F212: Module 2
2.2.2 Health and Disease
June 2009-January 2013
Questions

(a) discuss what is meant by the terms *health* and *disease*;
(b) define and discuss the meanings of the terms *parasite* and *pathogen*;
(c) describe the causes and means of transmission of malaria, AIDS/HIV and TB (knowledge of the symptoms of these diseases is not required);
(d) discuss the global impact of malaria, AIDS/HIV and TB
(e) define the terms *immune response*, *antigen* and *antibody*;
(f) describe the primary defences against pathogens and parasites (including skin and mucus membranes) and outline theirimportance. (**No** details of skin structure are required);
(g) describe, with the aid of diagrams and photographs, the structure and mode of action of phagocytes
(h) describe, with the aid of diagrams, the structure of antibodies;
(i) outline the mode of action of antibodies, with reference to the neutralisation and agglutination of pathogens;
(j) describe the structure and mode of action of T lymphocytes and B lymphocytes, including the significance of cell signalling and the role of memory cells;
(k) compare and contrast the primary and secondary immune responses;
(l) compare and contrast active, passive, natural and artificial immunity;
(m) explain how vaccination can control disease
(n) discuss the responses of governments and other organisations to the threat of new strains of influenza each year
(o) outline possible new sources of medicines, with reference to microorganisms and plants and the need to maintain biodiversity
(p) describe the effects of smoking on the mammalian gas exchange system, with reference to the symptoms of chronic bronchitis, emphysema (chronic obstructive pulmonary disease) and lung cancer;
(q) describe the effects of nicotine and carbon monoxide in tobacco smoke on the cardiovascular system with reference to the course of events that lead to atherosclerosis, coronary heart disease and stroke;
(r) evaluate the epidemiological and experimental evidence linking cigarette smoking to disease and early death

2 **(a)** In the UK in 2009, there was a major outbreak of a type of influenza known as 'swine flu'.

'Swine flu' was caused by a new strain of the influenza virus.

Explain why the influenza virus is usually described as a *pathogen* rather than a *parasite*.

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

(b) When an individual is infected with a virus, an immune response is triggered.

(i) Define the term *immune response*.

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(ii) One type of cell involved in an immune response is a plasma cell, which releases antibodies.

Plasma cells contain RNA.

Outline the roles of RNA in plasma cells.

In your answer you should give an account of the different roles of RNA.

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(iii) Outline **two** ways in which antibodies reduce the threat from pathogens.

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

(c) (i) In an attempt to reduce the consequences of further outbreaks of influenza, the government encourages immunisation of key groups of people, such as the elderly and children that have another risk factor.

Suggest **two other** groups who should be immunised **and** explain why immunisation for them would be particularly important.

1 .....

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[4]

(ii) Immunisation of large numbers of people costs the UK government a lot of money.

Other than the direct effects on health or reducing the number of deaths, suggest a reason why spending a large amount of money on immunisation is considered worthwhile.

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

(iii) Much of the money spent on immunisation programmes is used to publicise the health benefits of immunisation. Despite this, some individuals are reluctant to have the immunisation.

Give **one** reason why, despite being aware of the immunisation programme, some people choose not to be immunised.

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

[Total: 21]

Question 3 begins on page 10

5 **(a)** An investigation was carried out into the effect on lung function on giving up smoking.

The investigators measured the maximum volume of air that could be exhaled in one second (FEV_1) in a group of people who had stopped smoking, and in a similar group of people who continued to smoke over a five year period.

The results are shown in Fig. 5.1.

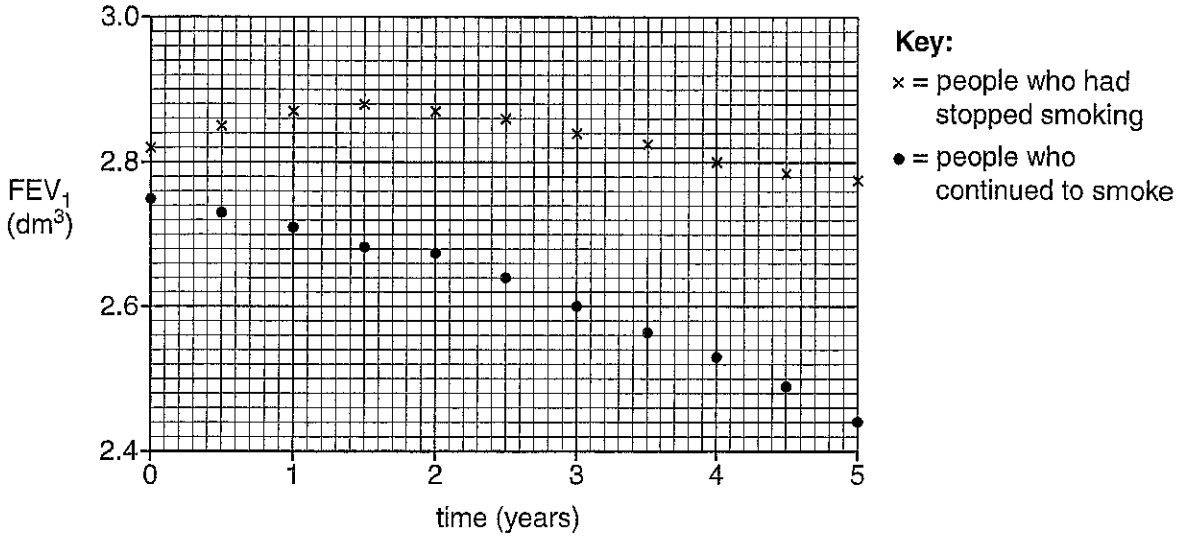

Fig. 5.1

(i) Using the information in Fig. 5.1, calculate the percentage decrease in the FEV_1 over the 5 year period for the group of people who **continued to smoke.**

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

Answer = ... % **[2]**

(ii) Describe the trends shown by the results in Fig. 5.1.

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QUESTION 5(b)(i) STARTS ON PAGE 18

(b) (i) One of the symptoms of smoking is the development of a smoker's cough.

Explain how smoking causes a smoker's cough **and** how the cough itself can lead to further problems in the lungs over a long period of time.

In your answer you should clearly distinguish between the development of the cough and the effects of prolonged coughing.

[7]

(ii) Chronic obstructive pulmonary disease (COPD) is a combination of diseases that can result in coughing, breathing difficulties and fatigue.

Name **two** specific diseases that contribute to COPD.

1 .....

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

(iii) One form of COPD develops because enzymes are released by phagocytes entering the alveoli. This enzyme action can break down elastin in the lining of the bronchioles and alveoli.

Use the example of elastin breakdown to explain the induced-fit hypothesis of enzyme action.

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[Total: 20]

2 Malaria is a disease caused by a eukaryotic parasite.

(a) State **two** features of the malarial parasite that indicate that it is **not** a prokaryote.

1 .....

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

(b) In a piece of word-processed homework, a student stated that one species of parasite that causes malaria is called:

Plasmodium Vivax

State **one** error made by the student.

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

(c) The malarial parasite is carried by an insect, the female *Anopheles* mosquito.

(i) Describe how the mosquito transmits the malarial parasite to a human.

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

(ii) In order to fight the spread of malaria, insecticides have been used in areas where the *Anopheles* mosquito breeds.

One problem that can occur when using insecticides in this way is the development of insecticide resistance.

Suggest **one other** reason why some people might be concerned about using insecticides.

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(iii) Suggest how the effects of insecticide use on a population of *Anopheles* mosquitoes could be measured **and** state the steps that should be taken in order to produce valid and reliable results.

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[Total: 12]

7 (a) Lymphocytes are important components of the immune system and can be classified into B lymphocytes and T lymphocytes.

For each of the statements in the table below, identify whether the description applies to:

- only B lymphocytes
- only T lymphocytes
- both B and T lymphocytes
- neither.

You may use each response once, more than once, or not at all. The first one has been done for you.

statement	can be applied to ...
form part of immune response	*both*
matured in thymus	
secrete substances which kill infected cells	
manufacture antibodies	
undergo clonal expansion	
activate other lymphocytes	

[5]

(b) Fig. 7.1 shows the concentration of antibodies in a patient's blood following an initial infection with a pathogen. This is known as the primary response.

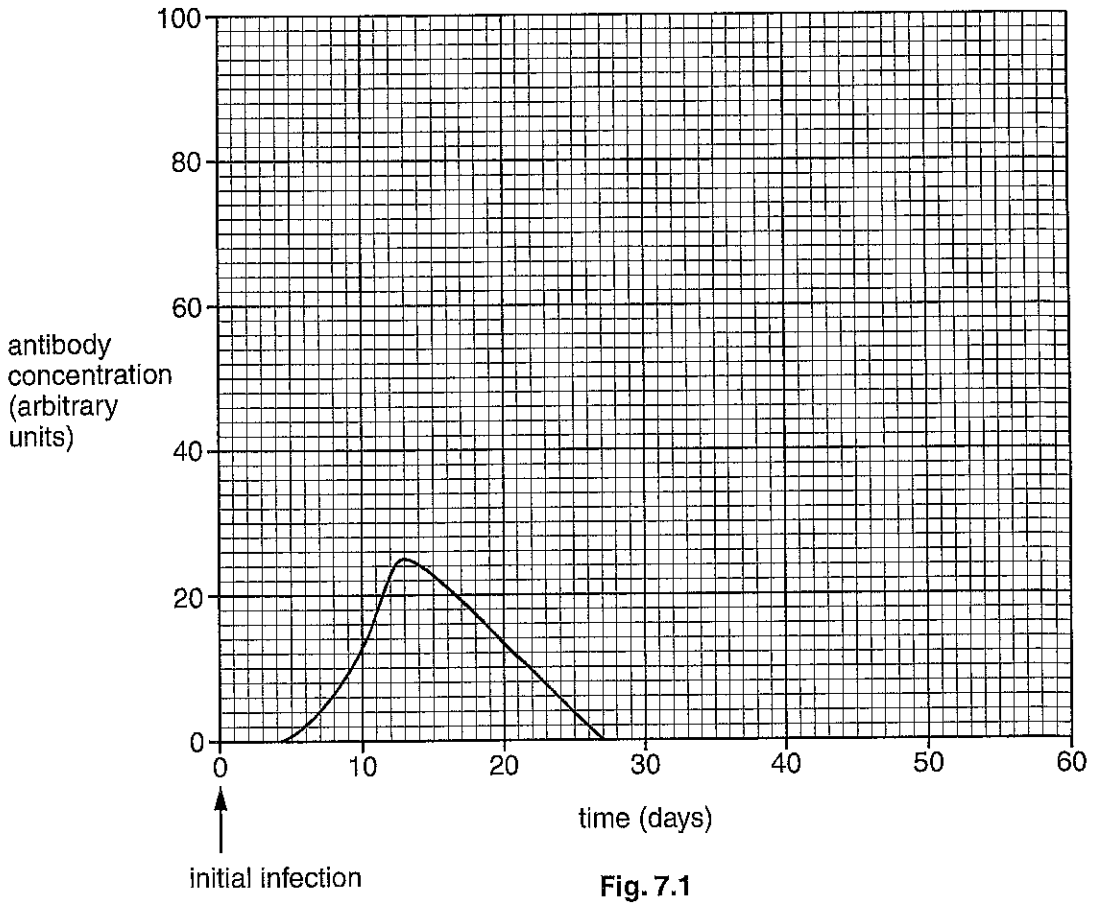

Fig. 7.1

(i) Describe the changes in antibody concentration that occur in the patient's blood during the primary response.

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

(ii) The patient was subsequently infected with the same pathogen 30 days after the initial infection.

Draw a line **on the graph** to show the likely concentration of antibodies in the patient's blood from 30 days onwards.

..... *The answer to this question must be drawn on Fig. 7.1* ..... **[2]**

QUESTION 7(c) STARTS ON PAGE 22

(c) Fig. 7.2 shows the structure of an antibody.

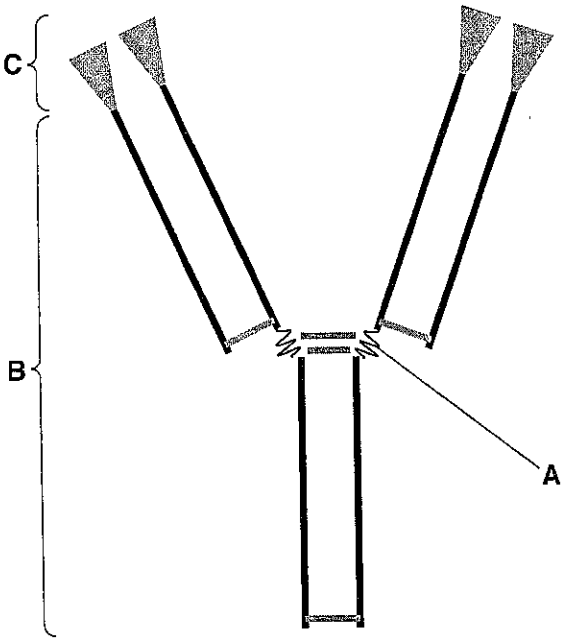

Fig. 7.2

Complete the table below by stating the name and function of each of the regions **A**, **B** and **C**.

region	name	function
A		
B		
C		

[6]

[Total: 16]

END OF QUESTION PAPER

4 **(a)** Each winter, the UK government recommends that vulnerable members of the public are vaccinated against the influenza (flu) virus.

(i) State **two** groups of people that the government would consider as being vulnerable.

1 .....

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2 .....

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

(ii) Suggest why the influenza vaccine has to be changed each year.

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Fig. 4.1 shows the concentration of antibodies in a patient's bloodstream following an influenza vaccination and then infection with the influenza virus.

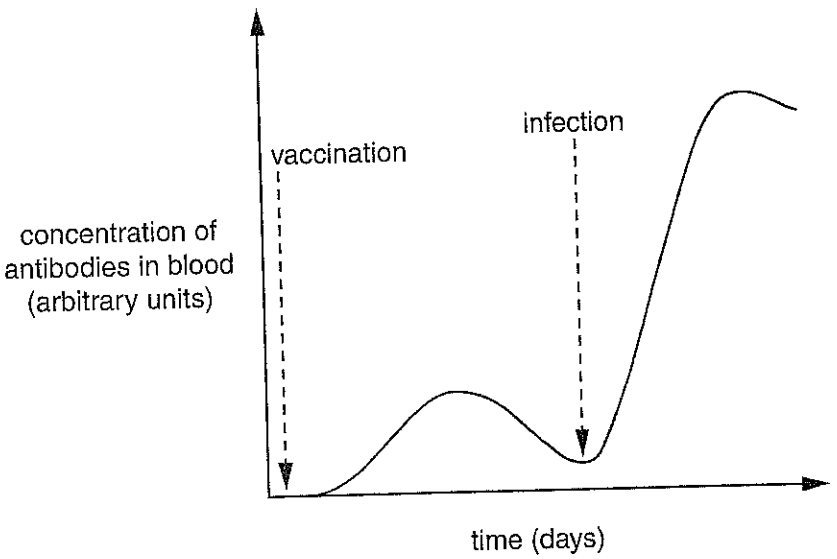

Fig. 4.1

(iii) Using the information from Fig. 4.1, state **two differences** between the primary and secondary immune responses.

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

(iv) Memory cells are produced when a patient is vaccinated against influenza.

Describe the role of these memory cells when the influenza virus enters the body.

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

QUESTION 4(b) STARTS ON PAGE 14

(b) Tamiflu® is an antiviral drug that can be used to treat influenza patients.

(i) State why a doctor would **not** prescribe antibiotics to treat influenza.

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

(ii) Neuraminidase is an enzyme which is present on the protein coat of the influenza virus.

This enzyme is used to break down the host cell membrane and allow the influenza viruses to leave the infected cell. Tamiflu® is a neuraminidase inhibitor.

Suggest how Tamiflu® could inhibit neuraminidase.

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(iii) Suggest how Tamiflu® could help to reduce the spread of influenza.

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(c) In an effort to find new drugs to combat a possible new influenza pandemic, researchers have investigated plants used in traditional medicine in Nepal. Two plants, an onion, *Allium oreoprasum*, and an asparagus, *Asparagus filicinus*, have been found to show antiviral properties.

Suggest why researchers in Nepal concentrated their research on plants that had been used in traditional medicine.

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

[Total: 16]

QUESTION 5 STARTS ON PAGE 16

5 **(a)** Fig. 5.1 shows the relationship between the mean number of cigarettes smoked per person per year and the incidence of lung cancer for both men and women between 1900 and 1990.

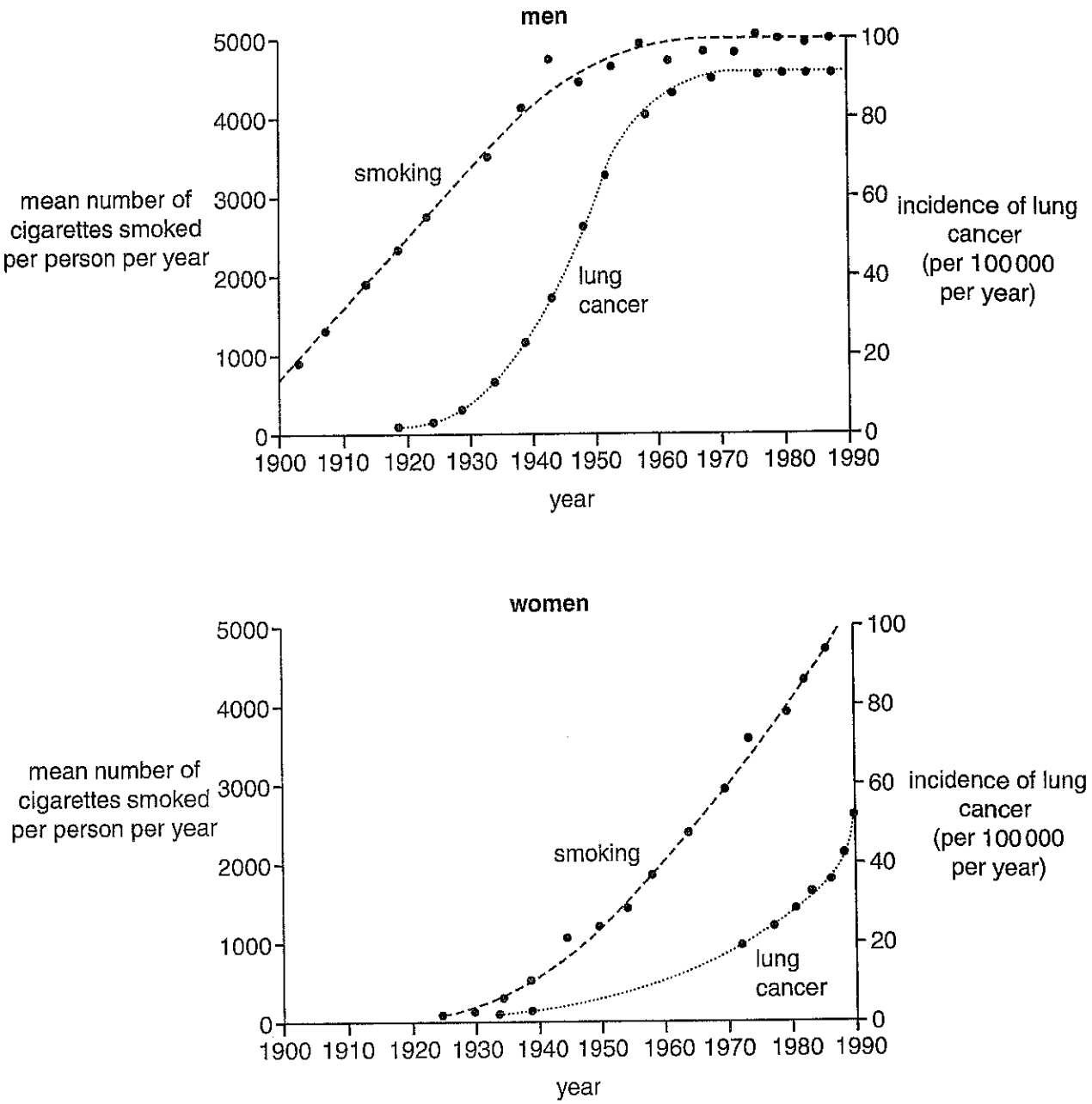

Fig. 5.1

(i) Compare the changes in the patterns of **smoking** in men and women from 1900 to 1990.

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

(ii) What evidence from Fig. 5.1 suggests that smoking causes lung cancer?

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

QUESTION 5(b) STARTS ON PAGE 18

(b) Describe how smoking contributes to the development of lung cancer.

In your answer, you should make clear the links between smoking and the development of lung cancer.

.... [6]

(c) Name **three other** diseases associated with smoking.

1 .....

2 .....

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

[Total: 13]

QUESTION 6 STARTS ON PAGE 20

Answer **all** the questions.

1 The condition known as AIDS is widespread in some parts of the world.

(a) (i) Identify the infective agent that causes AIDS.

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

(ii) The government has introduced needle exchange programmes for drug users.

Explain how this may help reduce the transmission of AIDS.

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

(b) Fig. 1.1 shows a simplified diagram of the structure of the infective agent that causes the condition known as AIDS.

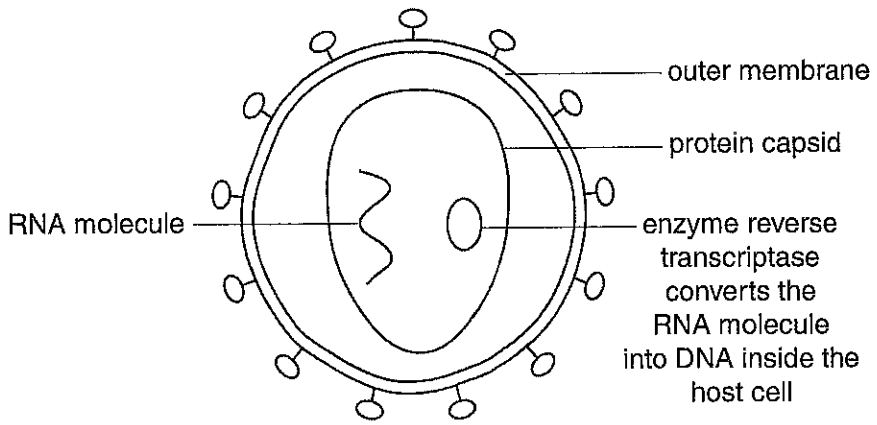

Fig. 1.1

(i) The proteins in the capsid and the RNA molecules are polymers. Polymers are made up of smaller monomer subunits.

Name the monomers that make up:

proteins .....

RNA ..... **[2]**

(ii) The infective agent that causes AIDS takes control of the T lymphocytes of the host.

Using the information in Fig. 1.1, suggest why the infective agent is able to 'take control' once it has entered the T lymphocytes.

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..... [2]

(c) People with AIDS frequently become ill following infection with opportunistic diseases such as tuberculosis (TB).

(i) State **three** factors that increase the chance of infection with TB.

1 .....

2 .....

3 ..... [3]

(ii) When an infection occurs, some T lymphocytes produce cell signalling molecules called cytokines. These cytokines stimulate specific groups of B lymphocytes to divide.

Describe how cytokine molecules can stimulate specific groups of B lymphocytes to divide.

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..... [3]

[Total: 13]

4 **(a)** The World Health Organisation has promoted the concept of health.

What is meant by the term *health*?

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

(b) The body has adaptations that provide it with a primary defence against the entry of pathogens and parasites.

State **two** features of the body that form part of the primary defence.

For each feature, explain how it **helps to prevent the entry** of pathogens and parasites into the body.

feature 1 .....

explanation .....

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feature 2 .....

explanation .....

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

(c) Fig. 4.1 shows the life cycle of the threadworm. This is a common parasite in young children.

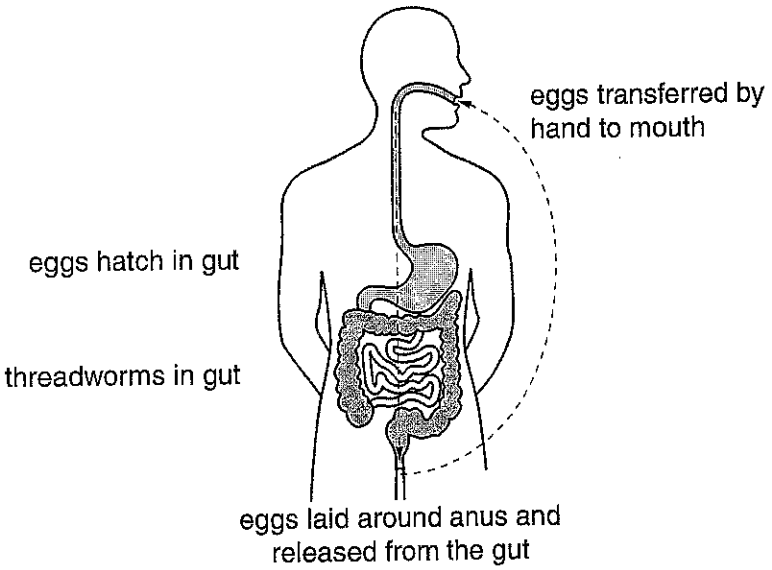

Fig. 4.1

(i) Define the term *parasite* **and** suggest how the threadworm benefits from this relationship.

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

(ii) Using the information in Fig. 4.1, suggest **two** ways in which the cycle of infection could be broken.

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

[Total: 12]

8 Complete the following passage by selecting the most suitable term from the list below.

Each term may be used once, more than once or not at all.

antibiotics	**natural**
antibodies	**non-specific**
antibody	**specific**
antigen	**vaccination**
artificial	**vaccines**

The body can acquire immunity in a number of different ways.

In passive immunity, ... are introduced directly into the body. This may occur via breast milk or the placenta, in which case it is described as ..... immunity. This immunity provides the growing child with valuable protection until its immune system has developed fully. It is sometimes important to provide immediate protection, such as when a person has a wound that could be contaminated with tetanus bacteria. In this case, suitable blood serum from another individual is injected into the bloodstream to provide ..... immunity.

Edward Jenner pioneered the technique of stimulating the immune system into action so that the body develops immunity without developing the symptoms of the disease. Jenner's technique mimics the way in which the body would develop ..... immunity from direct contact with the pathogen and the stimulation of the primary response. Nowadays, a harmless form of the ..... is injected so that the body develops antibodies and memory cells for future defence. This technique is known as ..... .

[6]

[Total: 6]

END OF QUESTION PAPER

5 (a) Smoking increases the risk of lung infections.

(i) Explain how the mucus and the cilia in the air passages reduce the chance of developing lung infections.

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..... [2]

QUESTION 5 CONTINUES ON PAGE 16

In an individual with bronchitis, the mucus contains a large number of pathogenic bacteria. Phagocytic white blood cells destroy the bacteria.

Fig. 5.1 shows the sequence of events that results in the destruction of a bacterium.

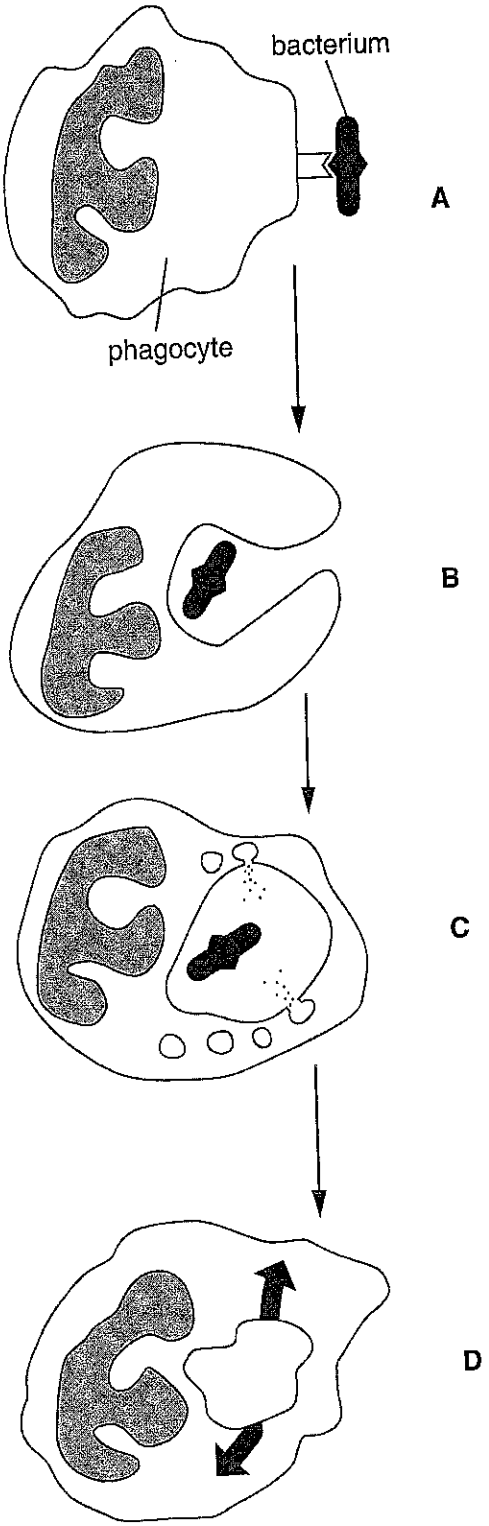

Fig. 5.1

(ii) Describe the events taking place at stages **A**, **B**, **C** and **D**, in sequence.

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(b) The immune system will produce specific antibodies in response to infection.

(i) Name the type of cell that produces antibodies.

.... [1]

Turn over

(ii) Describe how the structure of an antibody molecule is related to its function.

In your answer you must clearly link structure and function.

[7]

(iii) Identify the type of immunity provided by antibodies in breast milk.

Place a tick (✓) in the correct box.

type of immunity	
artificial active	
artificial passive	
natural active	
natural passive	

[1]

[Total: 17]

5 **(a)** Coronary heart disease (CHD) can be described as a multifactorial disease. This means that a number of different risk factors contribute to the development of the disease.

Fig. 5.1 shows the percentage of cases of CHD in a population to which each risk factor contributed.

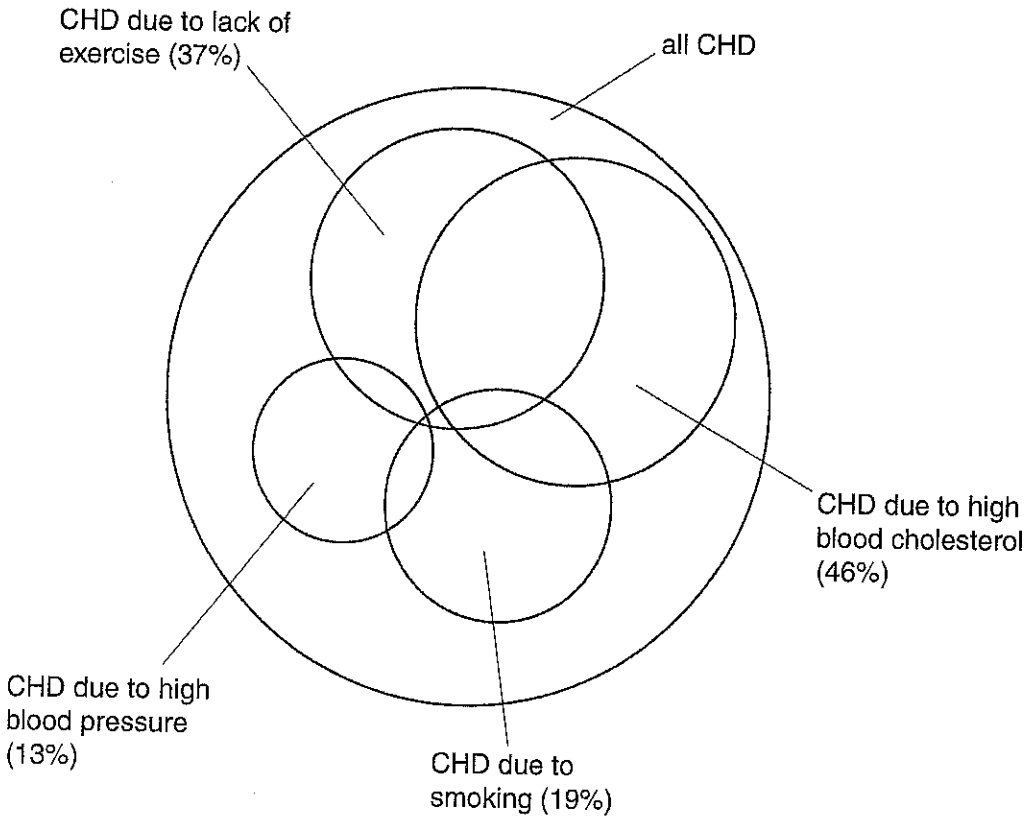

Fig. 5.1

(i) When you add up the different risk factor percentages for the population you find that it is greater than 100%.

Suggest why.

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

(ii) State **two** further risk factors that are **not** shown in Fig. 5.1.

1 .....

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

(iii) Smoking is a contributing factor in 19% of all cases of CHD.

Table 5.1 lists a number of effects of cigarette smoke.

Use a tick (✓) to indicate which component of cigarette smoke causes each effect.

The first row has been done for you.

Table 5.1

effect	nicotine	carbon monoxide
increases heart rate	✓	
constricts arterioles		
damages the lining of arteries		
reduces the ability of haemoglobin to carry oxygen		
makes platelets sticky		

[4]

(b) Cholesterol is transported in the form of lipoproteins. High levels of low density lipoproteins (LDLs) in the blood are a risk factor in heart disease.

Outline the role of LDLs in the formation of an atheroma.

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(c) An atheroma can grow to a point where it restricts blood flow in a coronary artery, causing coronary heart disease (CHD).

Fig 5.2 shows a method of reducing the symptoms of CHD.

A stent is a tubular device, containing a 'balloon', which can be inserted into the damaged artery. The stent can be opened up by inflating the balloon.

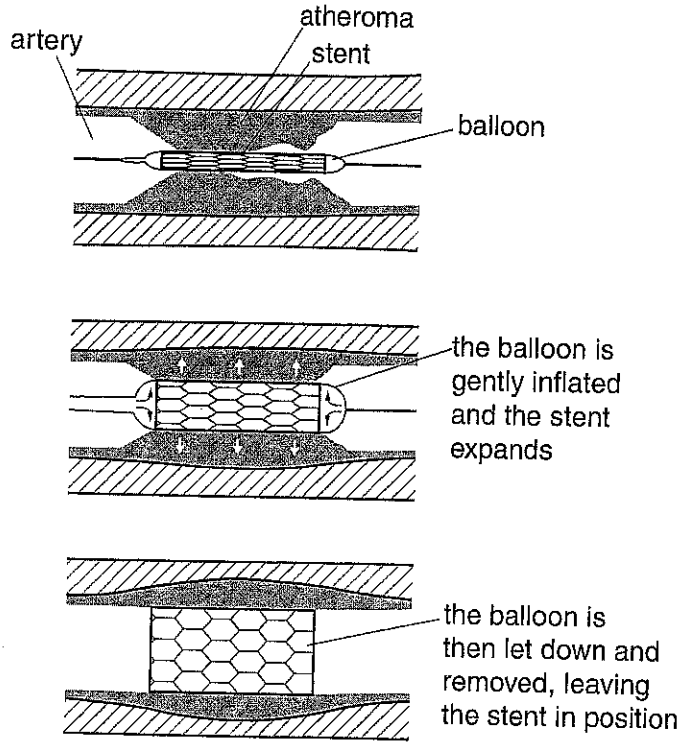

Fig. 5.2

Explain how the inserted stent would reduce the symptoms of CHD.

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[Total: 13]

2 Malaria kills over one million people every year, the vast majority being under the age of ten.

Adults who have survived malaria in childhood and then continue to live in an area where malaria is found, develop a limited form of immunity.

(a) (i) Name the parasite that causes malaria.

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

(ii) Name the vector for the malarial parasite.

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

(iii) Name a human cell in which the malarial parasite reproduces.

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

(b) Scientists are developing a vaccine using an attenuated (inactive) form of the malarial parasite.

The aim is to trigger an immune response without the development of the disease.

Describe the actions of the **B lymphocytes** in the immune response.

In your answer you should make clear how the steps in this part of the immune response are sequenced.

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(c) Suggest why adults who have survived malaria may lose their immunity when they **leave** a malarial area.

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(d) State **three biological** reasons why it has not been possible to produce an effective vaccine for malaria.

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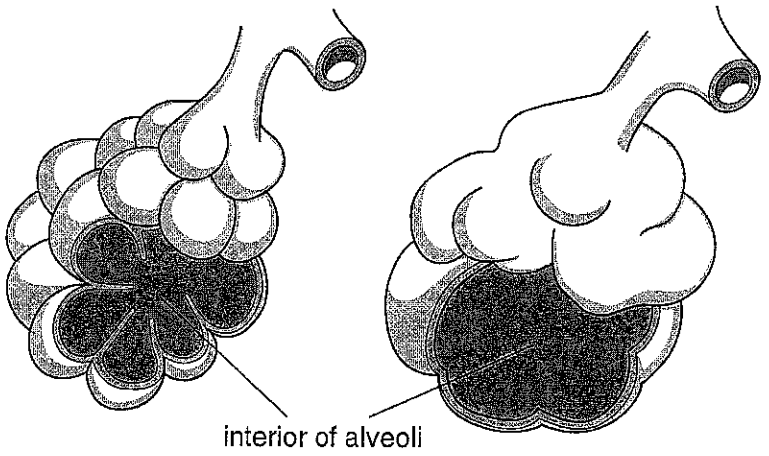
[Total: 16]

6 **(a)** Fig. 6.1 shows a diagram of alveoli in a healthy lung and alveoli in a lung from a person with advanced emphysema.



alveoli in a healthy lung alveoli from a person with advanced emphysema

Fig. 6.1

(i) Describe how smoking could cause changes in alveoli, such as those shown in Fig. 6.1.

In your answer you should make the links between the changes and their causes clear.

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..... [6]

(ii) Emphysema is a form of chronic obstructive pulmonary disease (COPD).

Describe **two** signs or symptoms of emphysema.

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(iii) Emphysema is described as a chronic disease.

Suggest the meaning of the term *chronic.*

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..... [2]

(b) An investigation was conducted into the effect of smoking on lung function. One measure of lung function is peak flow rate.

The peak flow rate is the maximum volume of air expelled from the lungs in one minute ($dm^3\ min^{-1}$).

Two male volunteers, one a smoker and one a non-smoker, had their peak flow measured once a year for seven years.

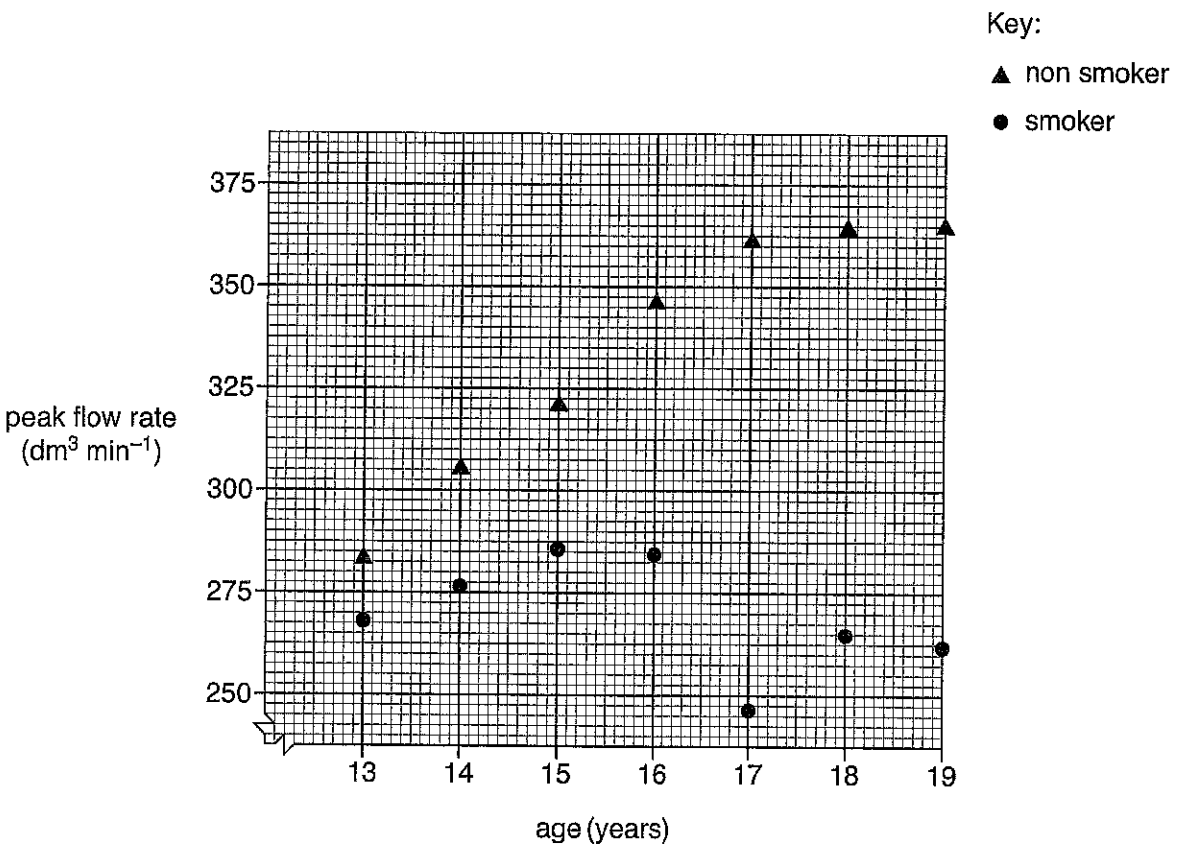

Fig. 6.2

(i) **Describe** the data shown in Fig. 6.2.

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(ii) **Explain** the results obtained for the smoker.

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(iii) Suggest **three** ways of improving the reliability of this investigation.

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[Total: 19]

END OF QUESTION PAPER