

Unit 1

Biology and Disease

Defence against disease

Practice Exam Questions

1.

(a) Phagocytes and lysosomes are involved in destroying microorganisms. Describe how.

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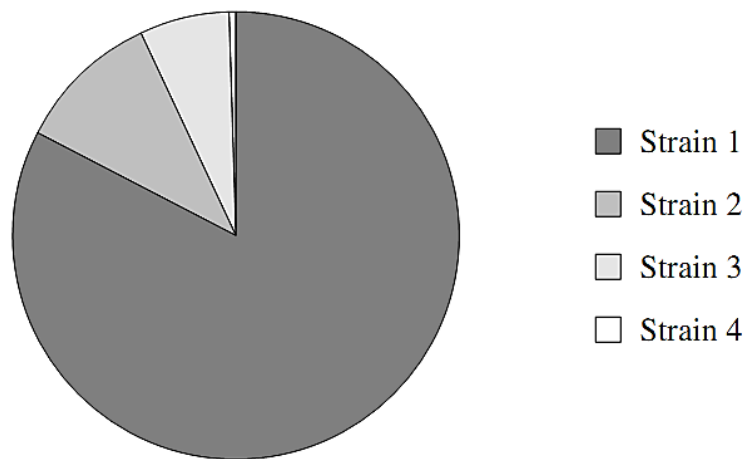
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(3 marks)

(b) The pie chart shows the proportions of people infected with four different strains of influenza virus early in 2004.



(i) A person may develop influenza twice within a short time. Use information from the pie chart to explain why.

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(2 marks)

- (ii) The information in the pie chart is valuable to companies who make influenza vaccines. Use your knowledge of antigens to explain why.

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(2 marks)

2.

Read the following passage.

Pathogens affect humans. They also affect farm animals. Once pathogens have entered the body of an animal they can cause disease. Vets sometimes have difficulty identifying the disease from which a particular animal is suffering. Until recently, they have had to take blood samples and send them to a laboratory. The laboratory carries out tests on the sample.

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New tests have been developed. Some of these new tests use monoclonal antibodies. Tests using monoclonal antibodies are fast, specific and allow vets to identify a disease while they are still on the farm.

Brucellosis is a disease of cattle. It is caused by bacteria. These bacteria can infect people who drink milk or eat dairy products from infected cattle. A test using monoclonal antibodies allows vets to identify cattle that are carriers. The carriers are cattle that carry the brucellosis bacteria but do not show any symptoms of the disease.

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Use the information from the passage and your own knowledge to answer the following questions.

- (a) Other than bacteria, name **one** type of pathogen (line 1).

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 (1 mark)

- (b) Give **two** ways in which a pathogen may cause disease when it has entered the body (lines 1–2).

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 (2 marks)

(c) Some new tests use monoclonal antibodies (lines 6–7).

(i) Explain why these antibodies are referred to as monoclonal.

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(1 mark)

(ii) Tests using monoclonal antibodies are specific (line 7). Use your knowledge of protein structure to explain why.

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(3 marks)

(d) The tests using monoclonal antibodies allow vets to identify brucellosis while they are still on a farm. Explain the advantages of this.

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(3 marks)

3.

Read the passage below.

Most cases of cervical cancer are caused by infection with Human Papilloma Virus (HPV). This virus can be spread by sexual contact. There are many types of HPV, each identified by a number. Most of these types are harmless but types 16 and 18 are most likely to cause cervical cancer.

A vaccine made from HPV types 16 and 18 is offered to girls aged 12 to 13. Three injections of the vaccine are given over six months. In clinical trials, the vaccine has proved very effective in protecting against HPV types 16 and 18. However, it will be many years before it can be shown that this vaccination programme has reduced cases of cervical cancer. Until then, smear tests will continue to be offered to women, even if they have been vaccinated. A smear test allows abnormal cells in the cervix to be identified so that they can be removed before cervical cancer develops.

The Department of Health has estimated that 80% of girls aged 12 to 13 need to be vaccinated to achieve herd immunity to HPV types 16 and 18. Herd immunity is where enough people have been vaccinated to reduce significantly the spread of HPV through the population.

Use information from this passage and your own knowledge to answer the following questions.

- (a) HPV vaccine is offered to girls aged 12 to 13 (line 5). Suggest why it is offered to this age group.

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(1 mark)

- (b) The vaccine is made from HPV types 16 and 18 (line 5). Explain why this vaccine may **not** protect against other types of this virus.

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(2 marks)

(c) Three injections of the vaccine are given (lines 5 to 6). Use your knowledge of immunity to suggest why.

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(2 marks)

(d) It will be many years before it can be shown that this vaccination programme has reduced cases of cervical cancer (lines 7 to 9). Suggest **two** reasons why.

1

2

(2 marks)

(e) Smear tests will continue to be offered to women, even if they have been vaccinated (lines 9 to 10). Suggest why women who have been vaccinated still need to be offered smear tests.

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(1 mark)

(f) Suggest **one** reason why vaccinating a large number of people would reduce significantly the spread of HPV through the population (lines 14 to 16).

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(2 marks)

4 (b) Scientists have developed vaccines against HPV. One of the vaccines contains HPV antigens.

(i) What is an HPV antigen?

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(2 marks)

(ii) A vaccine can be used to produce immunity to HPV. Describe how memory cells are important in this process.

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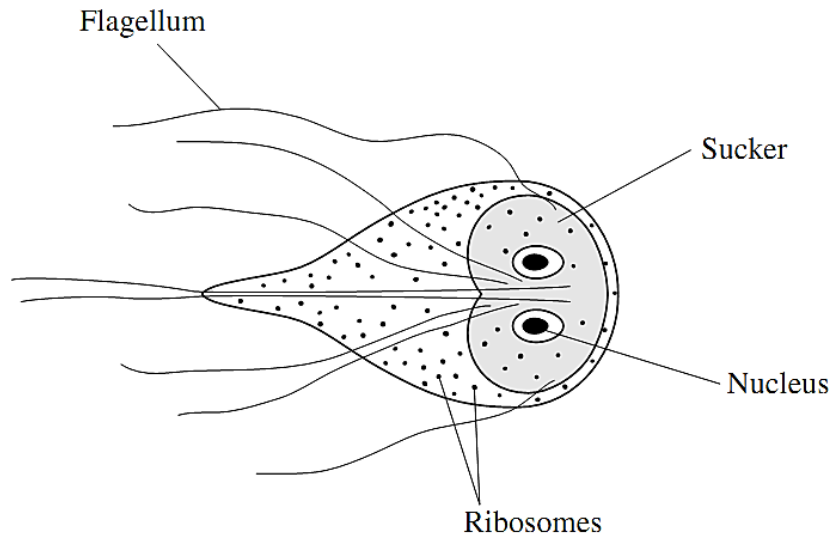
(3 marks)

(c) Some doctors suggested offering the vaccine to young men. Explain the advantage of vaccinating young men as well as young women.

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(2 marks)

- 5 Giardiasis is an intestinal disease. It is caused by the microorganism *Giardia lamblia*. The drawing shows some of the structures present in *G. lamblia*.



- (a) Name **one** structure shown in the drawing which confirms that *G. lamblia* is a eukaryotic organism.

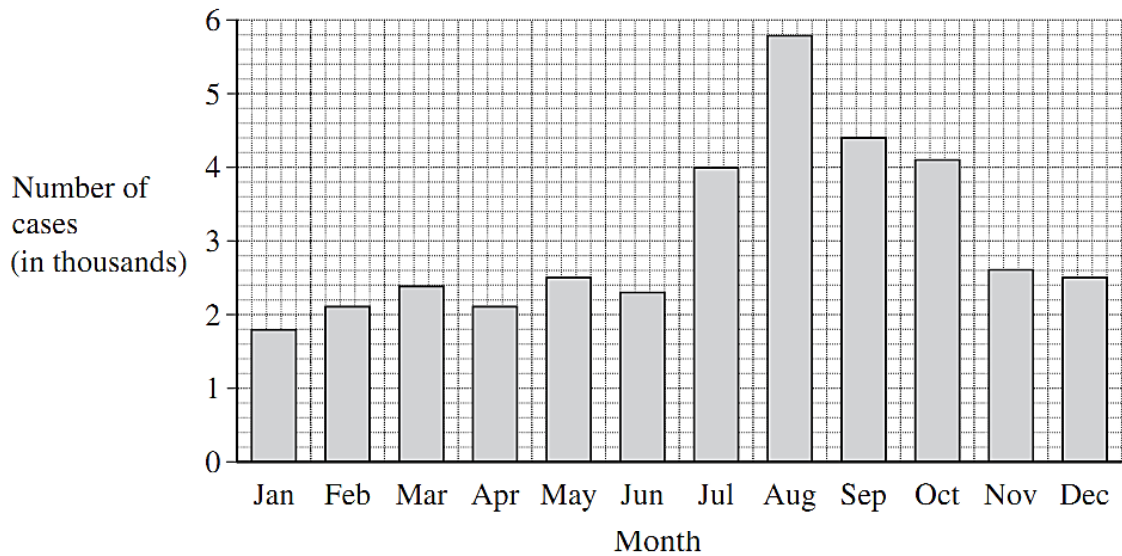
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 (1 mark)

- (b) *G. lamblia* can attach itself with its sucker. Explain how this is an adaptation to living in the intestines.

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 (1 mark)

- (c) Giardiasis is one of the main causes of diarrhoea in the USA. It is usually transmitted by drinking contaminated water. The bar chart shows the number of cases of giardiasis in one state of the USA during one year.



- (i) Calculate the percentage increase in the number of cases of giardiasis from January to August. Show your working.

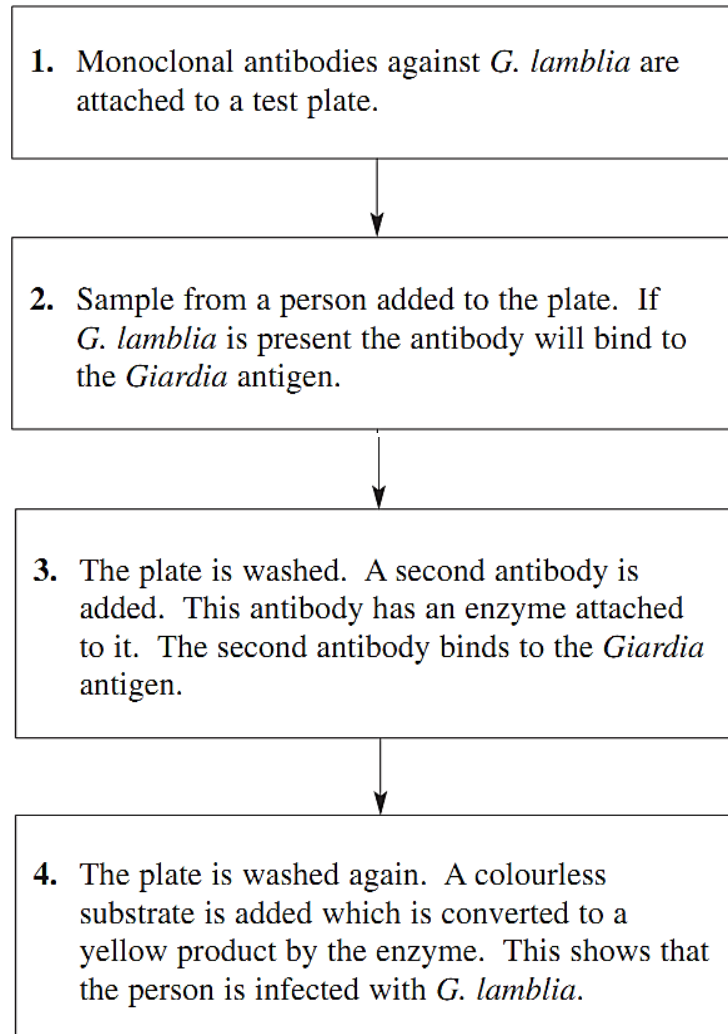
Answer (2 marks)

- (ii) Suggest **one** reason for the number of cases being highest in the late summer months.

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 (1 mark)

- (d) A test has been developed to find out whether a person is infected with *G. lamblia*. The test is shown in the flow chart.



- (i) Explain why the antibodies used in this test must be monoclonal antibodies.

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(1 mark)

- (ii) Explain why the *Giardia* antigen binds to the antibody in step 2.

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(1 mark)

- (iii) The plate must be washed at the start of step 4, otherwise a positive result could be obtained when the *Giardia* antigen is not present. Explain why a positive result could be obtained if the plate is not washed at the start of step 4.

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(2 marks)

Defence against disease; answers and markscheme

1.

(a)		Phagocytes engulf pathogens/microorganisms; Enclosed in a vacuole / vesicle/ phagosome; Lysosomes have enzymes; That digest/hydrolyse molecules/proteins/lipids/ microorganism;	3 max	
(b)	(i)	Get another strain / there are different strains; Therefore does not have memory cells against second strain;	2	Q The second marking point should only be awarded in the context of memory cells.
(b)	(ii)	Vaccines only work against certain strains; Because the antigens they possess are different; Enables company to target strain likely to be prevalent later / most common strain;	2 max	

2.

(a)		Virus / fungus / protozoan;	1	Neutral: named example
(b)		Produces toxins; Damages cells / tissues / example given e.g. cell lysis;	2	Neutral: infects / colonises / invades cells
(c)	(i)	(Antibodies) produced from a single clone of B cells / plasma cells; OR (Antibodies) produced from the same B cell / plasma cell;	1	Accept: hybridoma cell line instead of B cell / plasma cell Reject: idea that antibodies are cloned
(c)	(ii)	(Specific) primary structure / order of amino acids; (Specific) tertiary / 3D structure; (So) Only binds to / fits / complementary to one antigen;	3	Reject: 'active site' for either point 2. or 3. only once
(d)		(Rapid) treatment of carriers / infected cattle / disease; Can isolate / cull carriers / infected cattle; Infected (dairy) products not sold / consumed / tracked; Reduces spread of disease; No need to kill / prevents the death of non-infected animals;	3 max	Neutral: reference to rapid identification of infected cattle Neutral: ethical arguments

3.

(a)	Girls are not sexually active / not likely to carry HPV / vaccine may not work if already infected / few girls sexually active (at this age);	1	Neutral: girls are not sexually mature Neutral: to provide better protection Accept: provides immunity before sexually active Neutral: girls are less likely to have 'it' as could mean the vaccine from the question stem
(b)	Other (HPV) types have different antigens; No memory cells for other types / memory cells not activated; Antibodies cannot attach to antigen / correct antibodies not produced / antibodies are not complementary;	2 max	Accept: refs. to antigenic variability Accept: B cells for memory cells Accept: memory cells cannot recognise antigen for 'not activated' Accept: examples of memory cell activation
(c)	More antigen; More memory cells; So more antibodies produced / antibodies produced quicker (if infected);	2 max	Accept: 'many' / 'enough' instead of 'more' Neutral: primary / secondary response Accept: T cells / B cells / plasma cells instead of 'antibodies' Reject: the idea that vaccines contain antibodies Q Reject: antibodies 'fight' / 'antibiotics'

4(a)	<p>(yes): Many women (with cervical cancer) have <u>HPV 16 (18 &31)</u>;</p> <p>(no): Few women (with cervical cancer) have <u>HPV 6 /11</u>;</p> <p>(HPV infection does not mean causation because): Could be caused by another factor / example given / may be due to coincidence;</p> <p>No control group / did not study HPV in healthy women / did not study all HPV types / having cancer may increase susceptibility to HPV / does not add up to 100% / not all women with cancer have HPV / individual may have more than one HPV type;</p>	3 max	<p><i>Neutral:</i> correlation between HPV (16) and cervical cancer</p> <p><i>Reject:</i> many women with <u>HPV 16 (18 &31)</u> have cervical cancer / not all women have cancer</p> <p><i>Accept:</i> figures from graph for 'many' and 'few'</p> <p><i>Accept:</i> minor errors in reading HPV frequencies from graph</p> <p><i>Reject:</i> does not mean HPV <u>vaccine</u> causes cancer;</p> <p><i>Neutral:</i> refs. to sample size and factors that should have been kept constant</p>
4(b)(i)	<p>Protein / glycoprotein / glycolipid / polysaccharide;</p> <p>Causes immune response / antibody production;</p>	2	<p><i>Accept:</i> B / T cell production</p>
4(b)(ii)	<p>Memory cells produced / remain / stored (from previous infection);</p> <p>(When individual) comes into contact with virus / antigen (again);</p> <p>Rapid / secondary / greater response / many or more antibodies produced;</p> <p>Destroys virus / antigen before it can cause harm / symptoms / cancer;</p>	3 max	<p><i>Neutral:</i> antibodies produced / remain</p> <p><i>Neutral:</i> 'cell' instead of 'virus'</p> <p><i>Reject:</i> 'bacteria' once only</p> <p><i>Accept:</i> B cells / T cells</p> <p><i>Reject:</i> if destroys the virus / antigen <i>in the vaccine</i> before it can cause harm</p> <p>Q Do not allow 'fights HPV'</p> <p>Q Do not allow 'memory cells remember'</p>

5	(a)		Nucleus;	1	
5	(b)		Enables organism to remain in area (of food source) / prevent its removal;	1	Q 'To attach' is not sufficient unless qualified;
5	(c)	(i)	Correct answer of 222(%) Incorrect answer that clearly identifies difference in number of cases as 5800 –1800 or 5.8 – 1.8;	2	Correct answer gains two marks
5	(c)	(ii)	More water-related activities / more 'organisms' with increased temperature;	1	Q Allow any reference to growth or replication of 'organisms'. Do not penalise reference to bacteria. Q Do not allow increase in water consumption.
5	(d)	(i)	All have same shape / only binds to <i>Giardia</i> /one type of/specific antigen;	1	
5	(d)	(ii)	Has complementary (shape) / due to (specific) tertiary structure / variable region (of antibody);	1	Q Binds/fits not sufficient unless qualified;
5	(d)	(iii)	Enzyme/second antibody would remain / is removed by washing; Enzyme can react with substrate (when no antigen is present);	2	