NAME:		( )	CLASS:	

YISHUN TOWN SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2024

SEC 4 EXPRESS

BIOLOGY

(6093/2)

DATE : 26 August 2024 **DAY : Monday**

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

READ THESE INSTRUCTIONS FIRST

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

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

Section B
Answer **one** question. Write your answers in the spaces provided.

INFORMATION FOR CANDIDATES

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

You may use an approved calculator.

Section A	
Section B	
TOTAL	

This question paper consists of **18** printed pages

SECTION A (70 MARKS)

Answer **all** questions in this section.

1 The malarial pathogen, *P. falciparum*, enters red blood cells after a person becomes infected. **Fig. 1.1** shows a sample of an infected person's blood with 3 red blood cells which are infected with *P. falciparum*.

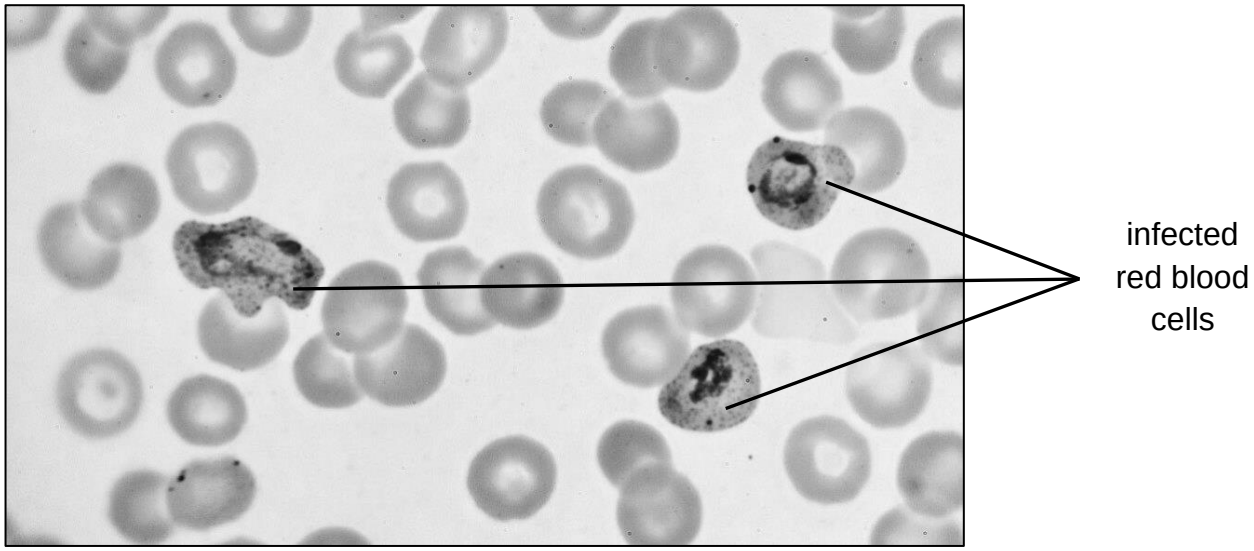

Fig. 1.1

(a) With reference to **Fig. 1.1**, suggest two ways how the presence of *P. falciparum* affects a red blood cell. [2]

1. ...……

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2. ...……

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(b) Using your answers from **(a)**, explain how the change might affect the function of the red blood cell. [2]

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(c) State three other components of blood not shown in **Fig. 1.1**. [2]

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2 Plants have specialised cells for the efficient transport of manufactured food.

Table 2.1 shows some of the features of two different types of cells found in plant tissue, which are adapted for the efficient transport of manufactured food.

feature of cell	cell type A	cell type B
cytoplasm	✓	✓
nucleus	×	✓
mitochondria	none	many
cellulose in the cell wall	✓	✓
ribosomes	×	✓

Key
✓ present
× absent

Table 2.1

(a) Name three substances that are transported by these specialised cells. [2]

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(b) Identify both cell types: [2]

Cell type **A**:……

Cell type **B**:……

(c) Explain how both cells work together to perform their function. [2]

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3 **Fig. 3.1** shows some common morning glory flowers in two different colours.

Fig. 3.1

The gene that determines flower colour in the morning glory plant has two alleles:

- a dominant allele that results in purple flowers, **A**
- a recessive allele that results in red flowers, **a**

Two heterozygous morning glory plants were crossed and their F_1 generation is grown in an open field.

(a) Using your knowledge of monohybrid inheritance, complete the genetic diagram to predict the ratio of the colour of the flowers of the F_1 generation. [4]

Phenotype of parents: …… ……

Genotype of parents: …… ……

Gametes: …… …… …… ……

Genotype of F_1 generation: …… …… …… ……

Phenotype of F_1 generation: …… …… …… ……

Ratio of F_1 generation: ……

(b) A student observed the flower colour of all the morning glory plants in the field and recorded 660 plants with purple flowers and 440 plants with red flowers.

(i) State the observed ratio. [1]

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(ii) Suggest why the ratio in **(a)** is different from the ratio in **(b)(i)**. [2]

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(c) State the expected ratio of the plants that are homozygous dominant to the plants that are heterozygous for flower colour in the F_1 generation in **(a)**. Hence, use it to calculate the expected number of heterozygotes in the open field. Show your working. [2]

Ratio: ……

Expected number of heterozygotes: ……

(d) A particular morning glory plant in Japan has over 20 different flower colour phenotypes, including shades of blue, purple, red and pink.

The flower colour of Japanese morning glory is controlled by at least four genes. The flower colour can change gradually after the flowers open each morning and can change with fluctuations in the carbon dioxide concentration of the surrounding air.

A student concluded that the flower colour phenotype in Japanese morning glory shows continuous variation.

Suggest **two** reasons why the student made this conclusion. [2]

1. ……

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2. ……

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4 Scientists investigated the response of stomata to changing carbon dioxide (CO_2) concentrations in the butterfly pea plant.

The scientists placed butterfly pea plants in chambers. They measured the width of open stomata (stomatal apertures) after the plants had been exposed to different CO_2 concentrations for 40 minutes. Other environmental factors were kept constant.

The relationship between CO_2 concentration and the average width of stomatal apertures is shown in **Fig. 4.1**.

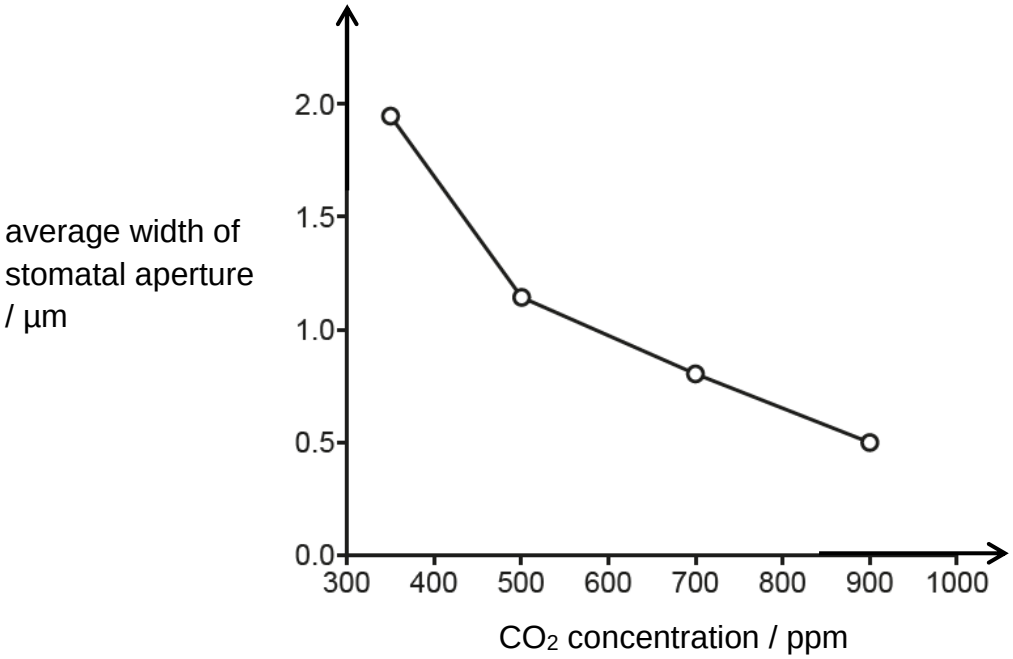

Fig. 4.1

(a) State two key environmental factors that were kept constant. [2]

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(b) In 2016, a study measured the atmospheric CO_2 concentration as 400 ppm.

In the future, climate change may reduce water availability and increase atmospheric CO_2 concentrations in some habitats.

Suggest how the stomatal response shown in **Fig. 4.1** would allow the butterfly pea plant to survive the effects of climate change. [2]

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(c) In another experiment, scientists investigated the effect of temperature on a certain process in the butterfly pea plant. **Fig. 4.2** shows how the rate of release of oxygen by a plant varies with temperature on a sunny day.

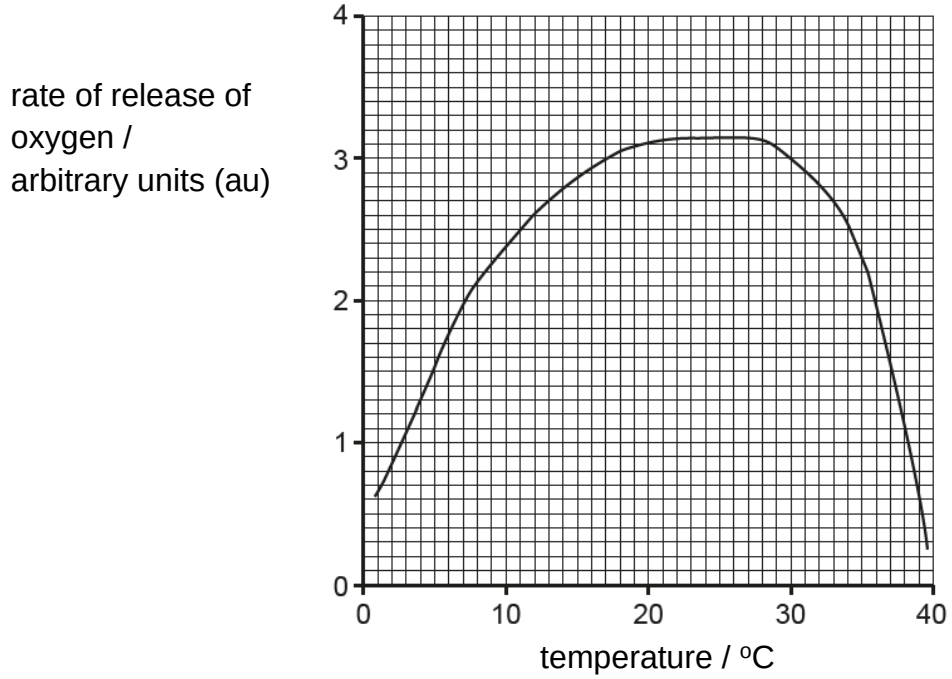

Fig. 4.2

(i) Calculate the average increase in rate of release of oxygen as the temperature increases from 5°C to 20°C. Show your working. Give your answer to **two** decimal places. [2]

(ii) Suggest why the rate of release of oxygen **levels off and then decreases** after 20°C. [3]

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(iii) On **Fig. 4.2**, sketch a curve to show the rate of release of oxygen on a cloudy day. [1]

5 The potato plant is an important food crop. Crop yield (amount of crop harvested) is reduced if the leaves of the plant are eaten by the larvae of the potato bug.

Scientists used genetic engineering to create two genetically modified (GM) varieties of potato plant. These plants produce proteins that are poisonous to insects.

- GM potato variety **A** contains a new gene.
- GM potato variety **B** contains another new gene.

The new varieties were tested by having a constant number of potato bug larvae introduced to the plants at time 0 hours. The number of larvae that were alive after 24, 48 and 72 hours was recorded. The percentage of the larvae that had died in each time interval was calculated. This was repeated for potato plants that had not been genetically modified (non-GM).

Table 5.1 shows the percentage of potato bug larvae that had died on the GM potato plant varieties and on non-GM potato plants.

Table 5.1

type of potato plant	**percentage of potato bug larvae that had died**		
	24 h	**48 h**	**72 h**
GM potato variety **A**	50	93	100
GM potato variety **B**	37	70	93
Non-GM potato	0	0	0

(a)(i) Define *genetic engineering*. [2]

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(ii) Suggest why the scientists created two different types of GM potato plant. [1]

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(iii) State why the scientists also performed the test on non-GM potato plants. [1]

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(b) Suggest how the results in **Table 5.1** provide information that could help to solve the global demand for food. [3]

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6 **Fig. 6.1** and **Fig. 6.2** show pollination in two insect-pollinated flowers of the same species.

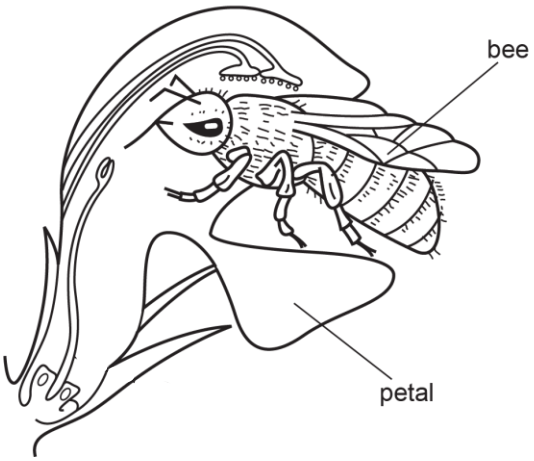

Fig. 6.1

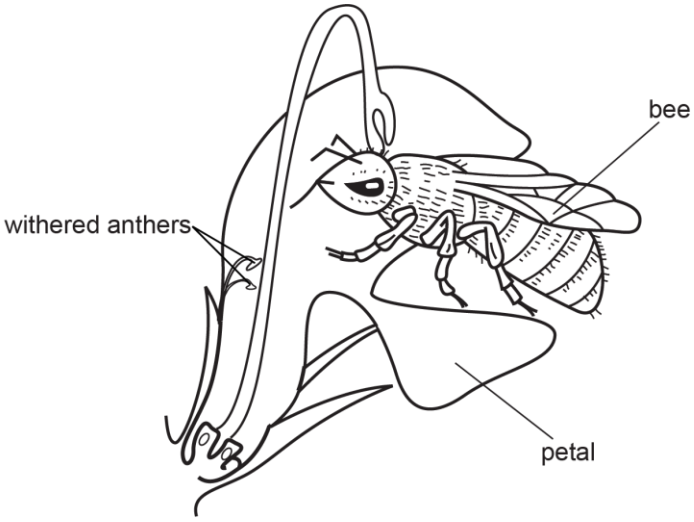

Fig. 6.2

(a) Describe what happens to the pollen in **Fig. 6.1** and **Fig. 6.2**. [2]

Fig. 6.1 ……

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Fig. 6.2 ……

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(b) With reference to **Fig. 6.1** and **Fig. 6.2**, explain how these flowers are adapted to make it more likely that cross-pollination will take place. [2]

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(c) **Fig. 6.3** is a section through the fruit of a pea plant showing some of its seeds.

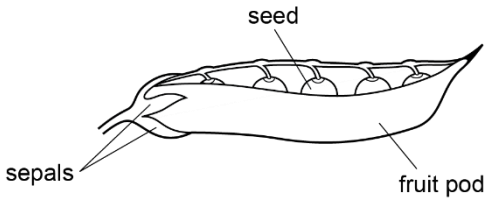

Fig. 6.3

Explain why the cells of the fruit pod, as shown in **Fig. 6.3**, are genetically different from the cells of the embryo in the seeds. [2]

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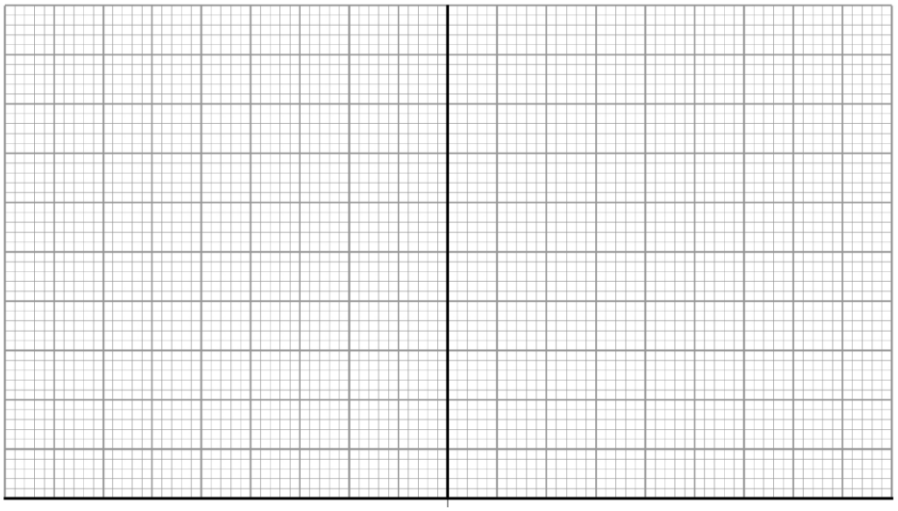
7 The food chain below shows some organisms in a river and the biomass of the organisms at each trophic level.

	algae	→	invertebrate animals	→	small fish	→	large fish
Biomass in g/m^2:	800		200		80		20

(a) Draw a pyramid of biomass for the food chain using the grid below. [2]



(b) Pollutants such as mercury may be directly discharged into the river. Describe how the process of bioaccumulation can take place in the small fishes. [2]

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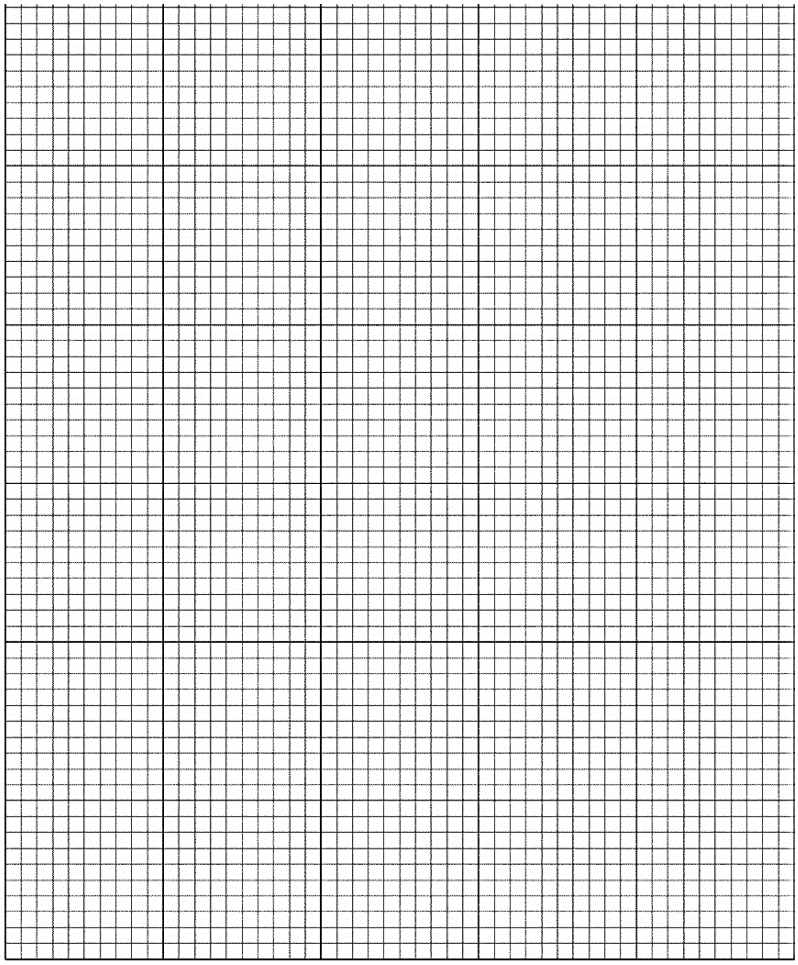
8 The concentration of reducing sugars in grapes changes as the grapes age (get older). **Table 8.1** shows the concentration of reducing sugars for grapes of different ages.

Table 8.1

age of grapes / days	concentration of reducing sugars / %
14	1.1
28	1.9
42	2.6
56	3.9
70	7.5
84	11.3

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



(b) Use your graph in **(a)** to estimate the age of the grapes that were used to make a grape extract that has a reducing sugar concentration of 5.6 %. Show your working on the graph. [1]

age of the grapes ……..…….

(c) In a study, the concentration of amylase in grapes was measured as the grapes aged. The results of the study are shown in **Fig. 8.2**.

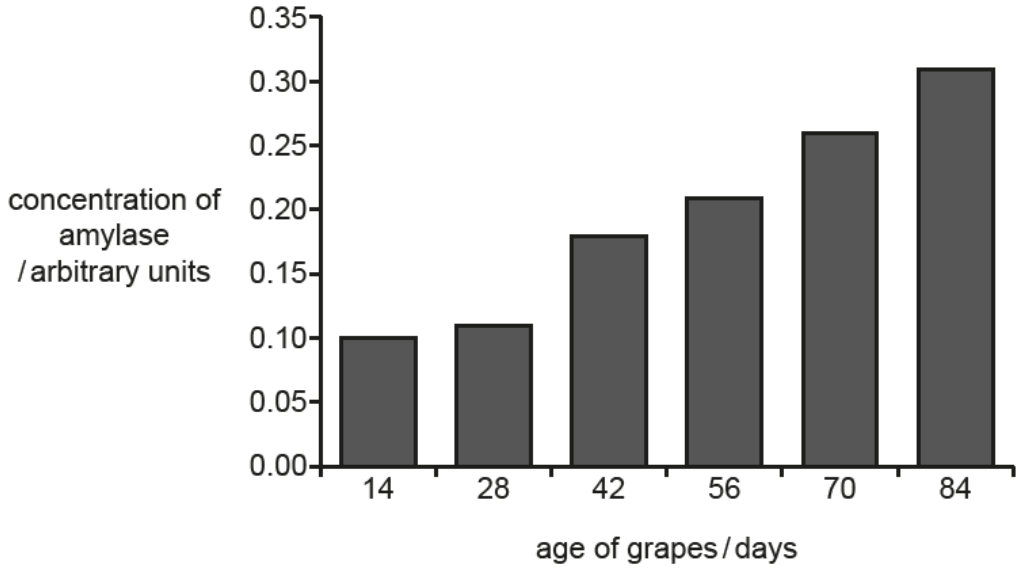


Fig. 8.2

With reference to the graph in **(a)** and **Fig. 8.2**, explain the change in the concentration of reducing sugars in grapes as they age. [3]

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(d) Explain how the presence of reducing sugars can be determined using the results of a Benedict's test. [2]

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9 **Fig. 9.1** shows a foetus in its mother's body shortly before it is born.

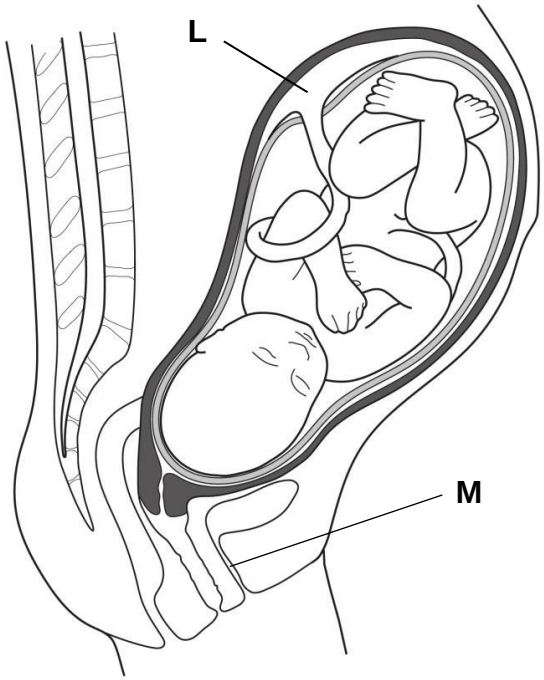

Fig. 9.1

(a) Identify structure **L** and describe its function. [3]

identity: ……

function: ……

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(b) Identify structure **M** and describe its function. [2]

identity: ……

function: ……

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(c) A sample of amniotic fluid containing skin cells belonging to the foetus was collected and analysed. The chromosomes found in the cells are shown in **Fig. 9.2**.

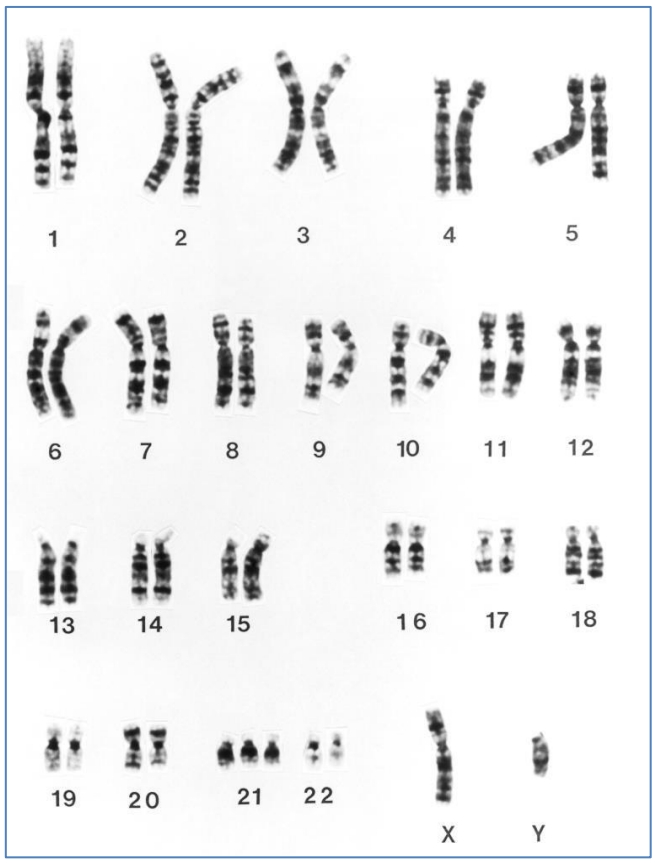

Fig. 9.2

(i) With reference to **Fig. 9.2**, suggest the sex and health of the foetus. [3]

sex: ……

health: ……...

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(ii) Name and describe a hereditary disease which cannot be detected from **Fig. 9.2**. [2]

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SECTION B (10 MARKS)

Answer **ONE** question.

10 Antidiuretic hormone (ADH) is involved in osmoregulation in the body. A student drank 0.5 dm^3 of water and the concentration of ADH in their blood was measured every 30 minutes for 3 hours. **Fig. 10.1** shows the results of this investigation.

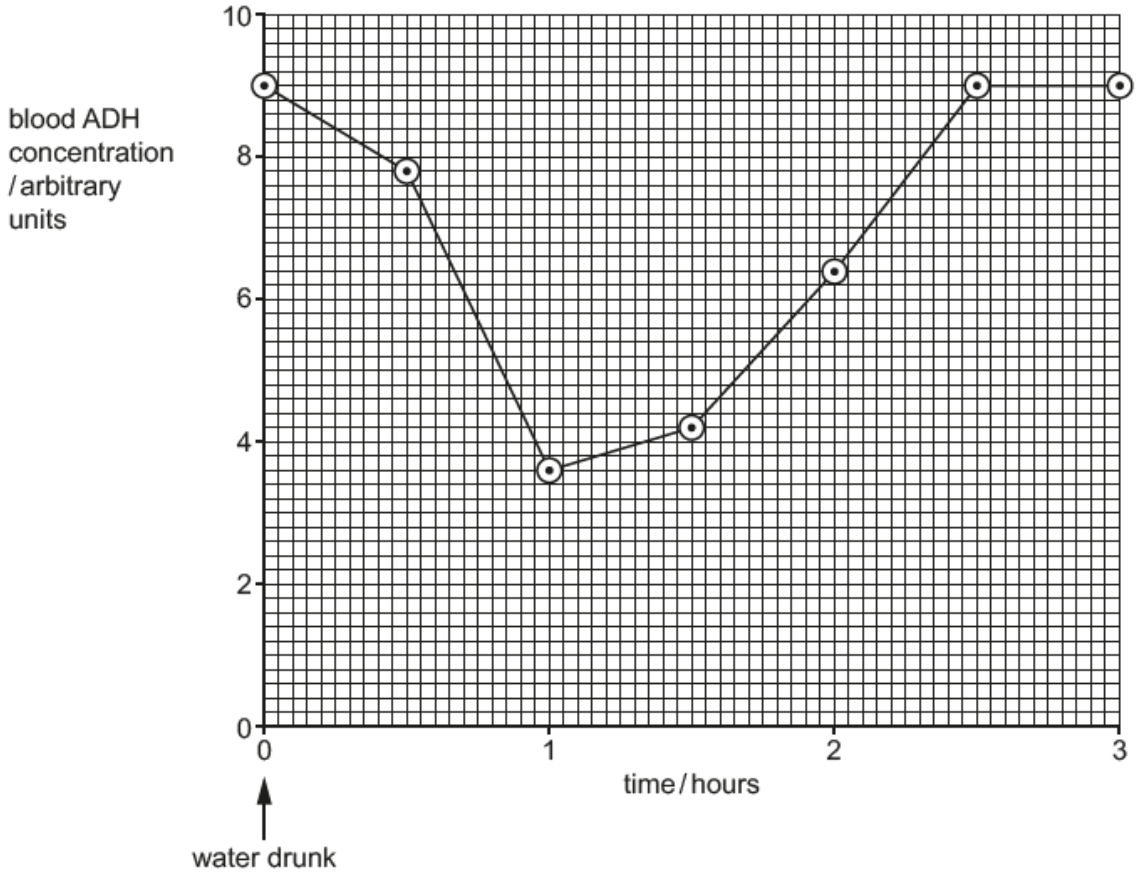

Fig. 10.1

(a) Explain the results shown in **Fig. 10.1**. [4]

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(b) Explain the term *osmoregulation*. [2]

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(c) Compare the similarities and differences between the endocrine control and the nervous control. [4]

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11 Some people are infected with HIV across the world.

(a) **Fig. 11.1** shows the number of people who have been newly infected with HIV (new infections) in 2018 across the world and the percentage changes in the number of new infections since 2010.

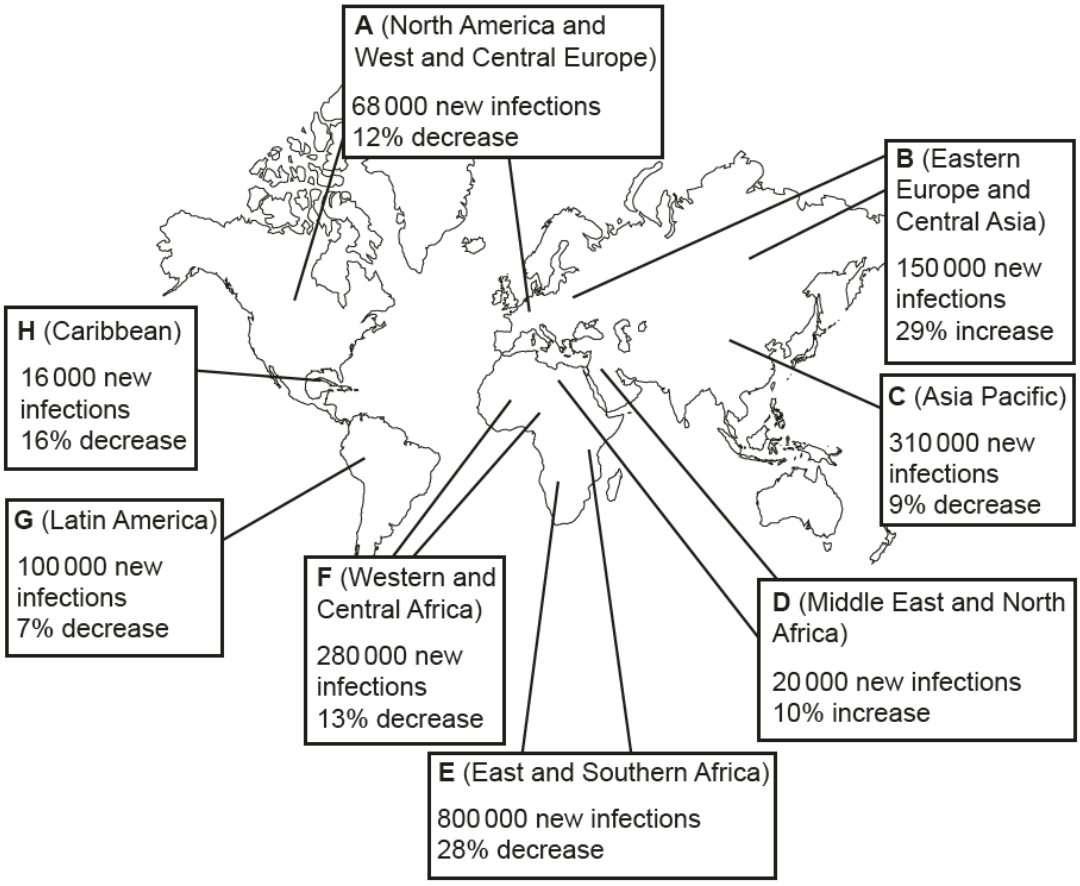

Fig. 11.1

(i) State the name of the disease which is caused by HIV. [1]

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(ii) Using **only** the data in **Fig. 11.1**, state two conclusions that can be made about the change in number of new HIV infections across the world between 2010 and 2018. You may use the letters in **Fig. 11.1** to identify the regions of the world. [3]

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(b) HIV infection cannot be treated using vaccination while other diseases due to viral infections can.

Define *vaccination* and how it can be used to prevent viral infections. [6]

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