



**TANJONG KATONG GIRLS' SCHOOL
PRELIMINARY EXAMINATION
SECONDARY FOUR EXPRESS
BIOLOGY**

CANDIDATE
NAME

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CLASS

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INDEX
NUMBER

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BIOLOGY

Paper 2

6093/02

18 August 2025

1 hour 45 minutes

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

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.
You may use a HB pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.

Section A

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

Section B

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

The use of an approved scientific 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	
Section A	
Section B	
Total	/ 80

This document consists of **22** printed pages.

Section A

Answer **all** questions.

- 1 A student investigates the uptake of potassium ions by root tissue.

A root is cut into four discs of uniform size. Each disc is added to an equal volume of a solution containing a fixed potassium ion concentration.

The experiment is carried out in different oxygen concentrations. The results are shown in Table 1.1.

Table 1.1

oxygen concentration / arbitrary units	0	4	11	20
rate of potassium ion uptake / arbitrary units	7	27	92	100

- (a) State, with a reason, one **other** variable that should be kept constant.

.....
.....
..... [2]

- (b) Using the information in Table 1.1, state and explain the **main method** by which potassium ions are taken into the root.

.....
.....
.....
.....
..... [3]

- (c) Suggest why the investigation uses four discs from one root tissue instead of one disc each from four root tissues.

.....

.....

..... [2]

- (d) The tissue given 0 arbitrary units of oxygen is then placed in concentrated sucrose solution.

Complete Fig. 1.1 which shows the cell wall to show the appearance of the cell after 30 minutes. Label the nucleus and cytoplasm.



Fig. 1.1

[2]

[Total: 9]

2 (a) State a metabolic waste product removed by the kidneys.

..... [1]

(b) Describe and explain the difference in water potential of glomerular filtrate and urine.

.....
.....
.....
.....
..... [3]

(c) Glomerulonephritis is a type of kidney disease. It involves damage to the glomeruli in the kidneys. One of the symptoms of glomerulonephritis is foamy urine caused by the presence of proteins in the urine.

(i) Explain how proteins end up in the urine.

.....
.....
..... [2]

(ii) State the elements and basic units contained in proteins.

elements

basic units [2]

[Total: 8]

- 3 Fig. 3.1 shows the stem of the *Myrmecodia* plant. It has a symbiotic relationship with ants in which both types of organisms benefit from the other.

The stem of the plant has many chambers which the ants live in.

The ants collect the nectar from the flowers and carry it to the chambers.

The chambers contain faeces produced by the ants and structures that absorb nutrients for the plants.

Faeces of ants contain proteins.

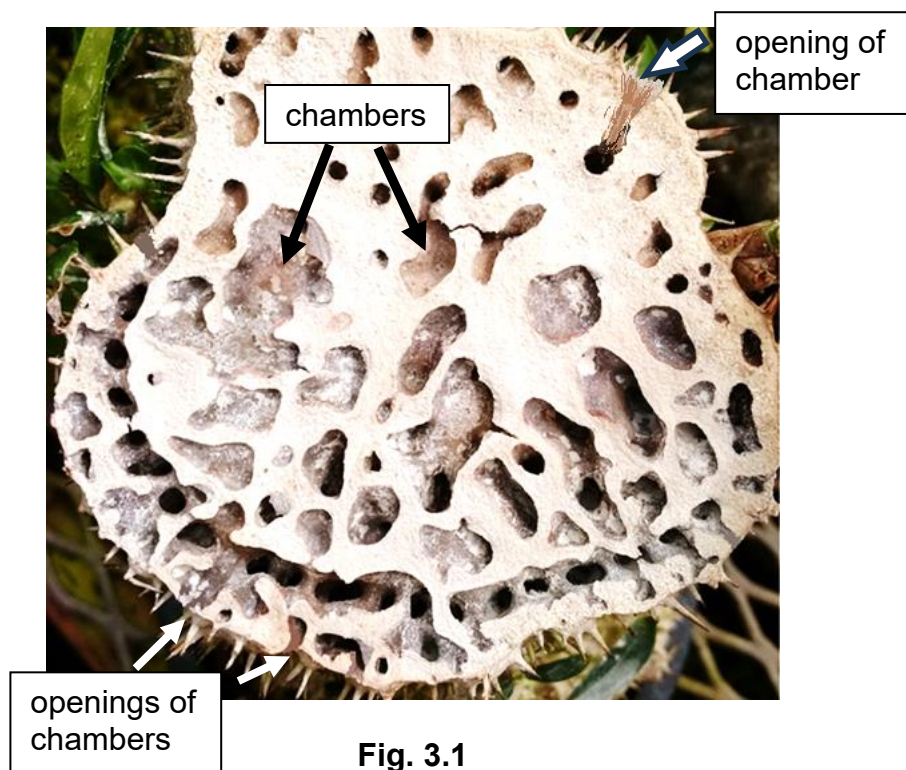


Fig. 3.1

- (a) Explain how faeces produced by ants can be used by the plant for growth.

.....

.....

.....

.....

.....

..... [3]

(b) State whether the environment in which the plant is growing is nutrient-rich or poor.

..... [1]

(c) Describe how ants obtain raw materials to carry out aerobic respiration.

.....

.....

.....

..... [2]

[Total: 6]

4 Fig. 4.1 shows part of the human alimentary canal.

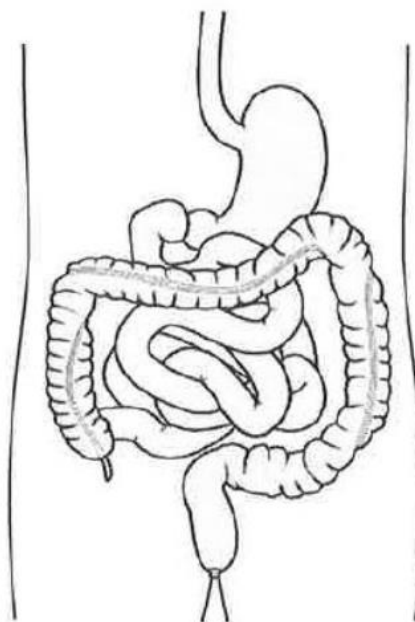


Fig. 4.1

- (a) On Fig. 4.1, name and label the structure
- (i) that is involved in digestion of proteins in acidic conditions, [1]
 - (ii) where most absorption of water takes place, and [1]
 - (iii) where undigested food materials are stored temporarily. [1]
- (b) (i) On Fig. 4.1, draw and label the organ that produces bile. [1]
- (ii) Describe the role of bile in digestion.

.....

.....

.....

..... [2]

(c) Fig. 4.2 shows a region in the human alimentary canal.

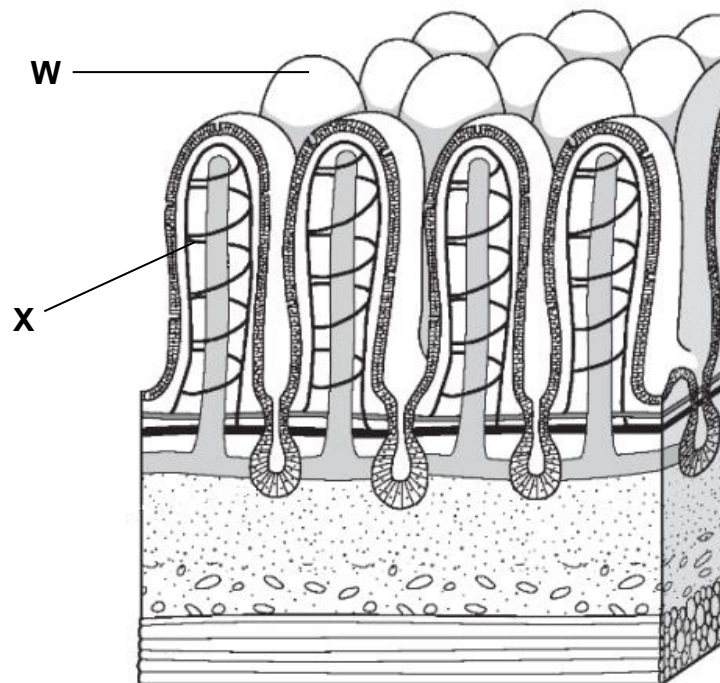


Fig. 4.2

(i) Name structure **W**.

..... [1]

(ii) Explain what may happen if the number of structure **X** is reduced.

.....
.....
..... [2]

[Total: 9]

- 5 Fig. 5.1 shows two varieties of moths of the same species. One variety has pale, speckled wings. A second variety has black wings. There are no intermediate forms.

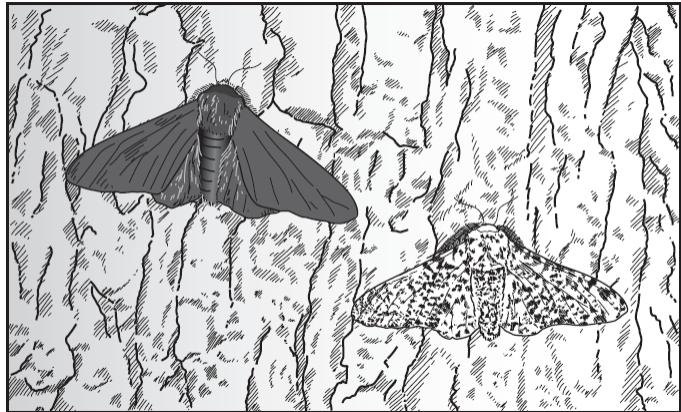


Fig. 5.1

Equal numbers of both varieties are released into the woods made up of trees with pale bark.

- (a) After two years, a survey of the moths is conducted in the area. The results are shown in Table 5.1.

Table 5.1

wing colour of moth	number of moths two years ago	number of moths two years later
pale, speckled	100	113
black	100	36

- (i) Account for the difference in the number of the varieties of moths observed after two years, in relation to the colour of the bark.

.....
.....
.....
..... [3]

- (ii) The area becomes more industrialised with more factories and heavy vehicles 10 years later. The bark of trees is covered with black soot.

Suggest how the number of black winged moth would change.

..... [1]

- (b) A scientist crossed two moths of the same phenotype and finds out that he is able to get more pale, speckled moths as compared to black moths in the next generation.

Using the letters **G** and **g** to represent dominant and recessive alleles respectively,

- (i) state the genotype of both moths he crossed,

..... and [1]

- (ii) construct a genetic diagram to predict the percentage of black-winged moths present in the next generation.

(iii) Explain what is meant by the term *dominant allele*.

.....

.....

..... [1]

[Total: 10]

- 6 (a) Table 6.1 compares the total cross-sectional area of the blood vessels that flow in the skin.

Table 6.1

blood vessels	total cross-sectional area (arbitrary units)
artery	100
capillary	1200
vein	800

- (i) With reference to the data in Table 6.1, explain why the rate of blood flow decreases when the blood flows from the arteriole to the capillary.

.....

 [2]

- (ii) Explain the significance of low rate of blood flow at the capillary.

.....
 [1]

- (b) State two characteristics of the blood flow that are found in **all** veins.

1
 2 [2]

(c) Fig. 6.1 shows an artificial heart.

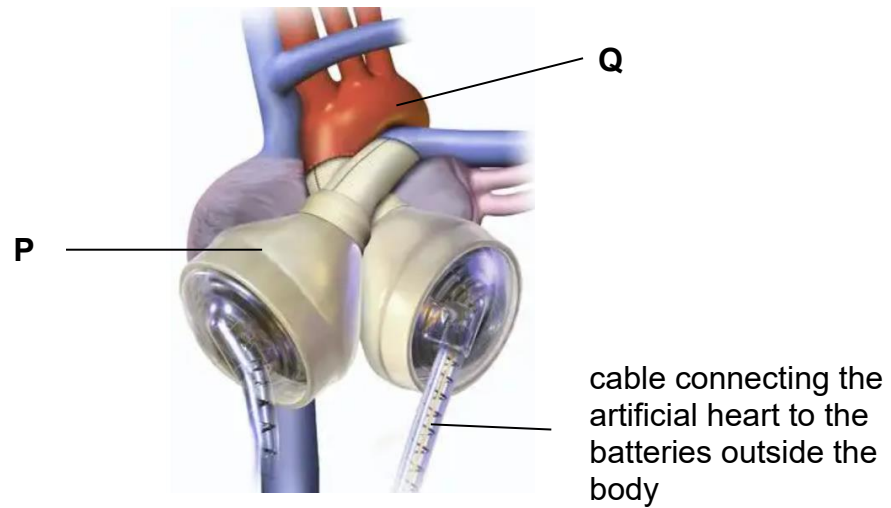


Fig. 6.1

An artificial heart is an implant consisting of plastic pumping chambers and artificial valves. It replaces the failing ventricles of a person's real heart. All heart valves and ventricles are removed from the real heart before installing the artificial heart.

(i) State the organ that receives blood from chamber **P**.

..... [1]

(ii) Name structure **Q**.

..... [1]

(iii) A patient with an artificial heart needs to take medicine containing anticoagulant to prevent the blood from clotting inside the implant. The anticoagulant inhibits the formation of thrombin.

Explain how this can prevent blood clotting.

.....
.....
..... [2]

(iv) State a disadvantage of using anticoagulant.

.....
..... [1]

[Total: 10]

- 7 Fig. 7.1 shows the mass of carbon added to and removed from the atmosphere each year.

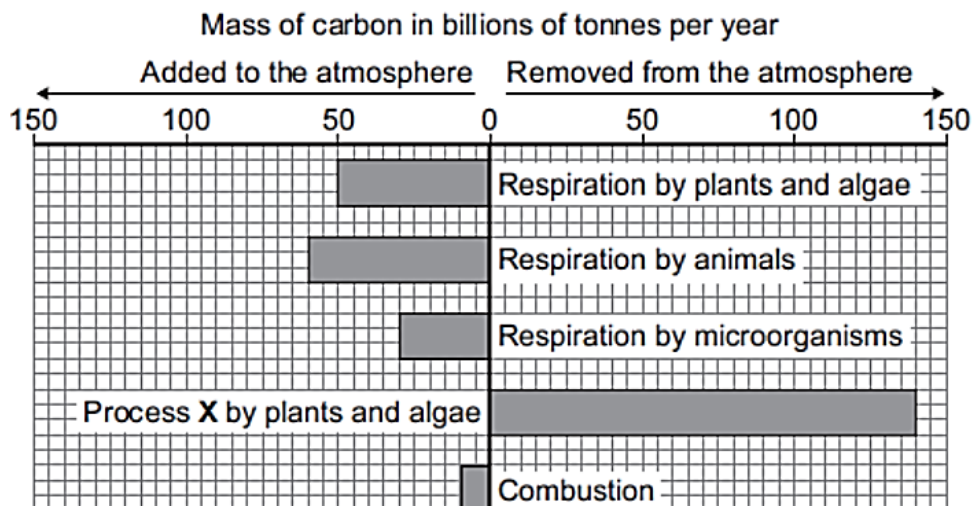


Fig. 7.1

- (a) Name process X.

..... [1]

- (b) Calculate the amount of carbon overall produced by plants and algae in a year. Show your working.

Answer: billions of tonnes [1]

- (c) The carbon compounds added to the atmosphere include carbon dioxide.

Describe another human activity **not** shown in Fig. 7.1 which can increase carbon dioxide level in the atmosphere.

.....

 [2]

- (d) Other than polluting the atmosphere by producing carbon dioxide when plastics are burnt, plastics can also affect food chains.

Explain how plastics may be found in large amounts in higher trophic levels.

.....

.....

..... [2]

[Total: 6]

- 8 Fig. 8.1 shows the blood volume supplied to some parts of the body at different levels of activity.

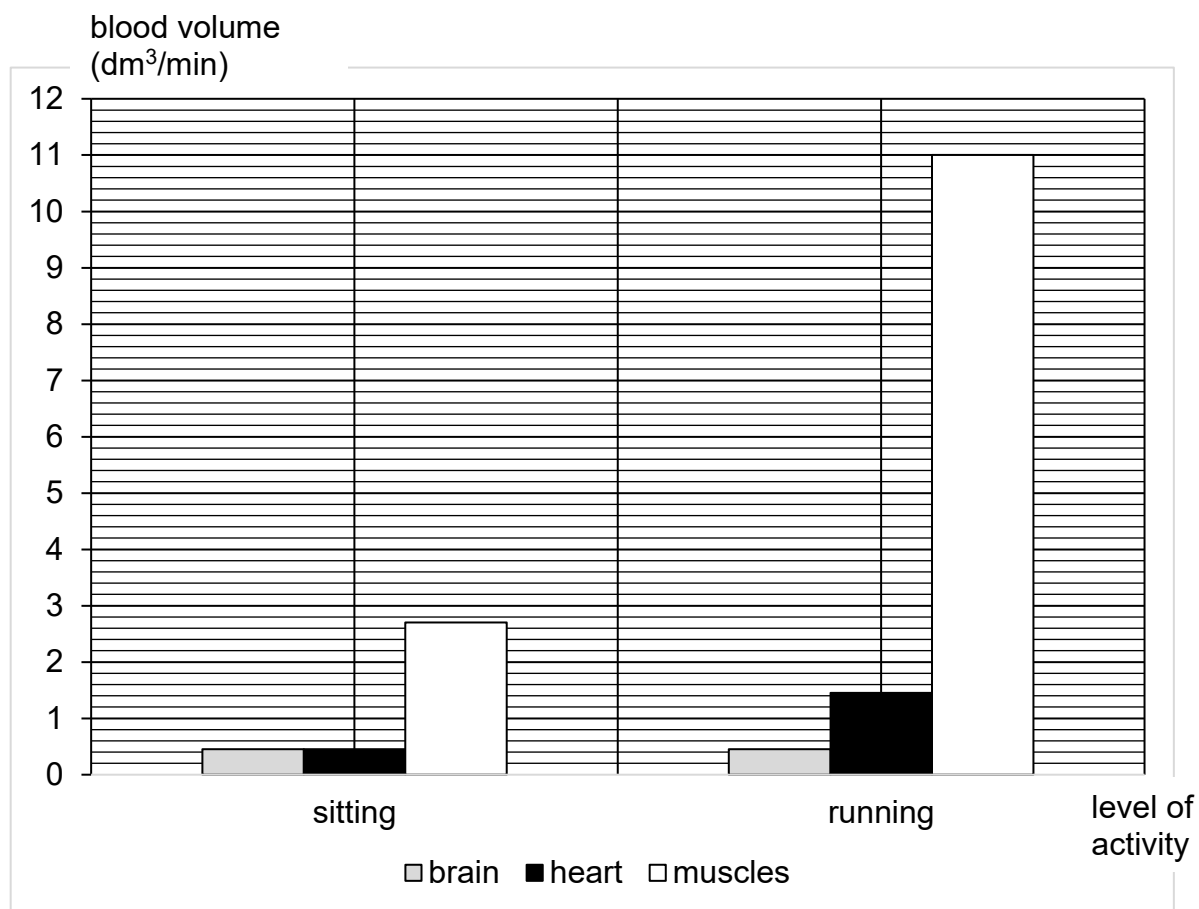


Fig. 8.1

- (a) Construct a table and record the data using the results in Fig. 8.1.

- (b) Describe the change in the blood volume sent to the brain when a person goes from sitting to running.

.....
..... [2]

- (c) (i) Calculate the percentage change in blood volume sent to the muscles during running when compared to sitting.

Show **all** your working.

percentage change in blood volume = [2]

- (ii) Describe and explain how the level of lactic acid in the body changes during and after exercise.

.....
.....
.....
.....
.....
.....
..... [4]

- (d) Name the organelle which muscle cells have more of in order to function efficiently.

..... [1]

[Total: 12]

Section B

Answer **one** question from this section.

- 9 (a) A man cannot produce insulin himself. He needs to inject insulin into his body daily.

Fig. 9.1 shows changes in the injected insulin level in the blood and amount of insulin his body needs over a 24-hour period.

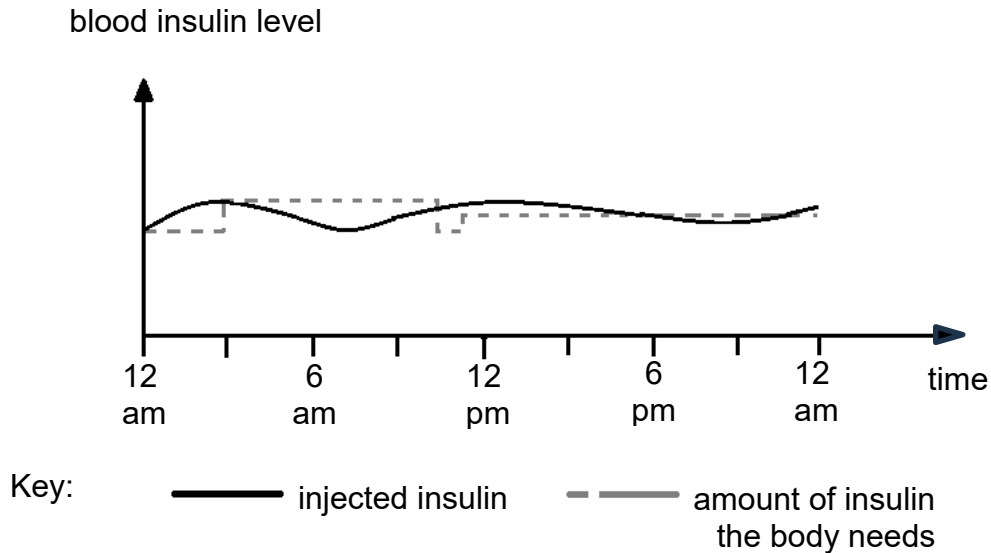


Fig. 9.1

With reference to Fig. 9.1, state and explain the time period when the man is most likely to have high blood sugar level.

.....

.....

.....

.....

..... [3]

(b) Describe the role of glucagon in humans.

.....

.....

.....

.....

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.....

..... [3]

(c) Describe the importance of complementary base pairing in gene expression where DNA is used to eventually carry out synthesis of insulin protein.

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..... [4]

[Total: 10]

10 (a) Fig. 10.1 shows a developing fetus inside the uterus.

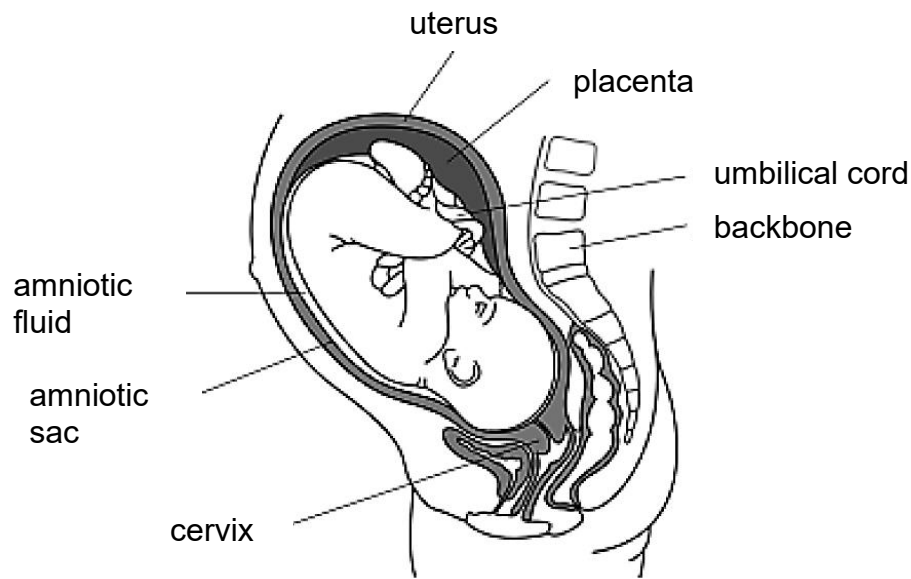


Fig. 10.1

Describe how the structures in Fig. 10.1 provide the following needs of the fetus as it grows:

(i) protection,

.....

.....

.....

..... [2]

(ii) excretion of metabolic waste.

.....

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.....

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.....

..... [3]

(b) Fig. 10.2 shows the male fertility rate between 1975 and 2010 in a country.

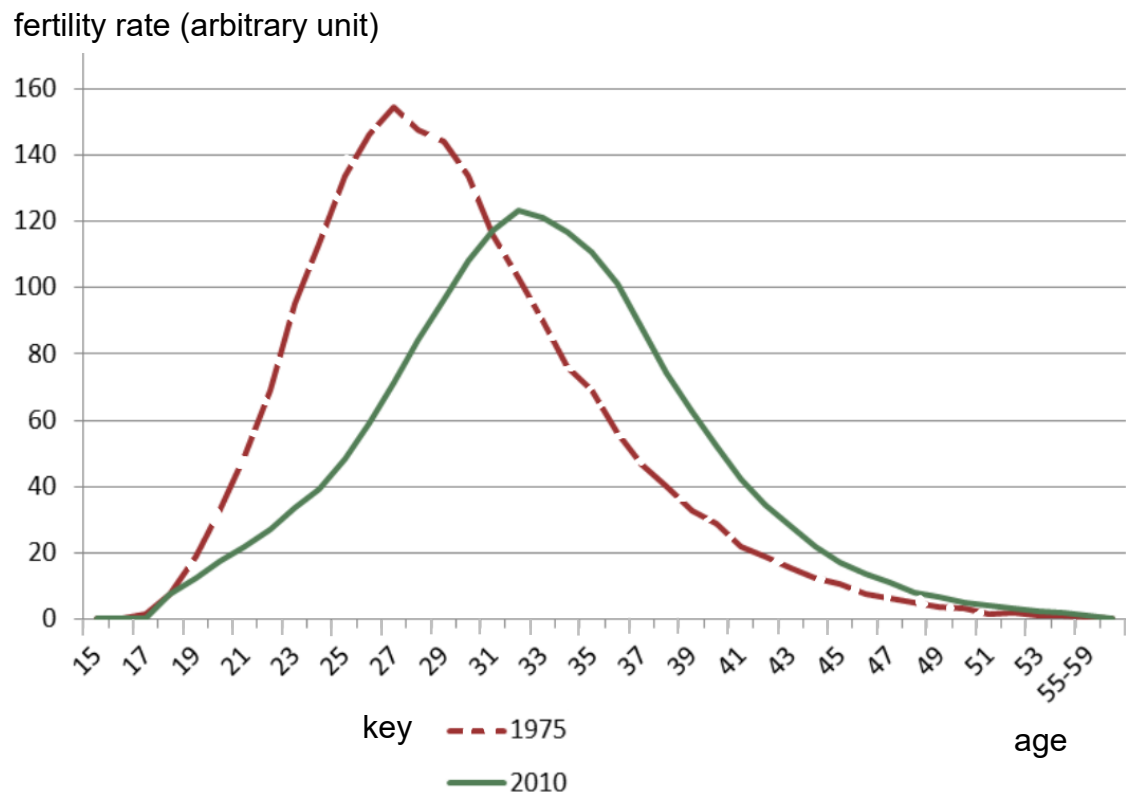


Fig. 10.2

Describe the trend shown in Fig. 10.2.

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..... [3]

(c) Meiosis is also known as reduction division.

Explain what it means and its significance.

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..... [2]

[Total: 10]