Name:	CCA Home Group:	Learning Group:	Index Number:

UNITY SECONDARY SCHOOL

Preliminary Examination 2023
Secondary Four (Express)

BIOLOGY

6093/02

Paper 2

13 September 2023

1 hour 45 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

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

Section A
Answer **all** questions in the spaces provided on the Question Paper.

Section B
Answer all **three** questions. The last question is in the form of either/or.
Write your answers in the spaces provided on the Question Paper.

Electronic calculators may be used.

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

This document consists of **20** printed pages, including this cover page.

Section A

Answer **all** questions.

Write your answer in the spaces provided.

1 A student investigated the volume of water lost in one hour by different species of plants at different temperatures.

Fig. 1.1 shows the results.

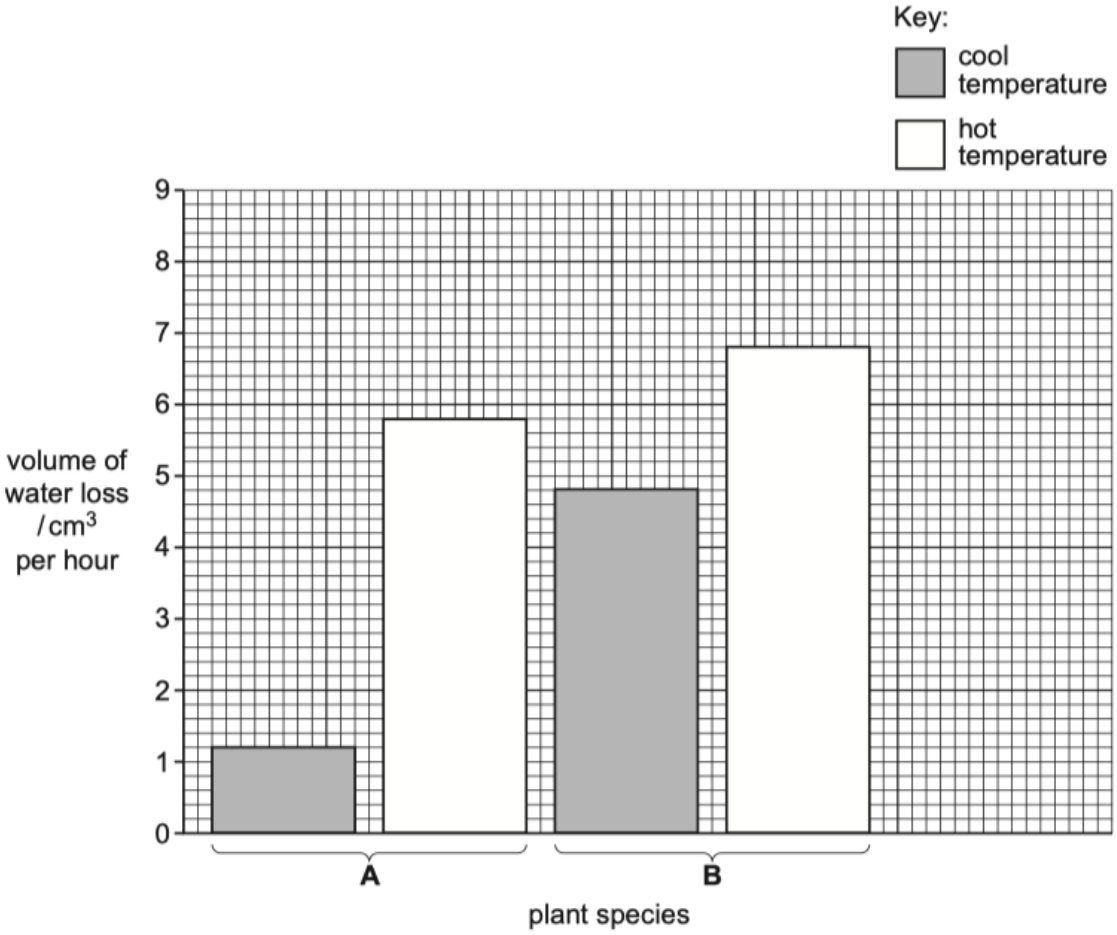

Fig. 1.1

(a) Compare the volume of water loss in species **A** and species **B**.

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..... [3]

(b) The investigation was repeated with increased humidity.
The temperature was cool.

Draw **one** additional bar **on Fig. 1.1**, for species **B** only, to show the expected result.

[2]

(c) State the name of the vessels that transport water through a plant.

..... [1]

[Total: 6]

2 Fig. 2.1 shows two photomicrographs of a cross-section of trachea.

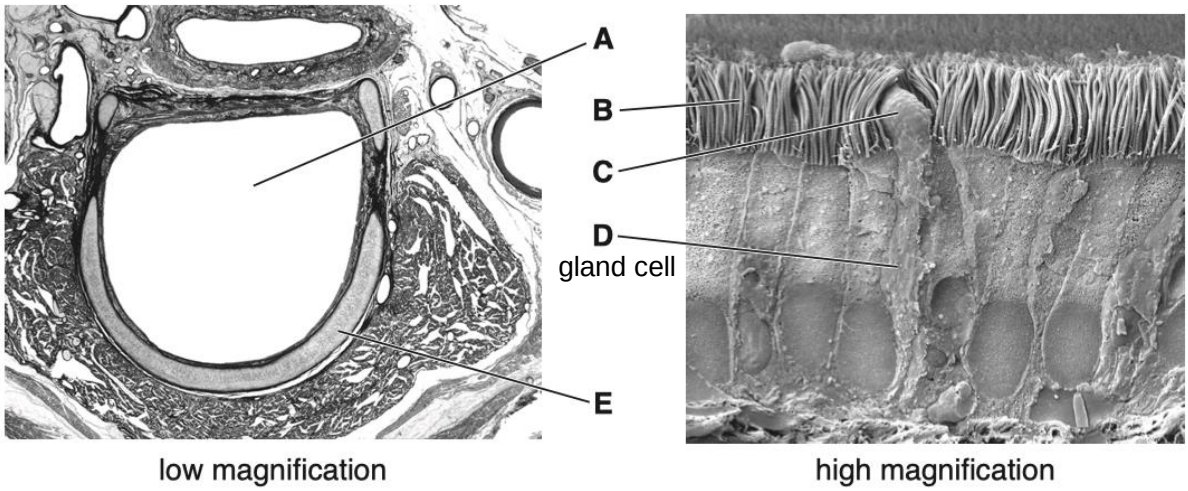


Fig. 2.1

The open space at the centre of the trachea is labelled **A** in Fig. 2.1. Air travels into and out of the trachea through this open space.

(a) Identify the following structures or substances in Fig. 2.1 and explain their functions.

structures	functions
B: ……..……	
C: ……..……	
E: ……..……	

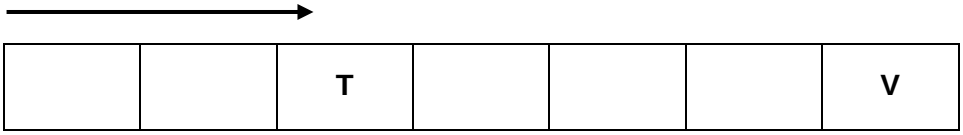
[3]

(b) **(i)** Table. 2.1 shows some events during inspiration.

Table 2.1

P	pressure in the thorax decreases
Q	air travels down the trachea
R	air enters the bronchi
S	air travels through the larynx
T	air enters the nose
U	the ribcage moves upwards and outwards
V	air enters the alveoli

Put the events shown in Table. 2.1 into the correct sequence.



[2]

(ii) Suggest why alveoli have thin walls.

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..... [2]

[Total: 7]

3 Fig. 3.1 shows part of the circulatory system, and some of the structures associated with organ **B**.

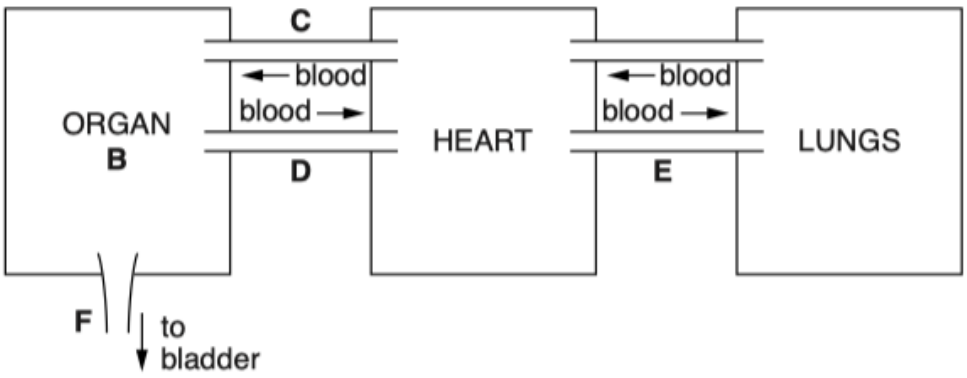

Fig. 3.1

(a) Name organ **B** in Fig. 3.1 …… [1]

(b) Name the blood vessels **C** and **E** in Fig. 3.1

C ……

E …… [2]

(c) Complete Table 3.1 to show **four** differences between the contents of **F** and the blood vessel, **C**, in a healthy person.

Table 3.1

difference	**C**	**F**
1		
2		
3		
4		

[4]

[Total: 7]

4 **(a)** Fig. 4.1 shows the changes that happen to the thickness of the uterine lining during the menstrual cycle.

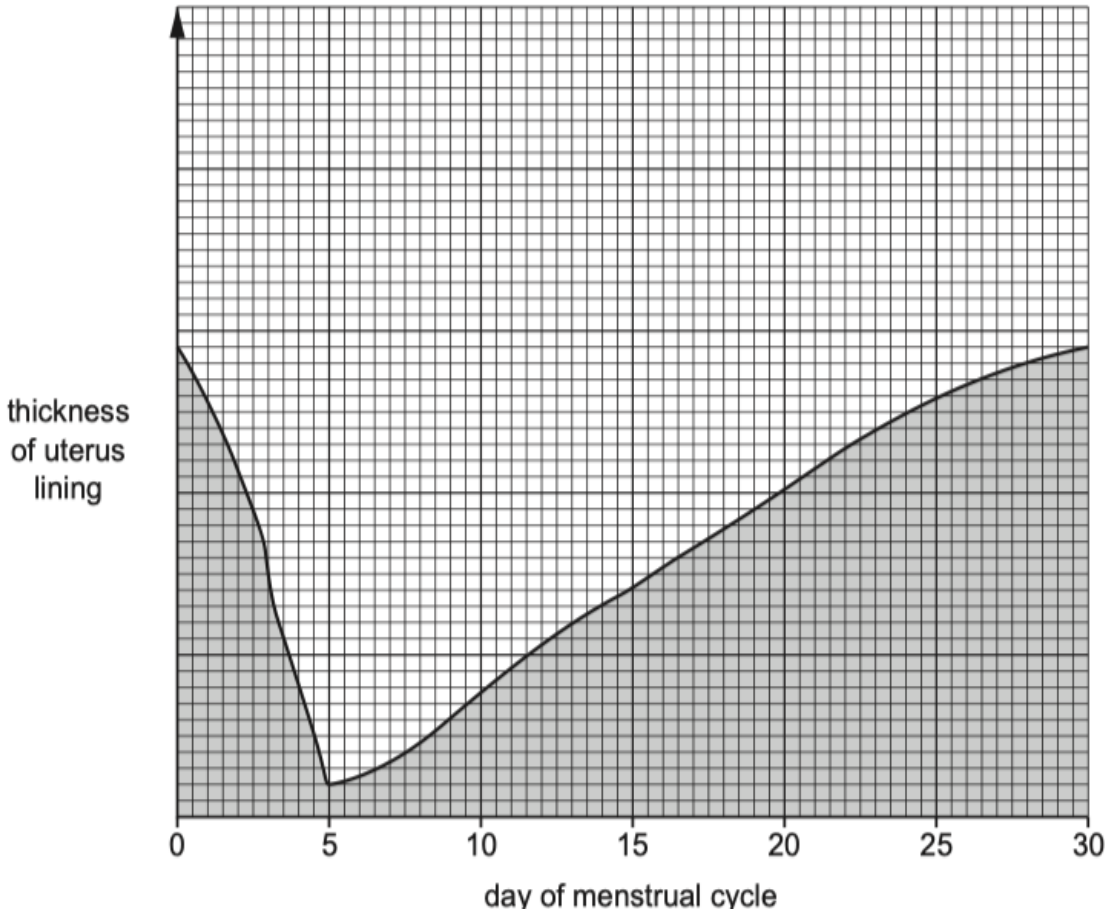

Fig. 4.1

Use Fig. 4.1 to answer the following questions:

(i) State the number of days of this menstrual cycle. .....

(ii) State the number of days that menstruation lasts. .....

(iii) State the day on which ovulation is most likely to occur. .....

(iv) State one day when the uterus lining is at its thickest. .....

[4]

[Total: 4]

5 Apple scab is a disease that infects apple trees. Fig. 5.1 shows apples from uninfected and infected apple trees.

uninfected apple tree

infected apple tree

Fig. 5.1

There is a gene that determines whether or not apple trees are resistant to apple scab disease. There are two alleles for this gene:

- disease-resistant, **R**
- not disease-resistant, **r**

(a) A farmer wanted to do a test cross to identify the genotype of disease-resistant apple trees. This would tell him whether his trees were either homozygous dominant or heterozygous.

Determine the phenotypes of the offspring if the unknown parent apple tree was heterozygous. Complete the genetic diagram:

parental phenotypes disease-resistant x not disease-resistant

parental genotypes …… x ……

gametes x

offspring genotype ……

offspring phenotype ……

[5]

(b) The farmer wanted to breed disease-resistant apple trees. He decided not to use heterozygous disease-resistant apple trees in his selective breeding programme.

Explain why.

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..... [2]

(c) **(i)** The farmer wanted to be sure that only the selected disease-resistant apple trees would reproduce. Suggest what the farmer could do to ensure that only the selected apple trees were pollinated.

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..... [1]

(ii) Describe how artificial selection differs from natural selection.

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OUT OF SYLLABUS

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..... [2]

[Total: 10]

6 **(a)** Define the term *gene*.

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..... [2]

(b) A gene mutation occurs when part of the DNA on a single chromosome is changed. State two factors that may increase the rate of gene mutation.

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..... [2]

(c) Sickle cell anaemia is caused by a gene mutation. Fig. 6.1 shows red blood cells from a healthy person and from a person with sickle cell anaemia.

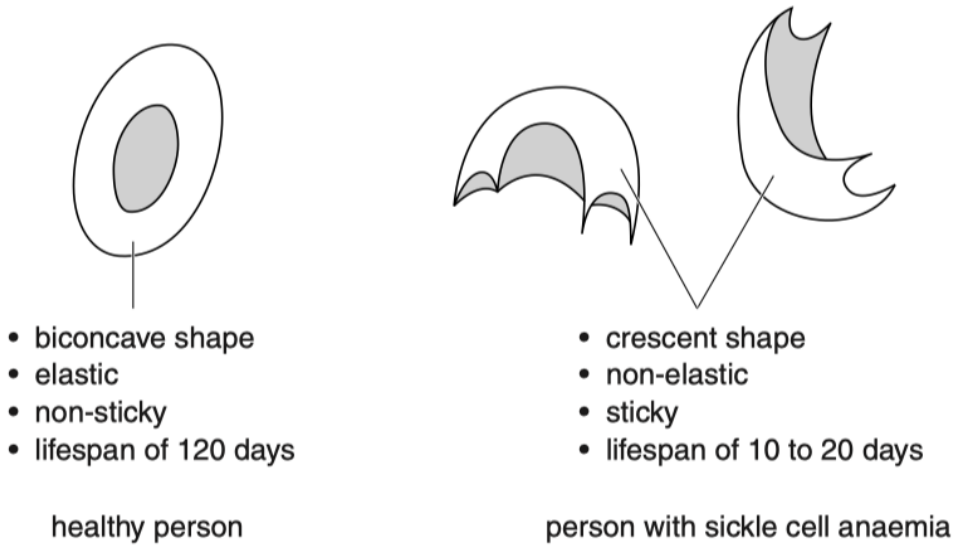

Fig. 6.1

Fig. 6.2 shows the flow of red blood cells through a blood vessel in a healthy person and in a person with sickle cell anaemia.

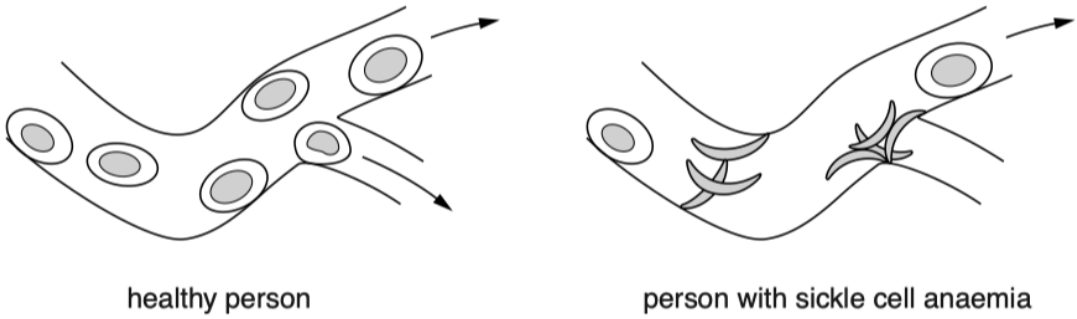

Fig. 6.2

Use information from Fig. 6.1 and Fig. 6.2 to suggest why the transport of oxygen to tissues is reduced in a person with sickle cell anaemia.

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..... [4]

[Total: 8]

7 A group of scientists investigated the total mass of carbon dioxide released when animals and plants are farmed and then used as food for humans.

(a) The total mass of carbon dioxide released for each food in the study included the mass released:

- during production of the food by farming
- after the food left the farm and before it was eaten.

Suggest and explain how human activity may result in the release of carbon dioxide after food has left the farm on which it was produced.

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..... [3]

(b) Some of the results of the investigation are shown in Table 7.1.

Table 7.1

food produced	mass of CO_2 released per kg of food produced / kg
beef	27.0
salmon	11.9
chicken	6.9
eggs	4.8
potatoes	2.9
rice	2.7
beans	2.0
tomatoes	1.1

(i) A farmer decides to change production from beef to tomatoes. Calculate the percentage change in carbon dioxide released per kg of food produced.

Space for working.

…… [1]

(ii) The choice of food in a diet can have a big impact on a person's carbon footprint. An increasing number of people choose to eat a diet consisting **only** of plants.

Use the results in Table 7.1 and your scientific knowledge to explain how this choice of diet may benefit the environment.

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..... [4]

[Total: 8]

Section B

Answer **three** questions.

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

8 Warm blooded animals need to maintain a constant internal body temperature. In cold weather some of these animals crowd together in groups.

Some students used test-tubes containing hot water to represent animals in an investigation into the loss of heat from animals' bodies.

One test-tube, **A**, represented one animal on its own, as shown in Fig. 8.1.

Another test-tube, **B**, represented an animal surrounded by seven similar animals in a group, as shown in Fig. 8.2.

Test-tube **C** represented one of the outer animals in the group, as shown in Fig. 8.2.

Fig. 8.1

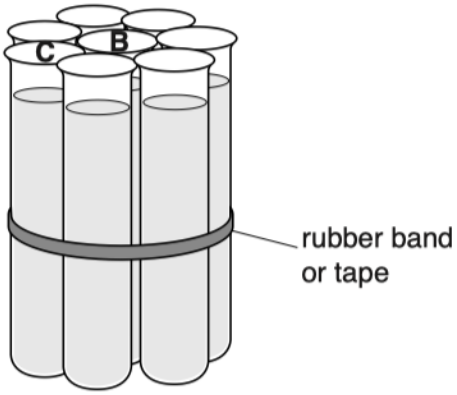


Fig. 8.2

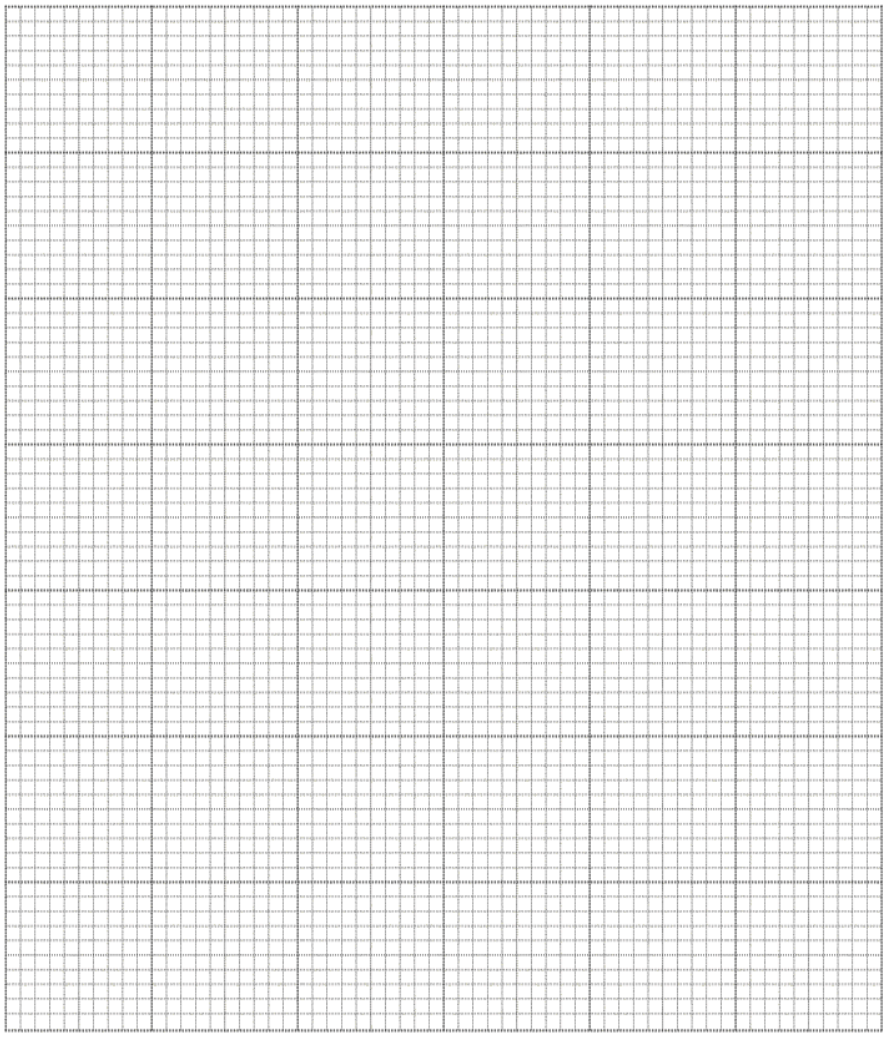
All nine test-tubes were filled with water at 70°C. The temperature of the water in test-tubes **A**, **B** and **C** was measured when the tubes were filled and then every two minutes for a total of ten minutes.

The results are shown in Table 8.1.

Table 8.1

time / minutes	temperature/ °C		
	tube **A**	tube **B**	tube **C**
0	70	70	70
2	63	69	68
4	54	69	66
6	47	68	64
8	44	68	62
10	36	67	60

(a) **(i)** On the grid below, plot the results for the three test-tubes **A**, **B** and **C** on the same axes. [5]



(ii) Describe and compare the temperature changes in test-tubes **A**, **B** and **C**.

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..... [3]

(iii) Suggest and explain one way to improve this investigation to make the results more reliable.

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..... [2]

(b) Suggest how animals crowding together in a group can help them to maintain body temperature in cold weather.

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..... [2]

[Total: 12]

9 Accommodation (focusing) is one of the functions of the eye.
Fig. 9.1 is a diagram of an eye that is focusing on a distant object.

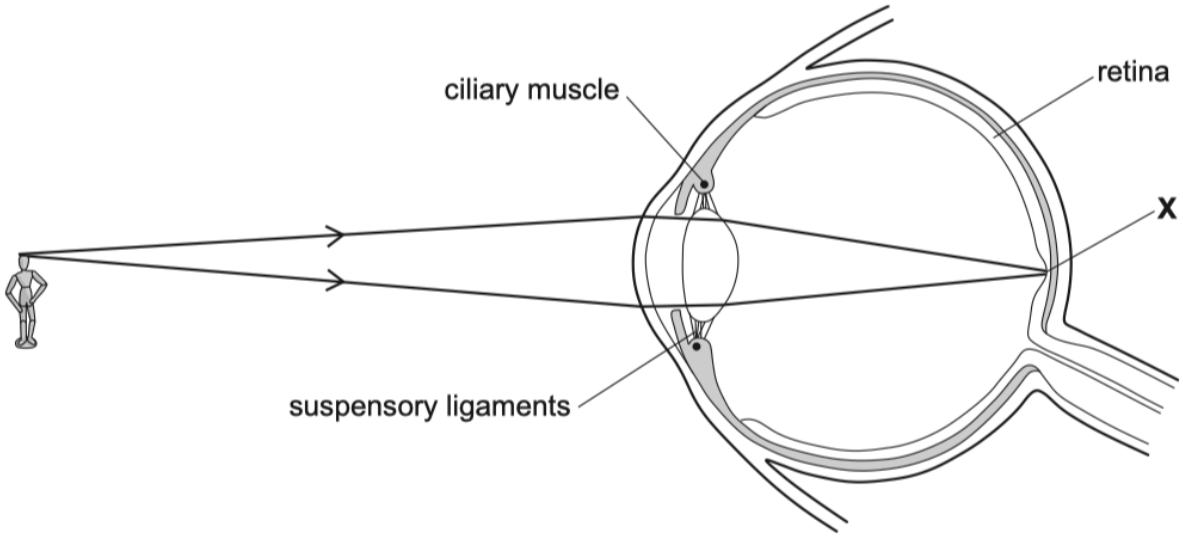

Fig. 9.1

(a) Describe the roles of the ciliary muscles and suspensory ligaments in focusing on a **distant object**, as shown in Fig. 9.1.

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..... [4]

(b) Fig. 9.2 is an incomplete diagram of an eye that is focusing on a **near object**.

Complete Fig. 9.2 by **drawing** the shape of the lens, suspensory ligaments and the light rays from the object to the retina. [4]

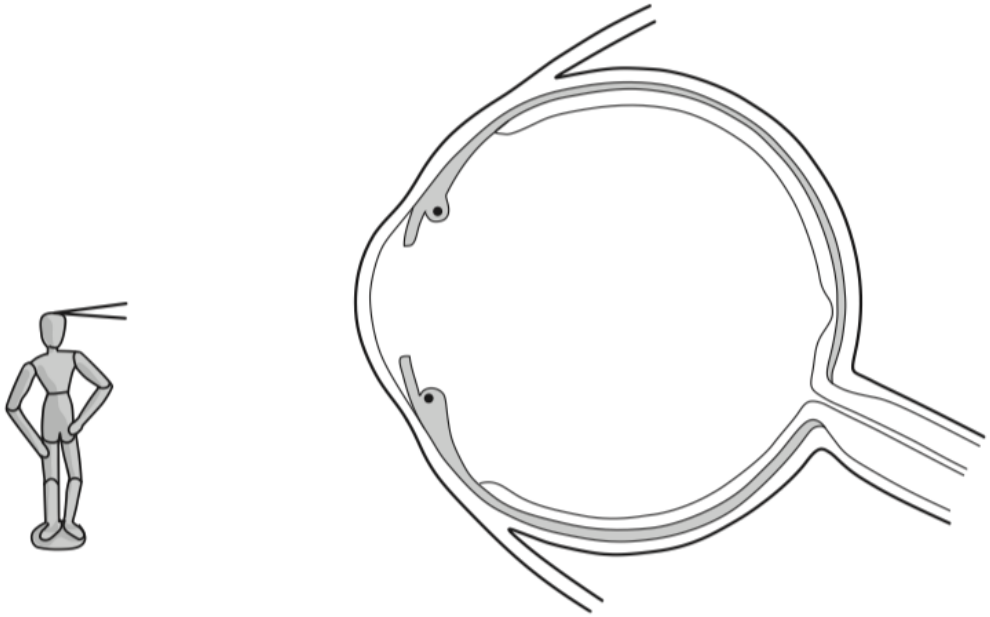

Fig. 9.2

[Total: 8]

Either

10 Fig. 10.1 shows a few bees with pollen on their legs.

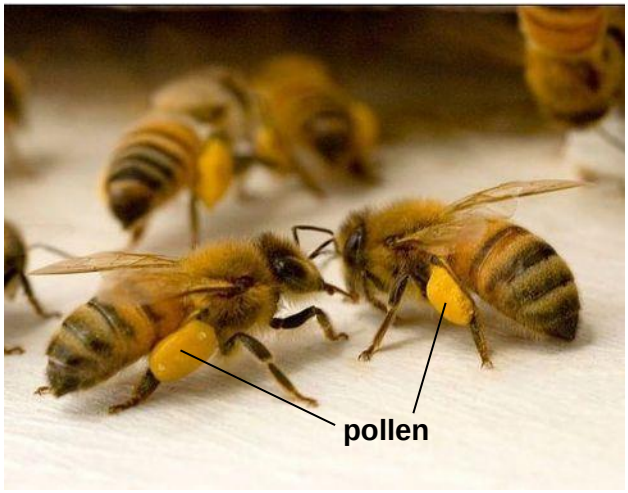

Fig. 10.1

(a) State where pollen is produced in a flower. …….. [1]

(b) Describe the ways in which flowers and pollen grains are adapted for insect pollination.

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..... [6]

(c) Name the process that produces haploid pollen nuclei.
Explain why it is important that the pollen nuclei are haploid.

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..... [3]

[Total: 10]

Or

10 **(a)** State the functions of the aorta and the vena cava and describe how each is adapted for its functions.

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..... [7]

(b) Some babies are born with a hole in their heart that allows blood to pass between the left and the right sides of the heart. Suggest how this condition may affect the efficiency of their circulatory system.

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..... [3]

[Total: 10]