Antibodies and vaccination

Question Paper 3

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Immunity
Sub Topic	Antibodies and vaccination
Booklet	Theory
Paper Type	Question Paper 3

Time Allowed : **66 minutes**

Score : **/ 55**

Percentage : **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 The control of malaria is one of the top priorities of the World Health Organization (WHO). At present, there is no effective vaccine for the disease, so other preventative measures must be taken to control the spread of malaria.

(a) Describe **one** method of controlling the spread of malaria by targeting its vector and explain its effect.

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(b) Explain why it has been difficult to develop an **effective** vaccine for malaria.

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(c) Another method of preventing malaria is to take drugs, such as chloroquine, but resistance to these drugs among certain species of the malarial parasite is increasing. New drugs are being developed.

A laboratory investigation was carried out to determine the effect of a new drug on two strains of the malarial parasite *Plasmodium falciparum*. The results are shown in Fig. 4.1.

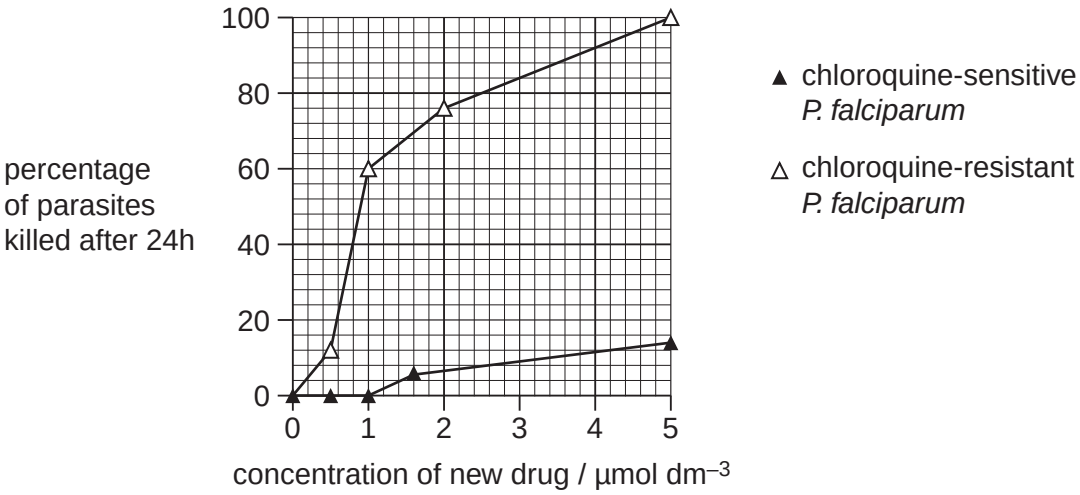

Fig. 4.1

With reference to Fig. 4.1, compare the effect of increasing the concentration of the drug on the chloroquine-resistant and chloroquine-sensitive strains of *P. falciparum*.

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(d) When a person becomes infected with the Human Immunodeficiency Virus (HIV) they become more susceptible to infection by the malarial parasite.

Fig. 4.2 shows maps of Africa produced by the WHO.

- Fig. 4.2a shows the percentage population of each country testing positive for HIV
- Fig. 4.2b shows the percentage **increase** in malaria as a result of HIV infection in each country.

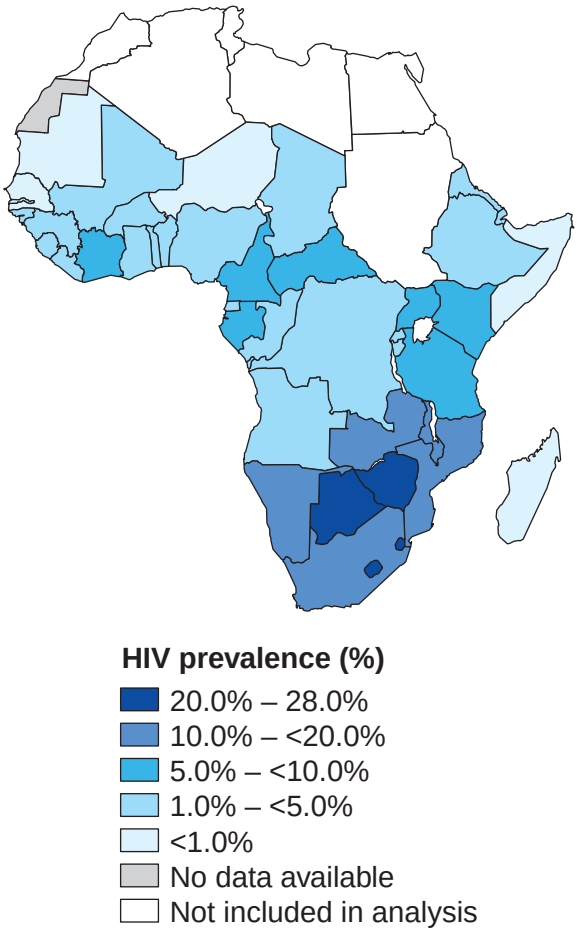

Fig. 4.2a

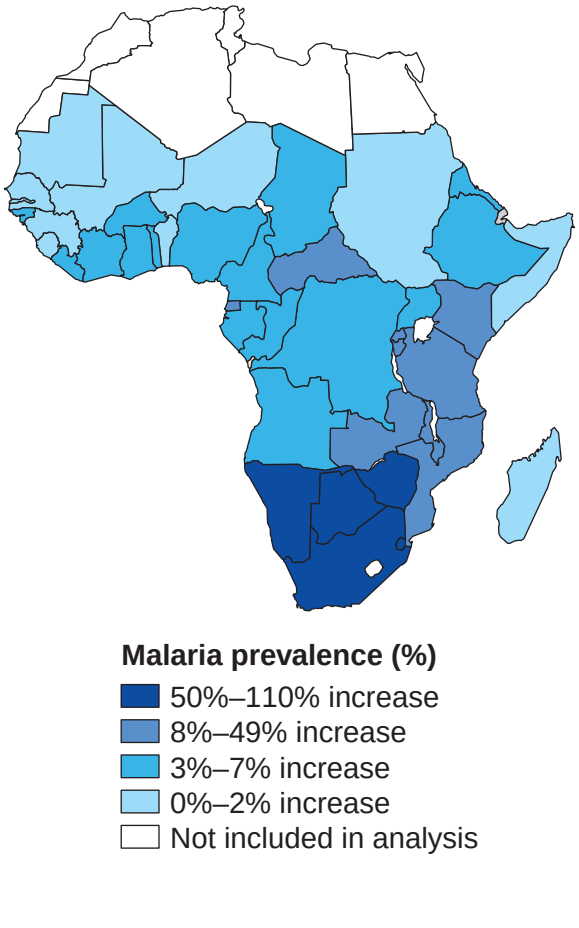

Fig. 4.2b

(i) Explain how the information in Fig. 4.2 supports the idea that there is a link between HIV infection and susceptibility to malaria.

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(ii) Suggest how HIV infection may have led to an increase in malarial infections in these countries.

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[Total: 12]

2 **(a)** The glycoproteins CD28 and CD40 are found on the surface of T-lymphocytes (T-cells). They are binding sites for cell-signalling molecules and are essential for triggering the cloning of T-cells in an immune response.

A monoclonal antibody (mAb), which could block the CD40 signalling pathway, was produced from hamsters using the hybridoma method.

Outline the procedure, starting with a hamster, for producing mAbs suitable for use in another mammal, such as a mouse.

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(b) The ability of the mAb produced in **(a)** to prevent rejection of transplanted hearts in mice was compared with that of a protein, **P**, which blocks the CD28 signalling pathway.

Four groups of mice were treated as follows:

- group **A** – no treatment
- group **B** – treated with protein **P** only
- group **C** – treated with mAb only
- group **D** – treated with both mAb and protein **P**.

Fig. 2.1 shows the percentage survival of the transplanted hearts in the four groups of mice over a period of 80 days.

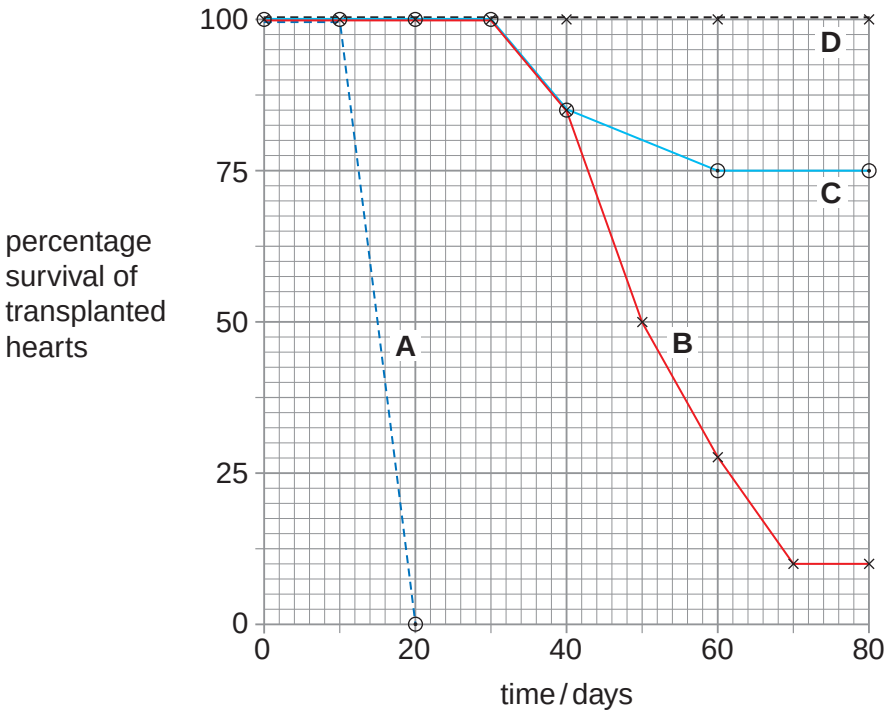

Fig. 2.1

With reference to Fig. 2.1

(i) describe the effectiveness of the four different treatments

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(ii) suggest an explanation for the differences in survival of the transplanted hearts in groups **B** and **D**.

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(c) Examination of the transplanted hearts showed that the hearts in group **A** had significant damage to their coronary arteries, whereas in group **D** these blood vessels appeared normal.

Explain the importance of the coronary arteries of the heart.

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(d) State two uses of mAbs in humans, other than preventing rejection of transplanted tissue.

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[Total: 15]

3 An estimated 300 to 500 million cases of malaria occur worldwide each year resulting in 1 to 3 million deaths. 80% of these cases are in children under the age of five.

There are four species of malarial parasite, of which *Plasmodium falciparum* is responsible for most of the deaths from this disease.

(a) Describe how the malarial parasite is transmitted.

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(b) Several potential vaccines against malaria have been developed. Some of these make use of proteins from the surface membrane of *P. falciparum*.

(i) Explain how using such a vaccine may give long-term immunity to malaria.

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(ii) Researchers have been trying to develop a successful vaccine against malaria for about 20 years. Explain why it has proved so difficult to develop such a vaccine.

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(c) Proteins on the surface of the parasite are responsible for binding to surface receptors on the red blood cells. These are removed when the parasites enter the red blood cells.

An enzyme has recently been discovered in *P. falciparum* that is responsible for the removal of these proteins. If the enzyme does not function then the parasites cannot enter red blood cells.

It has been suggested that a drug could be developed to inhibit this enzyme.

Describe **one** possible way in which such a drug might act on the enzyme to prevent it from functioning.

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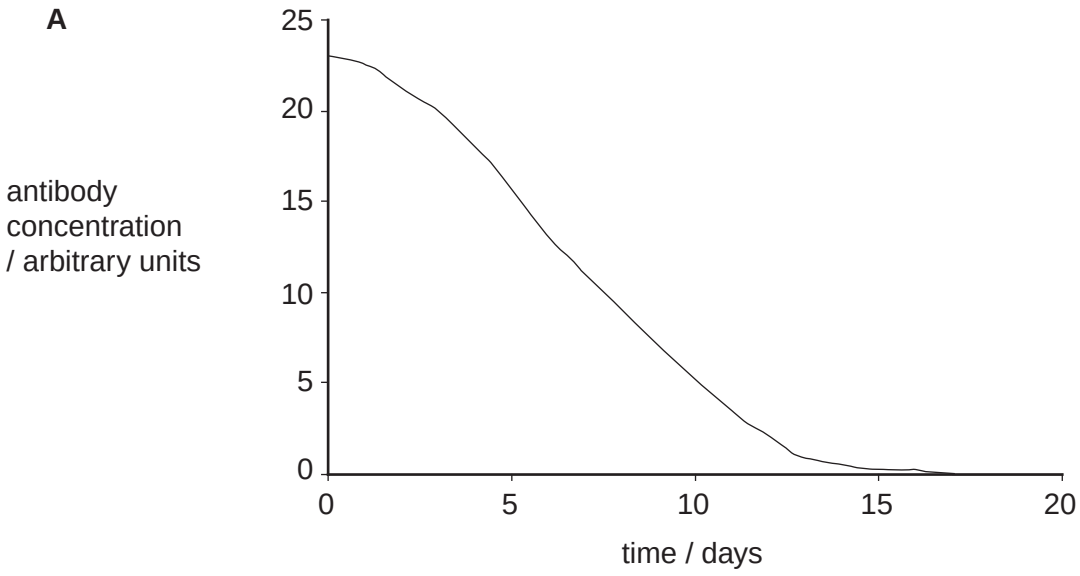
[Total: 12]

4 Two people took part in a study to find out the effectiveness of two types of immunisation. Person **A** received an injection of antibodies against tetanus and person **B** received a tetanus vaccination.

Over the new few weeks, the blood from these two people was analysed for the presence of antibodies to tetanus. The results are shown in Fig. 5.1**A** and Fig. 5.1**B**.

A



B

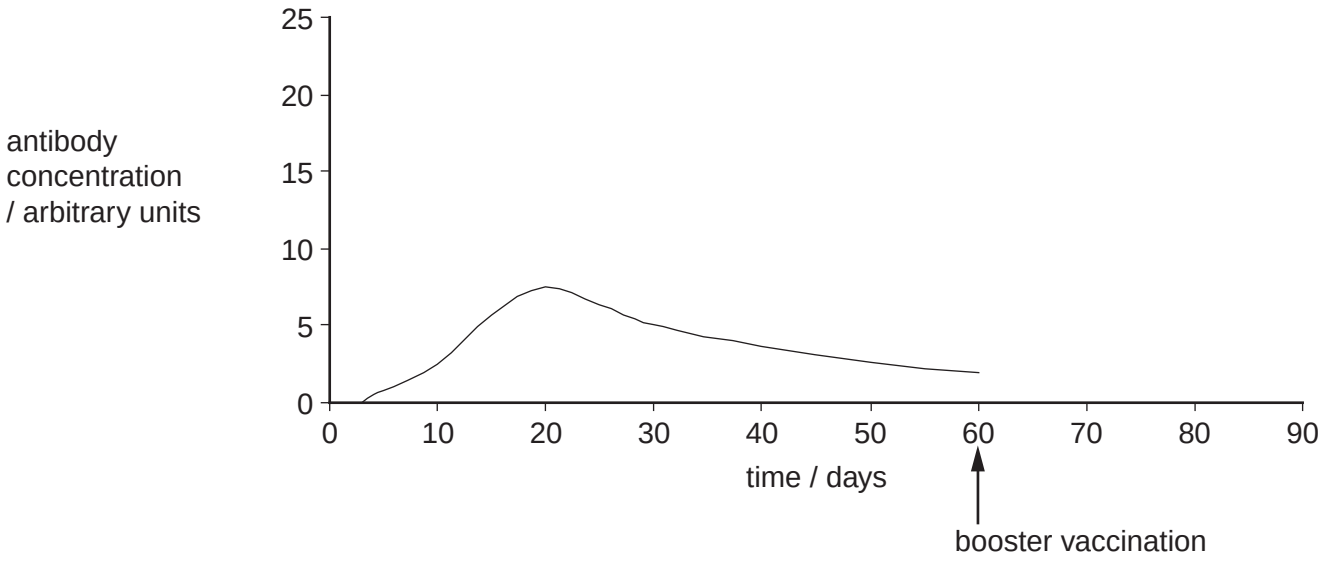


Fig. 5.1

(a) Name the types of immunity shown by Fig. 5.1 **A** and **B**.

A .....

B .....[2]

(b) Explain why the antibody concentration in person **A**,

(i) decreased during the study period

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(ii) did not increase.

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(c) **Sketch on** Fig. 5.1 **B**, on page **10**, what you would expect to happen to the antibody concentration if person **B** received a booster vaccination at **day 60**.

Put your answer to this question on Fig. 5.1 **B** on page **10**.

[2]

(d) Explain why, in this investigation, the experimenters had to measure the concentration of antibodies to tetanus rather than the concentration of all antibodies in the blood of **A** and **B**.

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[Total: 9]

5 During an immune response, some B lymphocytes change into plasma cells.

Fig. 3.1 is a drawing made from an electron micrograph of a plasma cell.

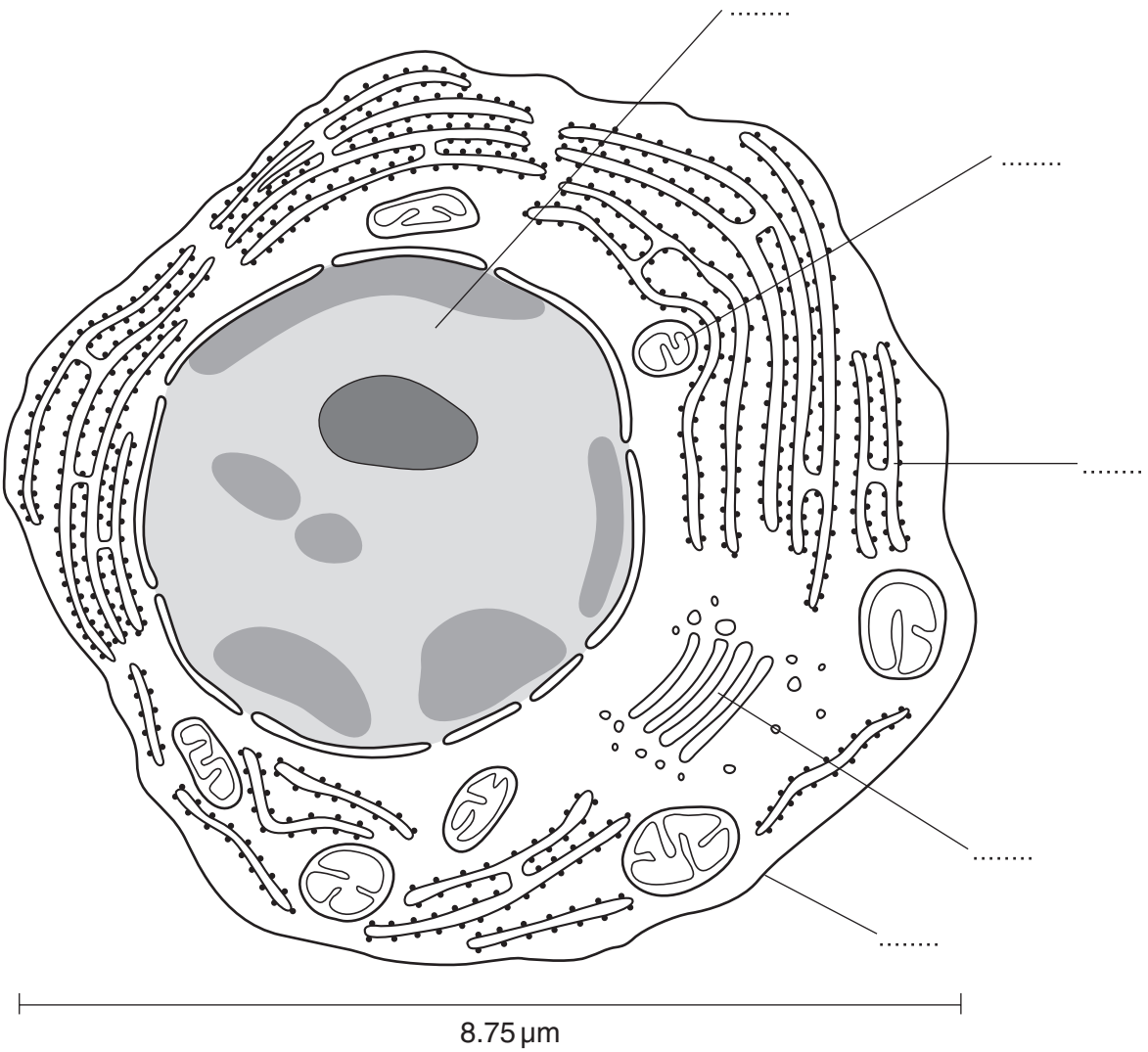

Fig. 3.1

(a) Use the label lines and the letters **A** to **E** to identify where the following processes occur.

A transcription
B polypeptide synthesis
C aerobic respiration
D formation of secretory vesicles
E active uptake of amino acids [4]

(b) State the function of plasma cells during an immune response.

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(c) State **two** ways, visible in Fig. 3.1, in which the plasma cell differs from a typical prokaryotic cell.

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2. ....

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[Total : 7]