Paya Lebar Methodist Girls' School (Secondary)
Preliminary Examination 2024
Secondary 4 Express (G3)

CANDIDATE NAME		CLASS		CLASS INDEX NUMBER	
		TG			

CENTRE NUMBER					INDEX NUMBER				

SCIENCE (BIOLOGY) 5088/4

Paper 4 Biology **16 August 2024**

No additional materials are required. **1 hour 15 minutes**

READ THESE INSTRUCTIONS FIRST

Write your name, class and class index number on the front cover.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.
The use of an approved calculator is expected, where appropriate.

Section A (55 marks)

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

Section B (10 marks)

There are two questions in this section. Answer only **one** question.
Write your answers in the spaces provided on the question paper.

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

For Examiner's Use	
Section A	/55
Section B	/10
7	
8	
Total	/65

This document consists of 19 printed pages.

Section A (55 marks)

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

1 Digestive enzymes catalyse the breakdown of large insoluble molecules.

(a) Explain why it is important that large insoluble molecules are broken down by chemical digestion.

……

…… [1]

(b) Fig. 1.1 shows the action of an enzyme.

(i) On Fig. 1.1, use label lines and labels to identify the enzyme, product and substrate that can be found in the stomach.

Fig. 1.1. [1]

(ii) Define *enzyme.*

……

……

……

…… [2]

(c) An enzyme **X** in biological washing powders speed up the removal of stains from clothing.

Some of these stains may contain fats.

A student investigated the effect of a bile-like substance to increase the effectiveness of the washing powder. He tested the effect of bile on the digestion of fats in milk.

She used an indicator that is pink in alkaline solutions and colourless in acidic solutions. She added the same volume of indicator to each test tube.

The student observed and recorded the colour of the contents of each test-tube at 0 minutes, 20 minutes and 40 minutes.

Table 1.1. shows the results of the investigation.

Table 1.1

set-up		indicator colour observed		
test tube	content	0 minutes	20 minutes	40 minutes
A	milk and bile	pink	pink	pink
B	milk and enzyme **X**	pink	pink	colourless
C	milk, enzyme **X** and bile	pink	colourless	colourless

(i) Name the enzyme **X** that will remove fat stains.

……..…... [1]

(ii) Explain why removing fat stains and protein stains from clothing requires a washing powder that contains more than one type of enzyme.

……..…

……..…

……..…

……..…... [2]

(iii) Describe and explain the difference in results between the test-tubes A, B and C.

……

……

……

……

……

…… [3]

[Total: 10 marks]

2 A student investigated osmosis in potato plant cells. He immersed cubes of potato tissue in water and different concentrations of sucrose solutions for 30 minutes.

The masses of potato cubes were measured before and after immersion.
The percentage changes in mass were calculated.
Table 2.1 shows the results.

Table 2.1

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 /%
0.00	1.32	1.42	7.6
0.20	1.32	1.38	4.6
0.40	1.35	1.36	0.7
0.60	1.33	1.29	-3.0
0.80	1.30	1.24	-4.8
1.00	1.32	1.25	……

(a) Using the information in Table 2.1, calculate the percentage change in mass at 1.00 mol / dm^{-3} and complete Table 2.1.

Give your answer to **one** decimal place.

[1]

(b) **(i)** Using the information in Table 2.1, plot a graph to show the percentage change in mass of potato at different sucrose solutions in Fig. 2.1 below.

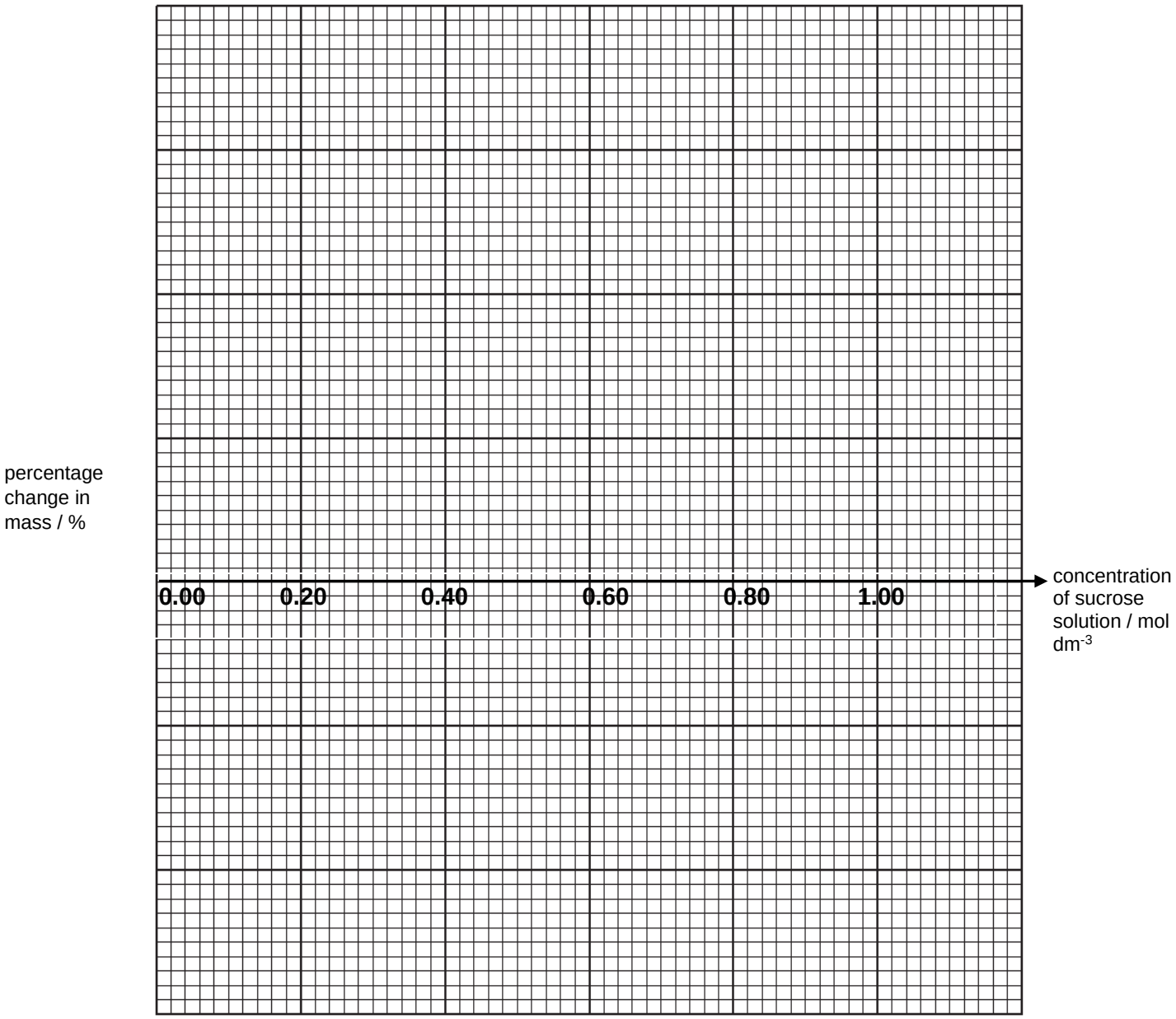


Fig. 2.1

[3]

(ii) Based on your graph in **(b)(i)**, state the water potential of the potato cells.

……..……... [1]

[Turn over]

(c) Using the information in Table 2.1 and Fig. 2.1, explain the results observed at the 0.4 mol dm^{-3} and 0.8 mol dm^{-3}.

……

……

……

……

……

…… [3]

(d) Suggest and explain the expected appearance of a cell from a potato cube and a red blood cell that has been immersed in distilled water for 30 minutes.

……

……

……

…… [2]

[Total: 10 marks]

3 Mammals have a double circulation.

(a) Fig. 3.1 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.

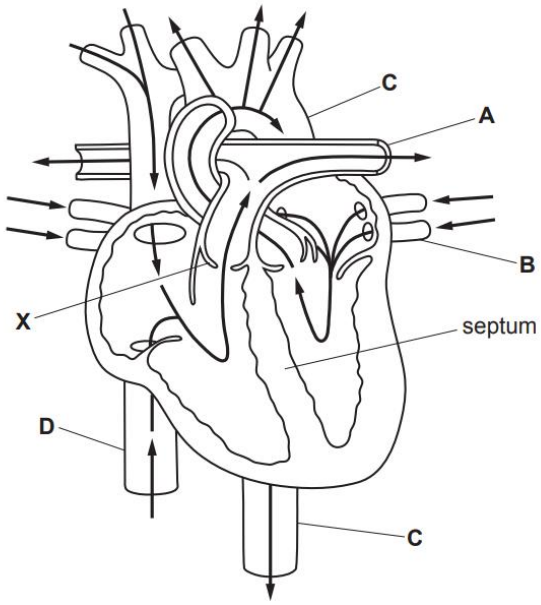


Fig. 3.1

(i) Identify the structures labelled **A** and **D**.

A …….

D ……. [2]

(ii) State the name of the chamber of the heart with the thickest wall.

……..……. [1]

(iii) Explain why the chamber in **(a)(ii)** has the thickest wall.

……..……..

……..……..

……..……..

……..……. [2]

[Turn over]

(iv) Identify the structure labelled **X** in Fig 3.1 **and** state its role in the heart.

……

……

……

…… [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 caused by the production of lactic acid.

Fig. 3.2 below shows the changes in pH during and after vigorous exercise.

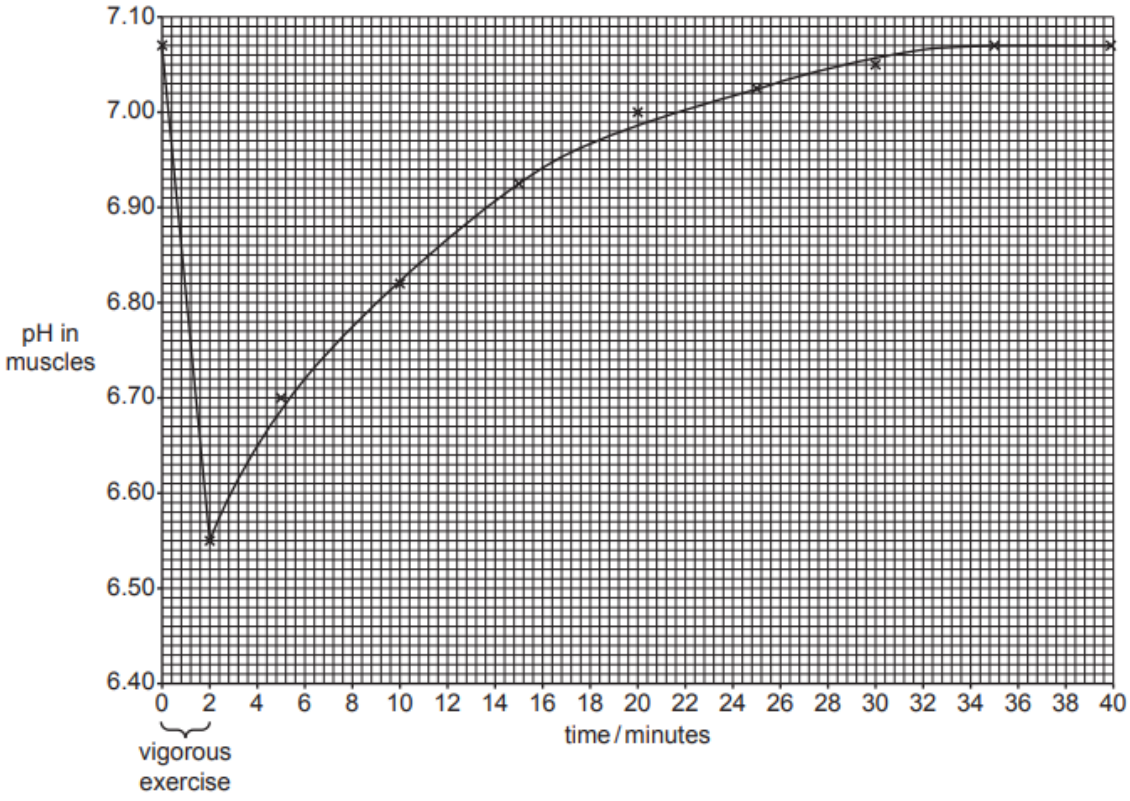


Fig. 3.2

(i) Describe and explain the results in Fig. 3.2.

0 to 2 min ……..……..……..…….....

……..……..……..…….....

……..……..……..…….....

2 to 40 min ……..……..……..…….....

……..……..……..…….....

……..……...……. [2]

(ii) A patient had a condition where the structure **X** does not close fully. Suggest and explain how that would affect the results in Fig 3.2.

……..……..……..…….....

……..……..……..…….....

……..……..……..…….....

……..……..……..…….....

……..……..……..…….....

……..……..……..…….....

……..……...……. [3]

[Total: 12 marks]

4 The water lily has adaptive features that are found in many different hydrophytes which are plants that grows in water.

Fig. 4.1 is a photograph of some leaves of a water lily and Fig. 4.2 is a photomicrograph of a cross-section of a part of a water lily leaf.

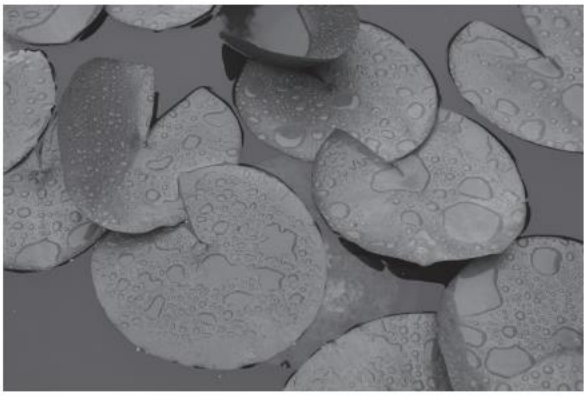


Fig. 4.1

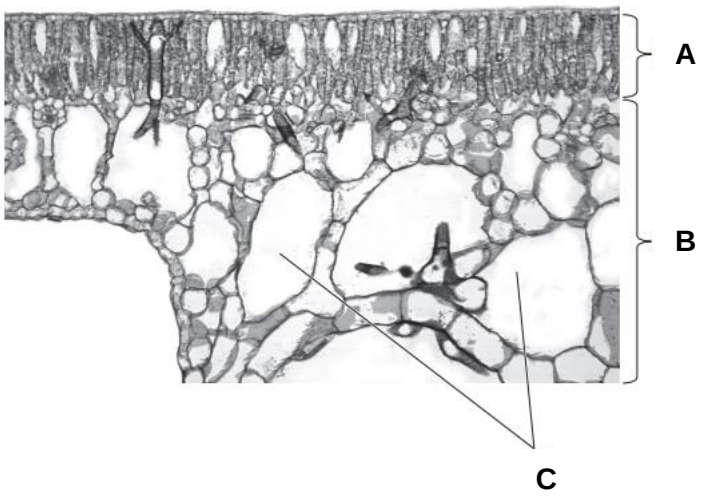


Fig. 4.2

(a) State the names of the parts labelled **A**, **B** and **C** in Fig. 4.2.

A ……

B ……

C …… [3]

(b) Explain how part **C** in Fig. 4.2 adapts the water lily for its environment.

……

……

……

…… [2]

(c) A scientist calculated the mean number of stomata per mm^2 in the upper and lower epidermis in tomato plants and water lily plants. Tomato plants are a type of land plant.

Table 4.1 shows the results.

Table 4.1

	mean number of stomata per mm^2	
plant	in upper epidermis	in lower epidermis
tomato	10	129
water lily	475	0

(i) State the name of the cells that control the opening and closing of the stomata.

…… [1]

(ii) Compare and explain the differences in the mean number of stomata in a tomato plant and in a water lily plant.

……

……

……

…… [2]

[Total: 8 marks]

5 A student investigated a seashore ecosystem.

The food web for this seashore is shown in Fig. 5.1

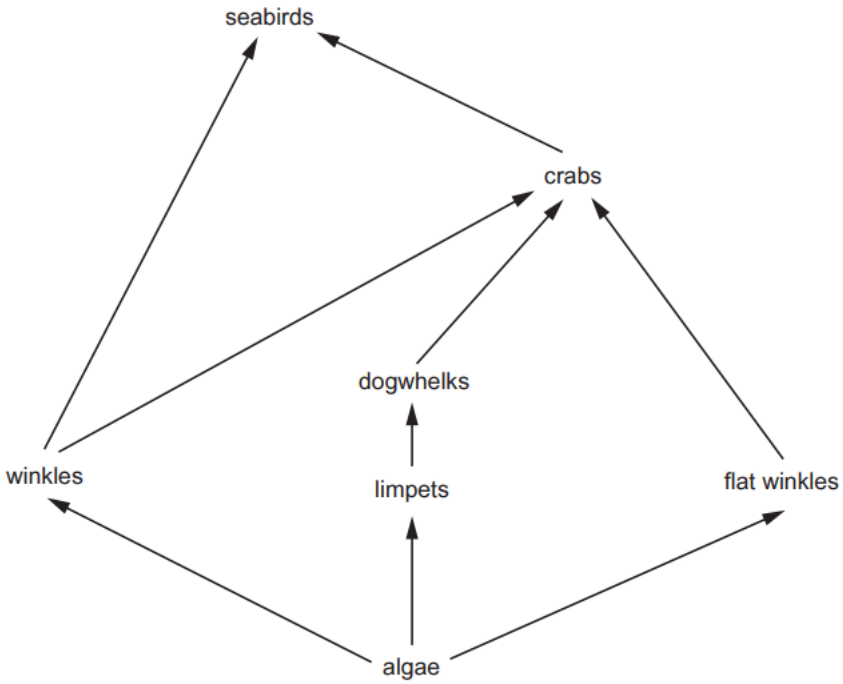


Fig. 5.1

(a) Complete Table 5.1 by counting the number of each type of organism in the food web.

Table 5.1

description	number of each type of organism in the food web
carnivore	
consumer	
herbivore	
producer	

[2]

(b) A new species of starfish was introduced in the seashore food web in Fig. 5.1.

The starfish species eats limpets.

Predict and explain what would happen to the number of dogwhelks and algae in this area after the starfish were introduced.

dogwhelks ……..……..…….....

……..……..…….....

algae ……..……..…….....

……..……..……. [2]

(c) Some bacteria that live on the seashore feed on dead material.

State the term used to describe organisms that get energy from dead or waste organic material.

……..……..……. [1]

[Total: 5 marks]

6 **(a)** Huntington's disease is a genetic disease caused by a mutation in a single gene.

The allele for Huntington's disease is dominant and represented by the letter **H**.

The allele for no Huntington's disease is recessive and represented by the letter **h**.

Fig. 6.1 is a pedigree diagram showing the inheritance of Huntington's disease in one family.

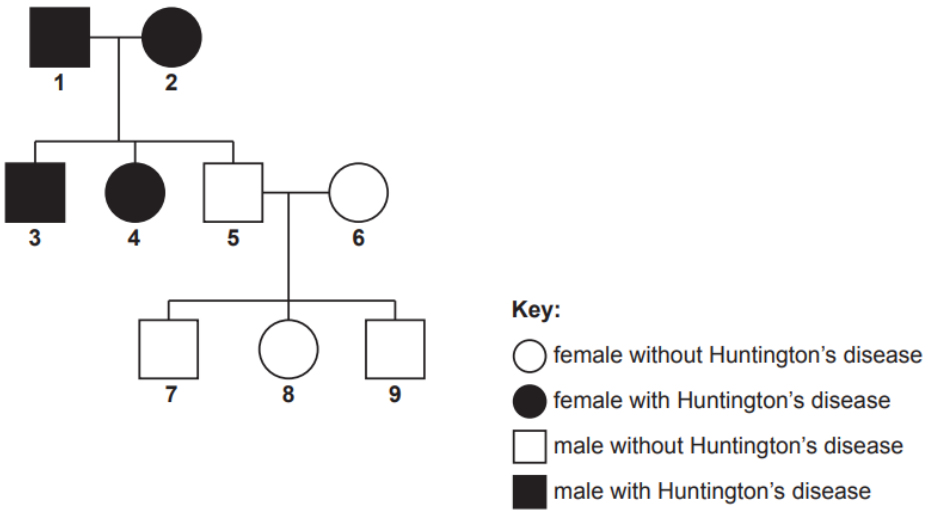


Fig. 6.1

(i) State the number of males with Huntington's disease in Fig. 6.1.

……..……...……. [1]

(ii) Explain using Fig. 6.1 why the allele for Huntington's disease is dominant.

……..……....

……..……....

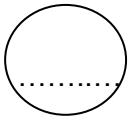
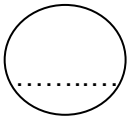
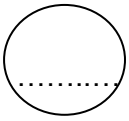
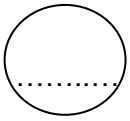
……..……....

……..……...……. [2]

[Turn over]

(iii) A person that is heterozygous for Huntington's disease has a child with a person that is homozygous recessive.

Complete the genetic diagram and calculate the ratio of the child inheriting Huntington's disease.

phenotype of parents	……..…		……..…	
genotype of parents	……..…		……..…	
gametes	 ……..…	 ……..…	 ……..…	 ……..…
genotype of offspring	……..…	……..…	……..…	……..…
phenotype of offspring	……..…	……..…	……..…	……..…
ratio of offspring phenotype				

[5]

(b) Chromosomes contain genetic information in the form of gene.

(i) Define the term *gene*.

……..……..……..

……..……..……. [1]

(i) State the chromosomes involved in the inheritance of sex in humans.

……..……..……. [1]

[Total: 10 marks]

End of Section A

[Turn over]

Section B (10 marks)

Answer **only ONE** questions from this section.
Write your answers in the spaces provided.

7 Antibiotic resistance is an increasing problem worldwide.

Erythromycin is an antibiotic.

Fig. 7.1 shows the daily doses of erythromycin per 1000 people over a 13-year period.

The number of bacterial infections resistant to erythromycin per 1000 people is also shown.

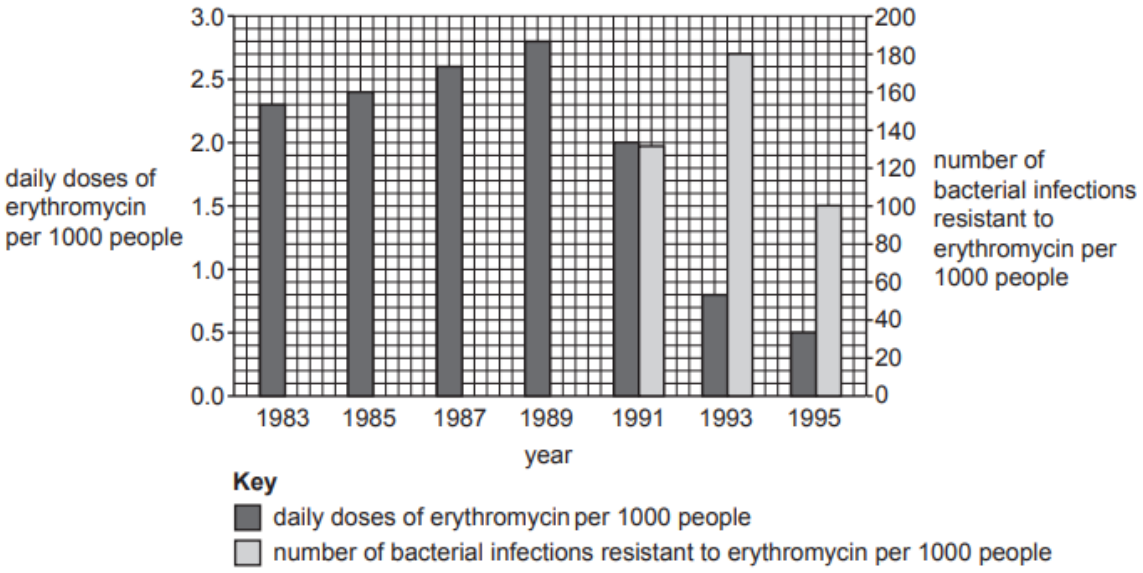


Fig. 7.1

(a) Describe the data shown in Fig. 7.1.

……

……

……

……

……

…… [3]

(b) Suggest reasons for the change in the number of bacterial infections resistant to erythromycin from 1993 to 1995 shown in Fig. 7.1.

……

……

……

…… [2]

(c) Explain how bacteria become resistant to antibiotics.

……

……

……

……

……

…… [3]

(d) *Salmonella* bacteria is resistant to erythromycin. *Salmonella* bacteria can cause food poisoning and are able to reproduce when the temperature is between 5.2°C and 46.0°C. *Salmonella* bacteria are killed after 10 minutes at 75.0°C. The bacteria is usually transmitted to humans by eating foods contaminated with animal faeces.

Suggest and explain the ways of preventing the spread of food poisoning caused by *Salmonella* bacteria.

……

……

……

…… [2]

[Total: 10 marks]

[Turn over]

8 Hormones regulate different process in the body.

(a) Fig. 8.1 shows the changes that happen to the thickness of the uterus lining during the menstrual cycle.

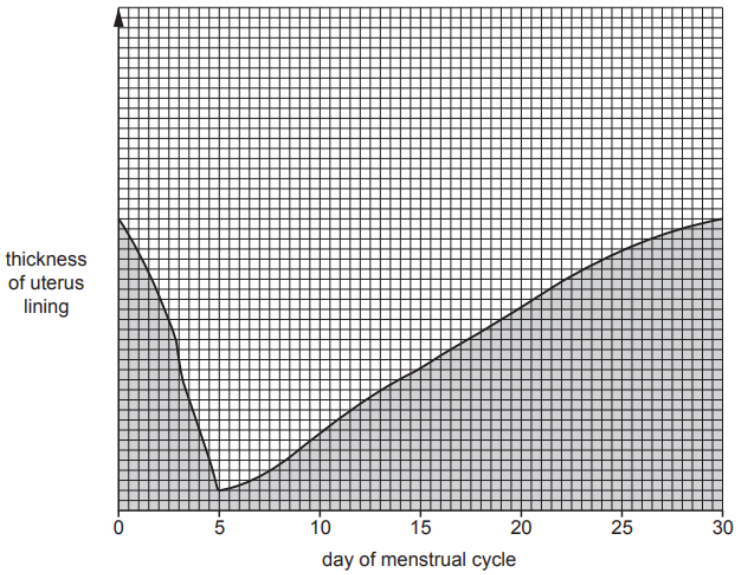


Fig. 8.1

(i) Define *hormone.*

……

…… [1]

(ii) Using Fig. 8.1, name and describe the actions of two hormones that regulate the changes to the uterine lining.

……

……

……

……

……

…… [3]

[Turn over]

(b) Pancreas releases two important hormones to regulate the blood sugar level.

Describe and explain how these hormones regulates blood glucose level.

Insulin

……

……

……

……

Glucagon

……

……

……

…… [4]

(c) Describe and explain how the DNA of the person determines the different types of hormones that are produced.

……

……

……

…… [2]

[Total: 10 marks]

End of Paper 4