after 1 minute (dependent, [1])
● Repeat the above procedures by adding 30 cm^3 of buffer solutions of different pH to the yeast suspension, namely pH 5, pH 7, pH 9, pH 11. (independent, [1])
● Repeat the whole experiment for a total of three times for each pH reading to calculate the mean volume of gas collected per minute (repeats, [1])
● Factors such as concentration of hydrogen peroxide solution, yeast suspension used, and volume of buffer solution should remain constant throughout the experiment. (constants, [1])
● Record the results in a suitable table.
● Plot the results in a graph to show the relationship between pH and mean volume of gas collected per minute.
● The higher the mean volume of gas collected, the higher the activity of catalase. Hence, the optimum pH of yeast is when the volume of gas collected is the highest. (results and analysis, [1])</td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>2a</td><td><table>
<tr><td>phenotype</td><td>number of fruit flies</td><td>percentage of F_2 offspring</td></tr>
<tr><td>normal wings</td><td><u>47</u></td><td><u>77</u></td></tr>
<tr><td>vestigial wings</td><td><u>14</u></td><td><u>23</u></td></tr>
<tr><td>total</td><td>61</td><td>100</td></tr>
</table></td><td>[1] per row</td></tr>
<tr><td>2b</td><td></td><td></td></tr>
</table>

	<table><tr><td></td><td>A</td><td>a</td></tr><tr><td>A</td><td>AA</td><td>Aa</td></tr><tr><td>a</td><td>Aa</td><td>aa</td></tr></table> genotypic ratio – 1 AA : 2 Aa : 1 aa phenotypic ratio – 3 normal wing : 1 vestigial wing	[1] [1]
2c	The feature investigated had distinct, clear-cut phenotypes, either normal or vestigial wings with no intermediates. The features were also only affected by allele pairing/genotypes of the flies and not by the environment.	[1] [1]
2di	Total males in repeat 1 and 2 – 129+117+31+43=320 Total females in repeat 1 and 2 – 95+94+30+47=266 Ratio = 1.2 : 1	 [1] [1]
2dii	The expected ratio of 1:1 is based on probability as the fusion of gametes is a random process. (Statistically, the observed ratio of offspring becomes closer to the expected ratio when the population of offspring is large.) The population of fruit flies in this investigation is too small to obtain a statistically accurate ratio, hence observed ratios will differ from expected ratios.	[1] [1]
3a	 Size [1], scale [1] accuracy [1], clarity [1]	
3b	Diameter on figure = 30 mm Actual diameter = 30/110 = 0.27 mm	 [1] [1]