Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER				

BIOLOGY **0610/41**

Paper 4 Theory (Extended) **May/June 2021**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **20** pages. Any blank pages are indicated.

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1 **(a)** Baker's yeast, *Saccharomyces cerevisiae*, is a single-celled organism that is classified in the kingdom Fungi.

Fig. 1.1 is a drawing of a section through a yeast cell.

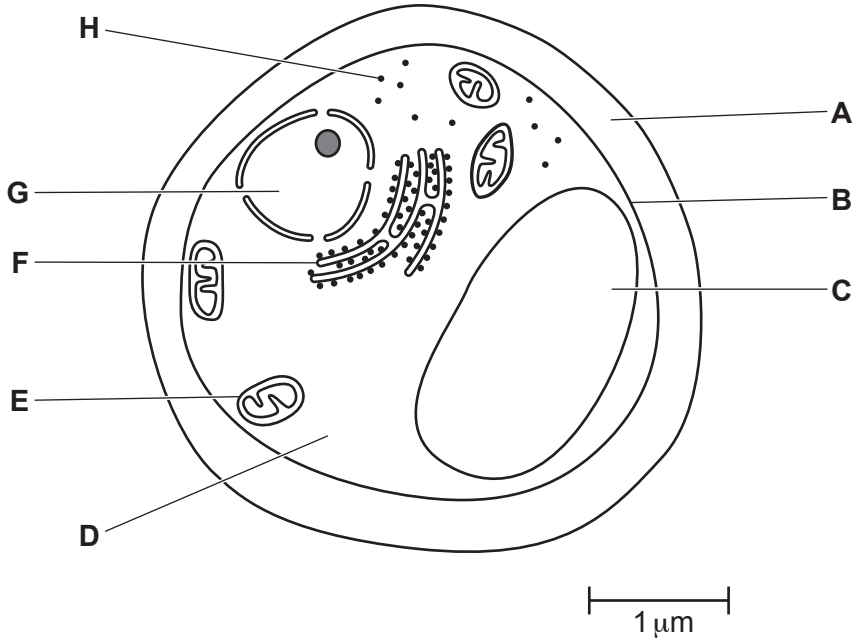

Fig. 1.1

(i) State **one other** kingdom that contains organisms that all have structure **A**.

..... [1]

(ii) Table 1.1 shows some cell functions.

Complete Table 1.1 by naming the cell structure responsible for each cell function and give the letter that identifies each cell structure in Fig. 1.1.

Table 1.1

cell function	cell structure	letter from Fig. 1.1
storage of genes		
aerobic respiration		
amino acids are assembled to make protein		

[3]

(b) A student made a drawing of one *Escherichia coli* bacterium. Fig. 1.2 shows the student's drawing.

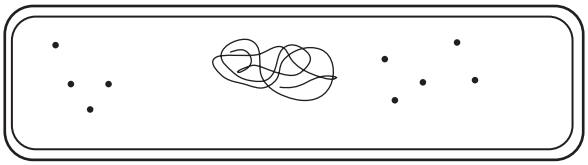

Fig. 1.2

The actual length of the bacterial cell is 2 μm.

(i) Convert the actual length of the cell to millimetres.

..... mm [1]

(ii) State the other information that the student needs in order to calculate the magnification of the drawing in Fig. 1.2.

..... [1]

(c) Describe the similarities **and** differences between the structure of the yeast cell and the structure of the bacterial cell.

Use the information in Fig. 1.1 and Fig. 1.2 in your answer.

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..... [6]

(d) Some bacteria are involved in the nitrogen cycle.

Fig. 1.3 shows part of the nitrogen cycle.

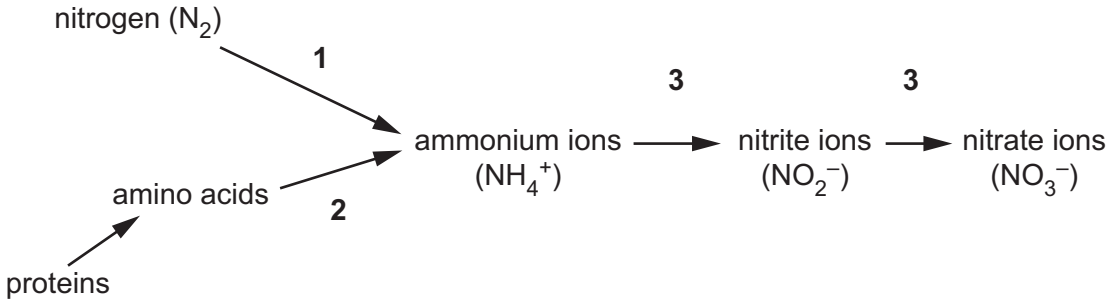

Fig. 1.3

State the processes that are represented by **1**, **2** and **3** on Fig. 1.3.

1 .....

2 .....

3 .....
[3]

[Total: 15]

2 Large quantities of plastic waste are polluting the oceans.

(a) A survey published in March 2018 showed the increase in plastic waste in the Pacific Ocean. One area of the Pacific Ocean is known as the Great Pacific Garbage Patch (GPGP).

Data were collected from areas inside and outside the GPGP between 1965 and 2015 to estimate the quantity of plastic waste.

The results are shown in Fig. 2.1.

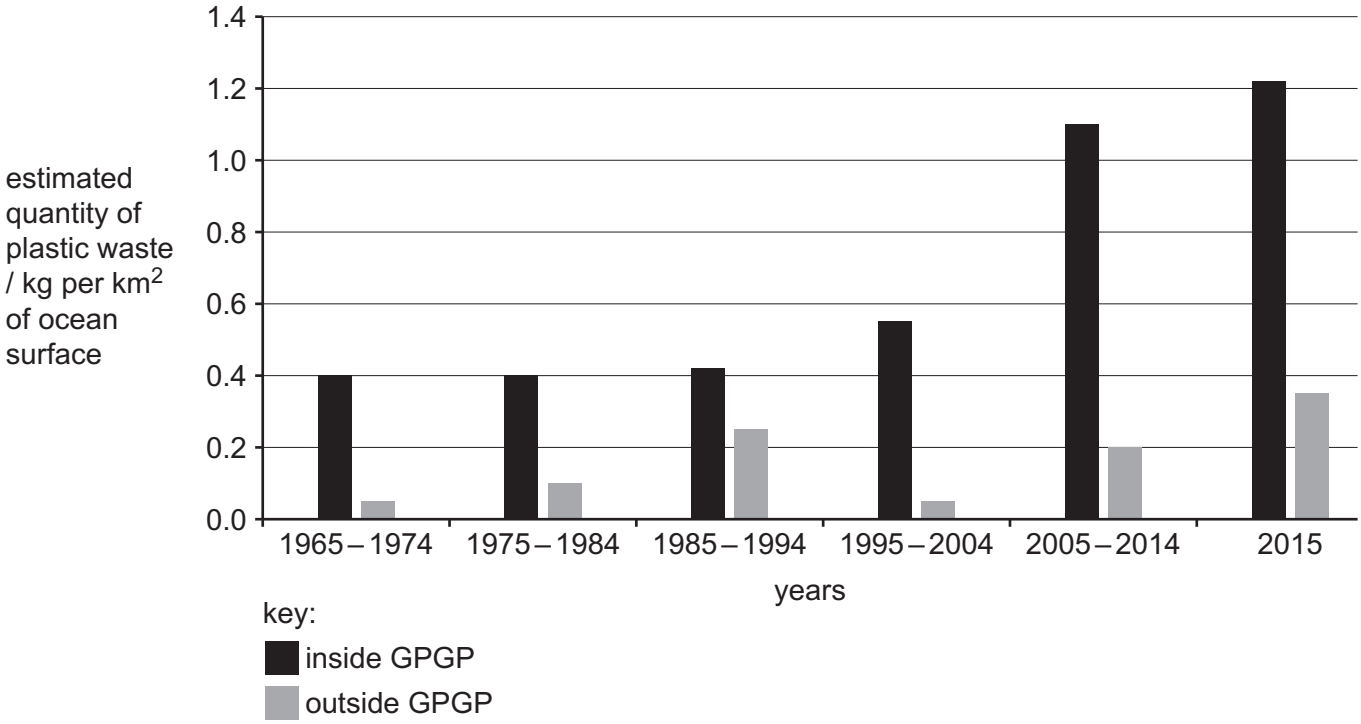

Fig. 2.1

Describe the results of the survey shown in Fig. 2.1.

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..... [4]

(b) The green turtle, *Chelonia mydas*, is a species of marine animal that is harmed by plastic waste.

Fig. 2.2 shows a green turtle swimming past a plastic bag in the Pacific Ocean.

Fig. 2.2

(i) Turtles are classified as reptiles.

State **one** feature shown by all reptiles that is **not** found in amphibians.

..... [1]

(ii) Outline the dangers of non-biodegradable plastic waste to marine animals, such as green turtles.

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..... [4]

(iii) Suggest ways to reduce the quantity of plastic waste.

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..... [2]

[Total: 11]

3 Bacteria are used in many biotechnological processes.

(a) Explain why bacteria are useful in biotechnology.

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..... [3]

(b) Insulin is one of many human proteins that are made by genetically engineered bacteria.

Some people cannot produce insulin because their immune system has destroyed the cells that make insulin.

(i) State the organ that contains the cells that have been destroyed.

..... [1]

(ii) State the name of the disease caused by the destruction of these cells.

..... [1]

(iii) State the function of insulin in the body.

..... [1]

(c) Genetically engineered bacteria that are used to make insulin were grown in a fermenter for five days.

Samples were taken from the fermenter every six hours and the number of bacteria in 1.0 mm^3 of the nutrient solution were counted.

Changes in the numbers of living bacteria in the samples taken from the fermenter are shown in Fig. 3.1.

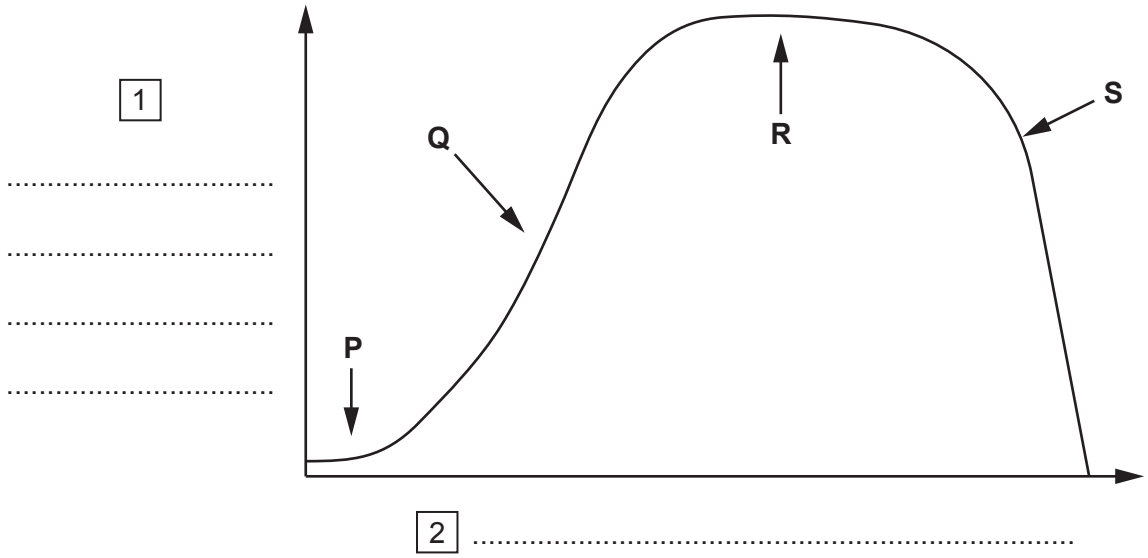

Fig. 3.1

(i) Complete Fig. 3.1 by adding labels for the axes at 1 and 2. [1]

(ii) State the names of the stages of population growth of the bacteria labelled **P** to **S**.

P .....

Q .....

R .....

S .....
[2]

(iii) Explain, with reference to Fig. 3.1, why the bacteria did not grow in the fermenter for longer than five days.

.....

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.....

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.....

..... [3]

(d) Mineral salts are important in the human diet. One of the most important is iron.

Explain:
- the importance of iron in the human diet
- the effects of an iron deficiency.

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..... [3]

(e) Fig. 3.2 shows a field of cassava, *Manihot esculenta*, which is a crop plant grown in parts of Africa and Asia.

Fig. 3.2

The plants store starch in their roots, which form a large part of the diet for many people. Cassava does not provide many vitamins or mineral ions.

Genetic engineers have modified cassava to increase its iron content. They have done this by incorporating a gene for a membrane protein from the plant *Arabidopsis thaliana*.

(i) State the name of the enzyme that is used to cut out the gene from the DNA of *A. thaliana*.

..... [1]

(ii) Describe how the gene from *A. thaliana* and the DNA from cassava form recombinant DNA.

.....

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..... [2]

(iii) Scientists who develop genetically engineered varieties of crop plants often breed them for several generations before releasing them for farmers to use.

Suggest why the scientists do this.

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..... [2]

[Total: 20]

4 Two identical potted plants were used to investigate plant responses.

Plant **A** was placed on a clinostat that continually rotated. Plant **B** was not rotated.

Both plants were then placed on their sides and kept in the dark.

Fig. 4.1 shows the two plants at the start of the experiment and after seven days.

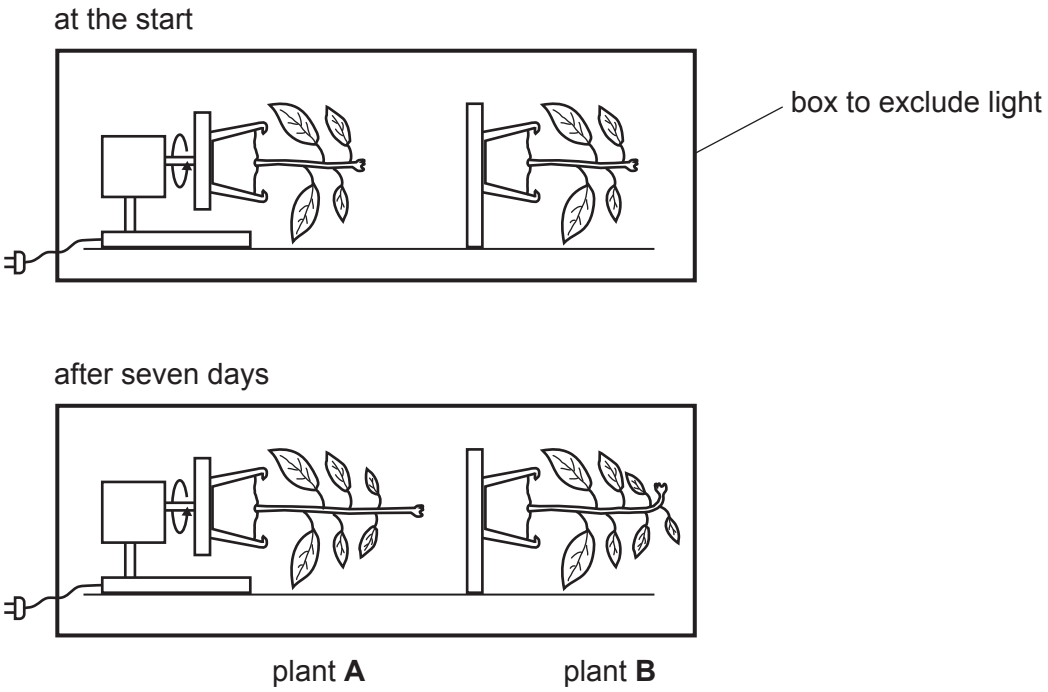

Fig. 4.1

(a) State the name of the response shown by the shoot of plant **B**.

..... [1]

(b) Explain the reason for constantly rotating plant **A**.

.....

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.....

..... [2]

(c) **(i)** State the name of the plant hormone that causes the response of the shoot of plant **B**.

..... [1]

(ii) Explain how the plant hormone causes the response of plant **B**.

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..... [3]

(d) Seeds germinate in the soil. The seedlings that grow from seeds show the same response as shown by plant **B** in Fig. 4.1.

Explain the advantages of this response to the survival of seedlings and mature plants.

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..... [3]

[Total: 10]

5 **(a)** Fig. 5.1 shows the female reproductive system.

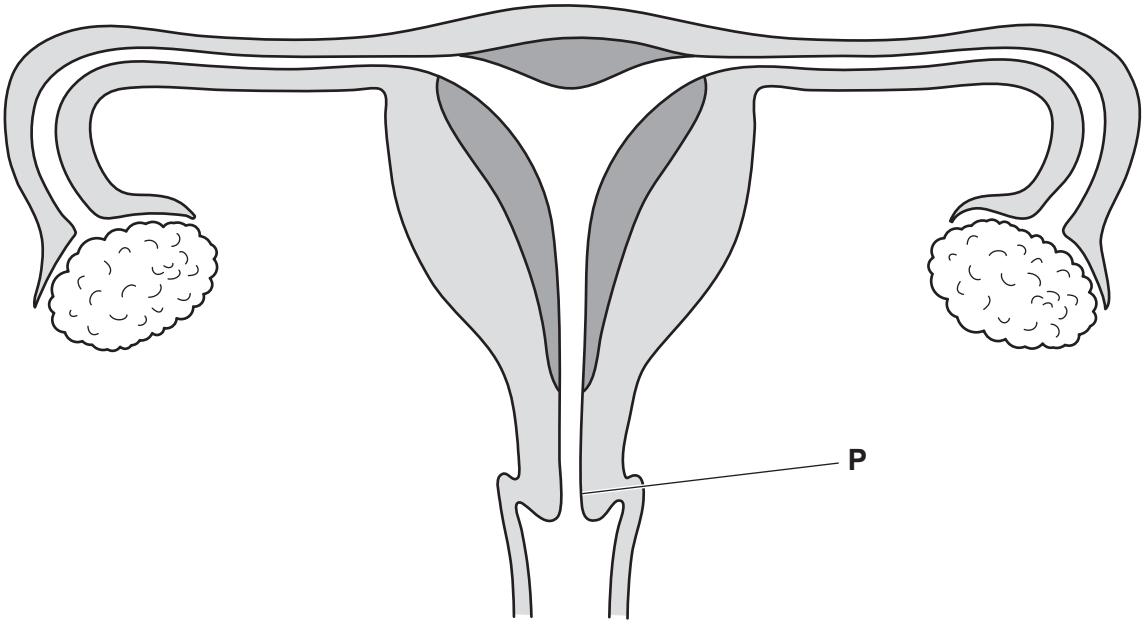

Fig. 5.1

Label Fig. 5.1 using the letters listed to show the position of the organs that are identified by their functions.

The first one (**P**) has been completed for you.

P site of secretion of mucus

Q site of fertilisation

R site of implantation

S site of oestrogen secretion

T site where sperm are deposited during sexual intercourse

[4]

(b) Fig. 5.2 shows a section through an egg cell at the time of ovulation.

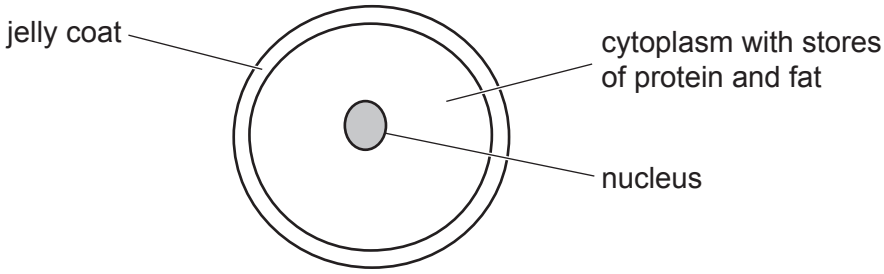

Fig. 5.2

(i) Explain why the egg cell contains stores of protein and fat.

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..... [3]

(ii) Describe the function of the jelly coat.

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..... [2]

(c) Fertilisation results in the formation of a zygote.

Describe how an embryo is formed from a zygote.

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..... [4]

[Total: 13]

6 **(a)** Antibodies are proteins that are produced by lymphocytes. Antitoxins are antibodies which neutralise the toxins released by some bacteria.

The transmissible disease diphtheria is caused by a bacterium that releases a toxin that can cause serious damage to the body.

A person is suspected of having caught diphtheria.

At a clinic, the person is given an injection of antitoxin antibodies that provide protection against the diphtheria toxin. She is also given an injection of the vaccine for diphtheria.

A few weeks later she is given a second injection of the diphtheria vaccine.

Fig. 6.1 shows the changes in concentration of the antitoxin antibodies and the antibodies produced in response to the vaccine.

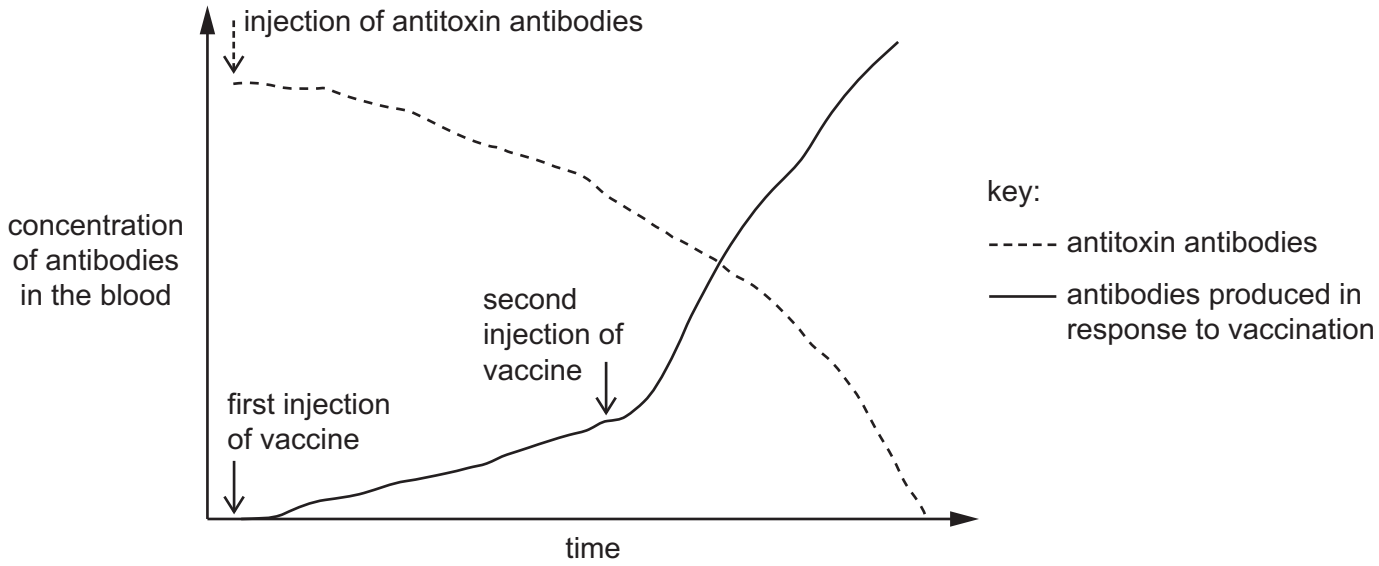

Fig. 6.1

(i) Explain the advantage of giving the person an injection of antitoxin antibodies.

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..... [2]

(ii) Explain how the two injections of the vaccine result in better protection against diphtheria than the injection of antitoxin antibodies.

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..... [3]

(b) Explain how antibodies protect the body against pathogens.

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..... [4]

(c) Antibodies can travel through the body in the lymphatic system.

State **two** functions of the lymphatic system **other than** defence against disease.

1 .....

2 .....
[2]

[Total: 11]

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