CAMBRIDGE INTERNATIONAL AS & A LEVEL BIOLOGY · 9700

BIOLOGY



EXAM QUESTION PACK

11 IMMUNITY

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Chapter 11

Immunity

11.1 The immune system

1494. 9700_m20_qp_12 Q: 38

Which row correctly describes B-lymphocytes?

	processed in the thymus	release antibodies immediately after formation
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key

✓ = correct

✗ = incorrect

1495. 9700_s20_qp_11 Q: 39

Which row correctly describes the type of immunity gained from being injected with an antitoxin?

	active	artificial	passive	natural
A	✓	✓	✗	✗
B	✓	✗	✗	✓
C	✗	✓	✓	✗
D	✗	✗	✓	✓

key

✓ = correct

✗ = not correct

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1496. 9700_s20_qp_12 Q: 38

A blood cell count can indicate how many white blood cells there are in the blood.

Where else in the body are white blood cells found?

1 bone marrow

2 lymph

3 lungs

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

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1497. 9700_s20_qp_12 Q: 39

Myasthenia gravis is a disease that results from the immune system failing to distinguish between self and non-self. Antibodies bind to a component of the junctions between a muscle and its nerve.

What correctly describes Myasthenia gravis?

A Impulses in the nerve to the affected muscle cannot be blocked.

B The affected muscle cannot be repeatedly stimulated.

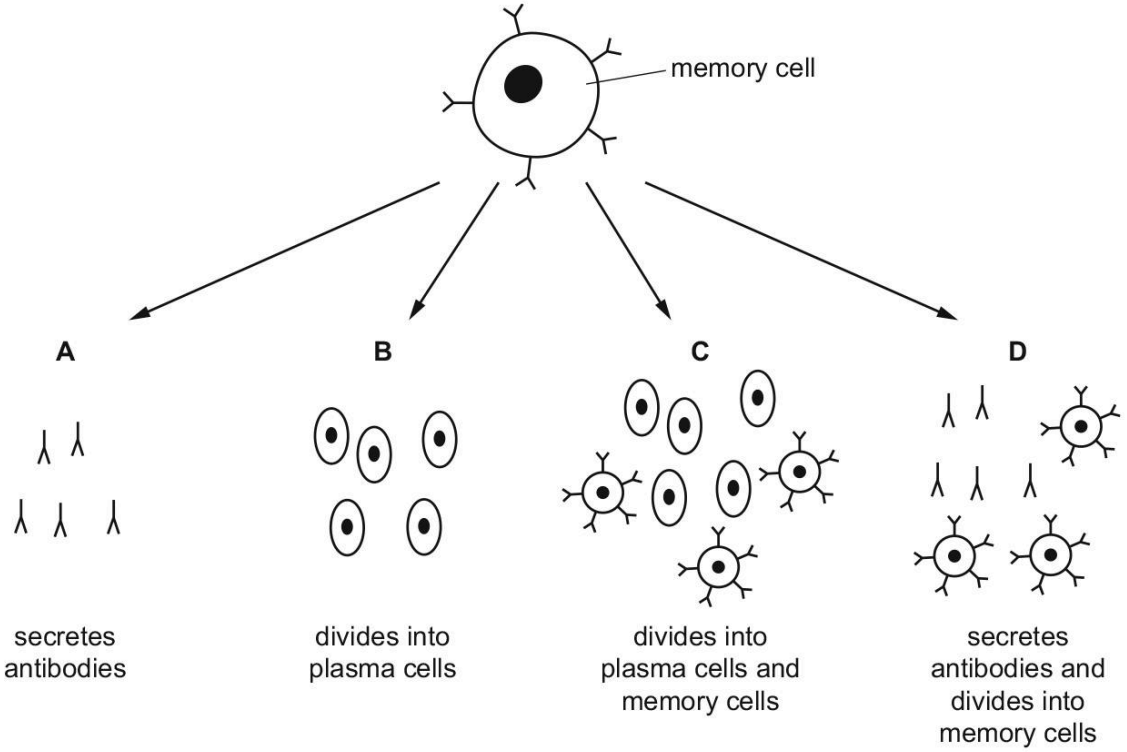
C The affected muscle is permanently stimulated.

D The nerve to the affected muscle does not carry any nerve impulses.

1498. 9700_w20_qp_11 Q: 38

When exposed to an antigen for a second time, memory cells stimulate a secondary immune response.

Which correctly shows the secondary immune response?



1499. 9700_w20_qp_11 Q: 40

Which row describes passive immunity?

	triggered by an antigen	involves an immune response	memory cells produced	permanent protection
A	✓	✓	✓	✓
B	✓	✓	✗	✗
C	✗	✗	✓	✓
D	✗	✗	✗	✗

key
✓ = correct
✗ = not correct

1500. 9700_w20_qp_12 Q: 38

Which row is correct for neutrophils and B-lymphocytes?

	neutrophil	B-lymphocyte
A	can change shape	activated by contact with antigens
B	found in organs rather than in blood	kill virus-infected cells
C	may be long-lived cells	always short-lived cells
D	their lysosomal enzymes digest bacteria	secrete cytokines

1501. 9700_w20_qp_12 Q: 40

A graft of tissue, such as skin, from a different person is usually rejected by the body.

Which statement about graft rejection is correct?

A The graft is rejected by B-lymphocytes because they make and release antibodies which react with the surface antigens on the graft cells.

B The graft is rejected by B-lymphocytes because T-lymphocytes are not stimulated to produce antibodies.

C The graft is rejected by T-lymphocytes because the graft tissue causes T-lymphocytes to release antibodies.

D The graft is rejected by T-lymphocytes because they circulate in the blood and can gather at the graft site.

1502. 9700_w20_qp_13 Q: 38

Muscle cells have cell surface receptors for the neurotransmitter, ACh. These receptors allow the muscle to respond to a nerve impulse.

In the condition myasthenia gravis, the helper T cells stimulate a clone of B cells to become plasma cells and secrete antibodies that bind to and block these ACh receptors. The muscles cannot be stimulated and begin to break down.

A short-term treatment for myasthenia gravis is to inject monoclonal antibodies into the blood.

What is the target of these monoclonal antibodies?

A antibodies that bind to ACh receptors

B muscle cell surface ACh receptors

C plasma cells secreting anti-ACh receptor antibodies

D the stimulating neurotransmitter ACh

1503. 9700_m19_qp_12 Q: 38

Why does the white blood cell count increase in people with leukaemia?

A More antibodies are required so there are more B-lymphocytes.

B More lymphocytes are produced in bone marrow.

C More memory cells are produced in plasma.

D More T-lymphocytes are required to stimulate the immune system.

1504. 9700_m19_qp_12 Q: 39

Where are antibodies found during an immune response?

	on the surface of pathogens	on the surface of memory cells
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key

✓ = antibodies found

✗ = antibodies not found

1505. 9700_s19_qp_11 Q: 39

Which statements describe myasthenia gravis?

1 Antibodies attack proteins within the body.

2 T-lymphocytes are involved in an inflammatory response.

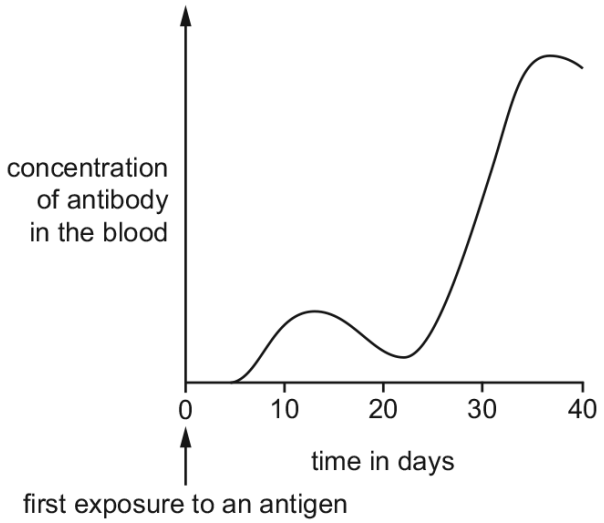
3 The immune system blocks receptors at the neuromuscular junction.

4 The immune system attacks the central nervous system.

A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

1506. 9700_w19_qp_11 Q: 38

The graph shows the amount of antibody produced in response to an antigen.



From the graph, which statement is correct?

A It takes 25 days to achieve active immunity.

B Memory cells for this antigen are present in the body within 20 days.

C T-helper lymphocytes are activated on day 12.

D The second exposure to the antigen occurred on day 25.

1507. 9700_w19_qp_12 Q: 39

The enzyme telomerase prevents loss of telomeres after many mitotic cell cycles.

Which types of white blood cell involved in an autoimmune condition will contain active telomerase?

	mature B-lymphocyte plasma cells	neutrophils	helper T-lymphocyte memory cells
A	✓	✓	✓
B	✓	✓	✗
C	✗	✗	✓
D	✗	✓	✓

key

✓ = contain active telomerase

✗ = do not contain active telomerase

1508. 9700_s18_qp_11 Q: 39

Which statement about the properties of the antigen binding sites in antibody molecules is correct?

A They are located on the light chains only.

B They have a hinge region to give flexibility for different antigens.

C They have binding sites for receptors on phagocytes.

D They have variable amino acid sequences for different antigens.

1509. 9700_s18_qp_12 Q: 39

Where are antigens found?

	on the surface of pathogen	on the surface of macrophage
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key

✓ = antigens found

✗ = antigens not found

1510. 9700_s18_qp_12 Q: 40

When an organ is transplanted from one person to another, rejection of the non-self organ must be avoided. At the same time, the immune system of the recipient must be maintained to prevent death from infections.

What prevents rejection of the transplanted organ?

A continued activity of B-lymphocytes

B natural active immunity

C natural passive immunity

D suppression of T-lymphocyte activity

1511. 9700_w18_qp_11 Q: 39

Which statements correctly describe lymphocytes?

1 Each B-lymphocyte has the ability to make several types of antibody molecules.

2 Some B-lymphocytes and T-lymphocytes become memory cells.

3 Plasma cells secrete antibodies into the blood plasma.

4 Some T-lymphocytes stimulate macrophages to kill infected cells.

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 1 and 4 only

D 2, 3 and 4 only

1512. 9700_w18_qp_11 Q: 40

Addison's disease can occur when antibodies are produced in response to an enzyme found in some organs of the body.

Which statements correctly describe Addison's disease?

1 It is a non-infectious disease.

2 It is a type of auto-immune disease.

3 Antibodies are produced against a self-antigen.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

---

1513. 9700_w18_qp_12 Q: 38

Where are antigens found?

	on the surface of macrophages	in blood plasma
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key

✓ = antigens found

✗ = antigens not found

1514. 9700_w18_qp_13 Q: 39

Where are antigens found?

	on surface of pathogen	in blood plasma
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key

✓ = antigens found

✗ = antigens not found

1515. 9700_m17_qp_12 Q: 39

Which of the statements could describe **both** B-lymphocytes and T-lymphocytes?

1 They contain specific protein receptors in their cell surface membranes.

2 They differentiate into plasma cells.

3 They divide by mitosis.

A 1 and 3 **B** 1 only **C** 2 and 3 **D** 2 only

1516. 9700_s17_qp_11 Q: 40

B-lymphocytes and T-lymphocytes are often unable to respond to the antigens on pathogens that are intracellular parasites.

What is the reason for this?

A The antigens are constantly mutating.

B The antigens can destroy the lymphocytes.

C The lymphocytes do **not** encounter the antigens.

D The lymphocytes do **not** recognise the antigens.

1517. 9700_s17_qp_12 Q: 40

What is the first response by the immune system to a pathogen?

A ingestion of the pathogen by phagocytes

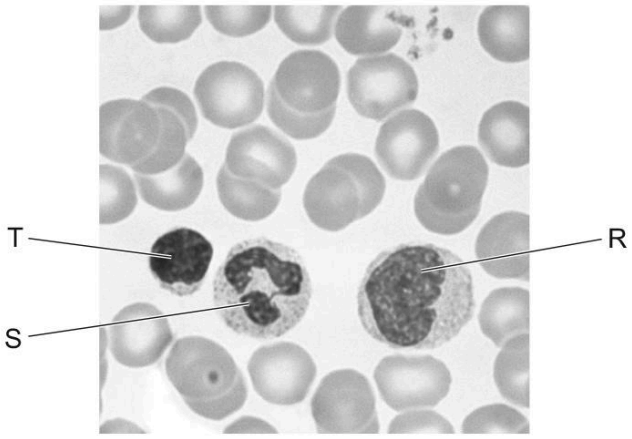
B production of antibodies

C production of antigens

D stimulation of B memory cells

1518. 9700_s17_qp_13 Q: 39

The photomicrograph shows human blood, with three types of white cell labelled.



Which row correctly identifies these white cells?

	cell R	cell S	cell T
A	lymphocyte	lymphocyte	lymphocyte
B	lymphocyte	phagocyte	phagocyte
C	phagocyte	lymphocyte	phagocyte
D	phagocyte	phagocyte	lymphocyte

1519. 9700_w17_qp_11 Q: 39

Which statements about endocytosis are correct?

1 It is part of phagocytosis.

2 It is a passive process.

3 Materials are taken into the cell.

4 Vesicles form within the cytoplasm.

A 1, 2 and 3 **B** 1, 2 and 4 **C** 1, 3 and 4 **D** 2, 3 and 4

1520. 9700_w17_qp_12 Q: 39

Which sequence of events occurs during an immune response?

1 development of plasma cells

2 mitosis of B-lymphocytes

3 recognition of non-self antigens

4 secretion of antibodies

A 2 → 3 → 4 → 1

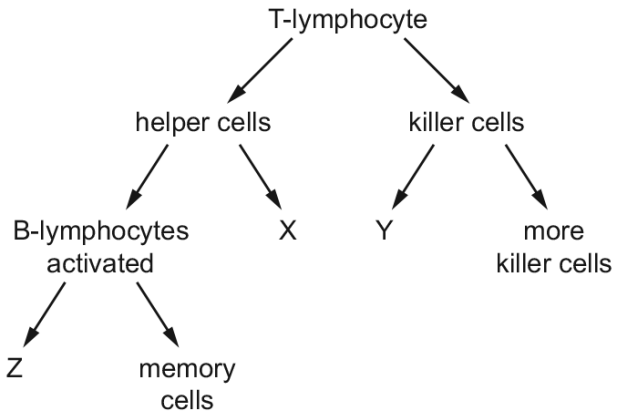
B 2 → 4 → 3 → 1

C 3 → 1 → 2 → 4

D 3 → 2 → 1 → 4

1521. 9700_w17_qp_13 Q: 39

The flow diagram shows the events following activation of a T-lymphocyte by binding to antigens on an infected cell.



Which row correctly identifies X, Y and Z?

	X	Y	Z
A	memory cells	macrophages	antibodies
B	memory cells	memory cells	plasma cells
C	neutrophils	memory cells	plasma cells
D	plasma cells	neutrophil	memory cells

1522. 9700_m16_qp_12 Q: 38

Which row correctly identifies the roles of B-lymphocytes and T-lymphocytes?

	secrete antibodies	secrete cytokines	provide humoral response
A	B-lymphocytes	T-lymphocytes	B-lymphocytes
B	B-lymphocytes	T-lymphocytes	T-lymphocytes
C	T-lymphocytes	B-lymphocytes	B-lymphocytes
D	T-lymphocytes	B-lymphocytes	T-lymphocytes

1523. 9700_s16_qp_11 Q: 40

What are the functions of T-lymphocytes during an immune response?

1 destroy infected body cells

2 differentiate into memory cells

3 secrete antibodies

A 1 and 2 **B** 2 and 3 **C** 1 only **D** 3 only

1524. 9700_s16_qp_12 Q: 39

What describes a non-specific immune response?

A activation of killer T-lymphocytes by infected cells

B cloning of B-lymphocytes to form plasma cells

C ingestion of a bacterial cell by a neutrophil

D presentation of antigens on the cell surface of macrophages

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1525. 9700_w16_qp_11 Q: 38

What describes a function of a T-lymphocyte?

A They are only found in blood and secrete cytokines in response to infection.

B They can leave the blood and accumulate at sites of inflammation.

C They can leave the blood and secrete cytotoxins when exposed to bacteria.

D They circulate in the blood and always present antigens in response to infection.

1526. 9700_w16_qp_12 Q: 39

The following are all responses made by cells of the immune system to a pathogen.

1 mitosis
2 bind to infected cell
3 produce memory cells
4 secrete antibodies

Which of the responses is correct for β-lymphocytes?

A 1, 2, 3 and 4 **B** 1, 2 and 4 only **C** 1 and 3 only **D** 2, 3 and 4 only

---

1527. 9700_w16_qp_13 Q: 14

Which molecules, found in cell surface membranes, help the immune system to identify cells?

1 cholesterol
2 glycolipids
3 glycoproteins
4 proteins

A 1, 2 and 3 **B** 1, 2 and 4 **C** 1, 3 and 4 **D** 2, 3 and 4

1528. 9700_w16_qp_13 Q: 38

Which event will occur following antigen-antibody binding?

A agglutination of bacteria to reduce their spread
B decreased susceptibility to phagocytosis
C more helper T cells are activated by the release of cytokines
D more plasma cells are cloned to produce more antigens

1529. 9700_w16_qp_13 Q: 39

Which statements about macrophages are correct?

1 More are found in tissues such as the lungs, than in the blood.
2 They have a role in antigen presentation.
3 They can engulf pathogens, dust particles and damaged body cells.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

---

1530. 9700_s15_qp_11 Q: 37

Which cells become memory cells in the immune response?

1 B-lymphocytes

2 T-lymphocytes

3 phagocytes

A 1, 2 and 3 **B** 1 and 2 only **C** 1 only **D** 2 only

1531. 9700_s15_qp_12 Q: 36

Which action is taken by a B-lymphocyte activated by an antigen?

A It attaches to the infected cell displaying the antigen and destroys it.

B It divides repeatedly to form a clone of genetically identical plasma cells.

C It engulfs the infected body cell which displays the antigen.

D It secretes cytokines which stimulate T-lymphocytes to produce plasma cells.

1532. 9700_s15_qp_13 Q: 37

What happens when people are injected with dead bacteria?

A B-lymphocytes produce antibodies.

B B-lymphocytes produce antigens.

C T-lymphocytes produce antibodies.

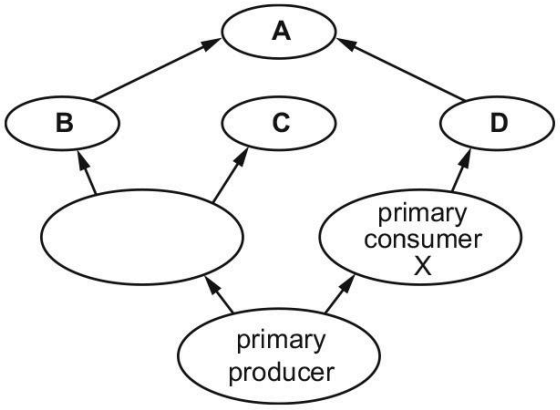
D T-lymphocytes produce antigens.

1533. 9700_s15_qp_13 Q: 39

A primary consumer, X, is lost from a community due to a lethal viral infection.

After a time, the size of the populations of some of the organisms shown in the food web changed.

Which population of organisms increased?



1534. 9700_w15_qp_11 Q: 36

What describes a function of a macrophage?

A They are found in tissues and secrete cytokines in response to infection.

B They can leave the blood and accumulate at sites of inflammation.

C They can leave the blood and secrete cytotoxins when exposed to damaged cells.

D They circulate in the blood and produce antigens in response to infection.

1535. 9700_w15_qp_12 Q: 35

Which statement is correct for a neutrophil?

A They are found in tissues and secrete cytokines in response to infection.

B They can leave the blood and accumulate at sites of inflammation.

C They can leave the blood and secrete cytotoxins when exposed to damaged cells.

D They circulate in the blood and present antigens in response to infection.

1536. 9700_w15_qp_12 Q: 37

Which statements correctly describe lymphocytes?

1 Each B-lymphocyte has the ability to make several types of antibody molecules.

2 Some B-lymphocytes and T-lymphocytes become memory cells.

3 Plasma cells secrete antibodies into the blood plasma.

4 Some T-lymphocytes stimulate macrophages to kill infected cells.

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 2, 3 and 4 only

D 1 and 4 only

11.2 Antibodies and vaccination

1537. 9700_m20_qp_12 Q: 39

Which features of monoclonal antibodies are important to their use in the treatment of cancer?

1 They can bind to tumour-associated antigens.

2 They can distinguish between different strains of pathogens.

3 They can deliver drugs to specific targets.

	1	2	3
A	✓	✓	✗
B	✓	✗	✓
C	✗	✓	✓
D	✓	✗	✗

key

✓ = is important

✗ = is not important

1538. 9700_m20_qp_12 Q: 40

A student was asked to explain why vaccination has successfully eradicated smallpox but not other diseases, such as measles, malaria and sickle cell anaemia. These are the statements made by the student.

1 The antigens of the virus causing smallpox did not change, unlike the antigens of the virus causing measles.

2 Sickle cell anaemia has many different types of mutation, unlike smallpox, so each would require a vaccine.

3 Unlike smallpox, malaria involves animals as part of the transmission cycle and this makes the cycle harder to break.

4 The vaccine against measles often causes a poor primary immune response so that booster vaccines are required, unlike the vaccine against smallpox.

Which statements are possible explanations?

A 1, 3 and 4 **B** 1 and 2 **C** 1 and 4 only **D** 2 and 4

1539. 9700_s20_qp_11 Q: 40

Where are antibodies found during an immune response?

	on surface of pathogen	in blood plasma
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key

✓ = antibodies found

✗ = antibodies not found

1540. 9700_s20_qp_12 Q: 40

A monoclonal antibody, specific for a virus, was treated with an enzyme to break the bonds between the variable and constant regions.

The separated variable and constant regions were then added to cells infected with the virus.

Which statements are correct?

1 The constant regions would bind to different parts of the virus antigens.

2 The viruses could be engulfed by phagocytes if they were present.

3 The variable regions would all bind to the same part of the virus antigens.

A 1 and 2 **B** 1 and 3 **C** 2 only **D** 3 only

1541. 9700_s20_qp_13 Q: 39

Which method of gaining immunity can be described as natural active immunity?

A feeding on colostrum

B inhaling the chicken pox virus

C injection with antibodies

D through the placenta

1542. 9700_s20_qp_13 Q: 40

Which statements correctly explain why smallpox has been eradicated, but not malaria or cholera?

1 Cholera vaccines provide only short-term immunity.

2 Plasmodium antigens change during the life cycle.

3 Smallpox antigens remain stable.

4 Vaccines only work against viruses.

A 1, 2 and 3 **B** 1, 2 and 4 **C** 1, 3 and 4 **D** 2, 3 and 4

1543. 9700_w20_qp_11 Q: 39

Monoclonal antibodies are produced for use in diagnosis or treatment of disease. To obtain the antibodies for an antigen, a mouse is injected with the antigen.

Some of the events in the production of the monoclonal antibody are listed.

1 Plasma cells are fused with cancer cells to form a hybridoma.

2 Hybridomas that secrete the required antibody are identified and cloned.

3 B-lymphocytes that recognise the antigen multiply and become plasma cells.

4 Hybridomas divide by mitosis and secrete antibodies.

5 Plasma cells are removed from the mouse spleen.

What is the sequence of the first four events in the production of the monoclonal antibody?

A $3 \rightarrow 5 \rightarrow 1 \rightarrow 2$

B $3 \rightarrow 5 \rightarrow 1 \rightarrow 4$

C $5 \rightarrow 1 \rightarrow 2 \rightarrow 4$

D $5 \rightarrow 1 \rightarrow 4 \rightarrow 2$

1544. 9700_w20_qp_12 Q: 39

Rabies is usually a fatal disease. Rabies is transmitted to people in the saliva of infected animals.

A person who has been bitten by an infected animal needs immediate treatment.

The treatment is a vaccination against rabies **and** an injection containing antibodies to the rabies antigen.

What type of immunity is given by the injection of antibodies?

A artificial active

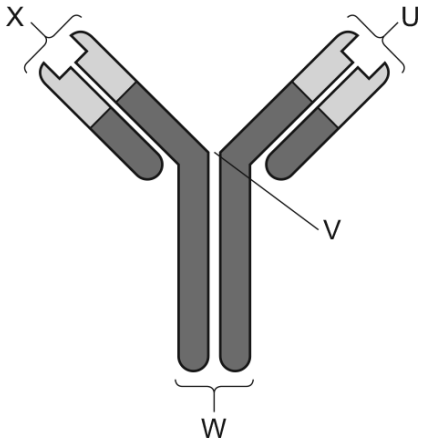
B artificial passive

C natural active

D natural passive

1545. 9700_w20_qp_13 Q: 39

The diagram shows the simplified structure of an antibody.



Which statement is correct?

A U and X allow the antibody to bind to two different antigens.

B V allows the antibody to fit around the antigen.

C W can bind to one specific antigen.

D X can bind with a specific phagocyte receptor.

1546. 9700_w20_qp_13 Q: 40

Why have vaccination programmes eradicated smallpox but not TB?

A Vaccination can provide immunity only for smallpox but not for TB.

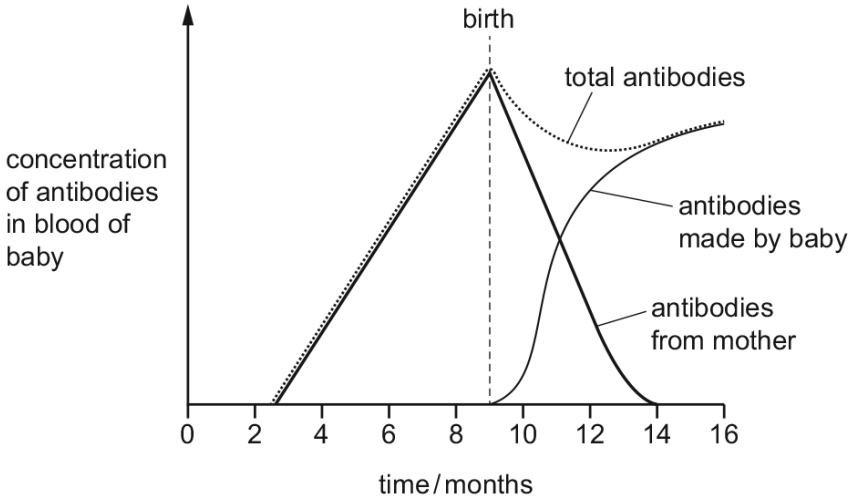
B Only TB is associated with poor living conditions.

C The smallpox virus showed little variation of antigens.

D The TB pathogen is a bacterium and the smallpox pathogen is a virus.

1547. 9700_m19_qp_12 Q: 40

The graph shows the changes that occur in the concentration of antibodies in the blood of a baby before birth and during the first few months after birth.



Which description about the changes in immunity during the first few months after birth is correct?

A active artificial immunity decreases, active natural immunity increases

B active natural immunity decreases, active artificial immunity increases

C passive artificial immunity decreases, active natural immunity increases

D passive natural immunity decreases, active natural immunity increases

---

1548. 9700_s19_qp_11 Q: 40

Which row shows the cells that are able to divide continuously and are involved in monoclonal antibody production?

	cancer cells	mouse B-lymphocyte plasma cells	hybridoma cells
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✓

key

✓ = correct

✗ = not correct

1549. 9700_s19_qp_12 Q: 38

Which are specific immune responses?

1 phagocytosis

2 production of antibodies

3 production of memory cells

A 1 and 3 only **B** 1 only **C** 2 and 3 only **D** 2 only

1550. 9700_s19_qp_12 Q: 39

Newborn babies have natural passive immunity.

What is correct for this type of immunity?

	immunity is temporary	antibodies are broken down
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

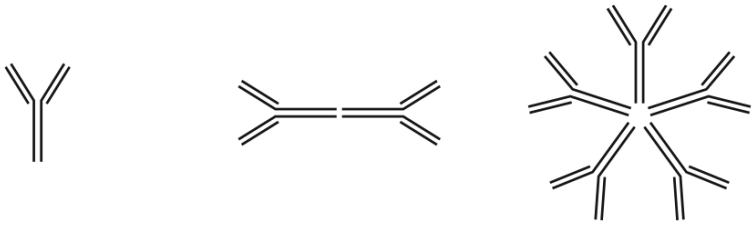
key

✓ = correct

✗ = not correct

1551. 9700_s19_qp_12 Q: 40

The diagrams show three different types of antibody structure.



IgG IgA IgM

Which row is correct?

	IgG	IgA	IgM
A	one binding site for an antigen molecule	two light chains	two heavy chains
B	two heavy chains	four binding sites for antigen molecules	five hinge regions
C	two hinge regions	four heavy chains	five light chains
D	two light chains	four hinge regions	ten binding sites for antigen molecules

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1552. 9700_s19_qp_13 Q: 40

What describes artificial active immunity?

A protection against a pathogen by an injection of antibodies

B protection against a pathogen by drinking colostrum containing antibodies

C stimulation of lymphocytes by antigens contained in a vaccine

D stimulation of lymphocytes by antigens on the surface of invading pathogens

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1553. 9700_w19_qp_11 Q: 39

Which sequence summarises the hybridoma method for the production of monoclonal antibodies?

A	B	C	D
inject mammal with antibodies	inject mammal with antibodies	inject mammal with antigens	inject mammal with antigens
↓	↓	↓	↓
harvest antibodies from blood	harvest B-lymphocytes from spleen	harvest antibodies from blood	harvest B-lymphocytes from spleen
↓	↓	↓	↓
test for wanted antibody	fuse with cancer cells	test for wanted antibody	fuse with cancer cells
↓	↓	↓	↓
fuse with cancer cells	test for wanted antibody	fuse with cancer cells	test for wanted antibody
↓	↓	↓	↓
large scale culture	large scale culture	large scale culture	large scale culture

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1554. 9700_w19_qp_11 Q: 40

The vaccination programme for smallpox was a medical success story which resulted in the World Health Organisation finally declaring the world free from smallpox in 1980.

Which statement correctly identifies the reasons for the success of the smallpox vaccination programme?

A The virus also infected animals making it easy to stop the transmission cycle.

B The virus remained in the body following infection and could become active later.

C The virus was stable and not prone to mutations.

D The virus was unstable and prone to mutations.

1555. 9700_w19_qp_12 Q: 38

Immune response to a vaccination against a virus can be assessed by making three measurements:

1 the concentration of anti-virus antibody in the blood

2 the time taken to increase the antibody concentration significantly after a booster vaccination

3 the number of virus-specific lymphocytes per cm^3 blood.

What describes the immunity of an individual when the values of 1, 2 and 3 are all low ten years after vaccination?

A active immunity due to the presence of memory cells

B low immunity due to the absence of antibodies

C low immunity due to the absence of memory cells

D passive immunity due to the presence of antibodies

1556. 9700_w19_qp_12 Q: 40

Which features of monoclonal antibodies make them useful in the diagnosis and treatment of disease?

1 A particular monoclonal antibody attaches to a specific antigen.

2 Identical monoclonal antibodies can be produced in large numbers.

3 Binding a monoclonal antibody to its specific antigen may mark that antigen for destruction by white blood cells.

4 Fluorescent or radioactive markers can be attached to a monoclonal antibody to show where the antigen is in the body.

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 2 and 3 only

D 3 and 4 only

1557. 9700_w19_qp_13 Q: 37

Scientists studied the multidrug resistant bacterial infections in children, caused by one type of bacteria, between 2007 and 2015. The percentage of multidrug resistant infections rose from 0.2% to 1.5%.

What was the percentage increase in multidrug resistant infections between 2007 and 2015?

A 1.3% **B** 87% **C** 130% **D** 650%

1558. 9700_w19_qp_13 Q: 38

Why is it necessary for a person with a bacterial infection to take antibiotics at evenly spaced time intervals?

A to increase the concentration of antibiotic slowly to a level which is lethal to the bacteria

B to maintain a concentration of antibiotic in the body which is lethal to the bacteria

C to prevent the development of resistant strains of bacteria

D to select and kill the resistant strains of bacteria

1559. 9700_w19_qp_13 Q: 39

The enzyme telomerase prevents loss of telomeres after many mitotic cell cycles. Three types of cell are used to produce monoclonal antibodies.

1 cancer cells undergoing uncontrolled cell division

2 mature B-lymphocytes

3 hybridoma cells

Which cells involved in this technique contain active telomerase enzyme?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

---

1560. 9700_w19_qp_13 Q: 40

What explains why monoclonal antibodies are useful in the diagnosis of disease?

A They bind to and neutralise one type of antibody.

B They bind to and neutralise one type of pathogen.

C Their shape is complementary to one specific antibody.

D Their shape is complementary to one specific antigen.

1561. 9700_m18_qp_12 Q: 38

Some children are born with severe combined immunodeficiency (SCID).

Children with this inherited disease do not normally have any T-lymphocytes and suffer from many infectious diseases.

How may these children be cured from SCID?

A transfusion of antibodies

B treatment with stem cells

C use of different antibiotics

D vaccination against all diseases

1562. 9700_m18_qp_12 Q: 39

The hybridoma method is used for the production of monoclonal antibodies.

Which two types of cell are used in this method?

A stem cell and B-lymphocyte

B stem cell and T-lymphocyte

C tumour cell and B-lymphocyte

D tumour cell and T-lymphocyte

1563. 9700_m18_qp_12 Q: 40

A vaccine is used to create artificial active immunity. After being given a vaccine, it will take a period of time before a person develops long-term immunity against the disease.

Which statement about this period of time explains this delay?

A No memory cells have been produced from B-lymphocytes.

B No plasma cells have been produced from B-lymphocytes.

C The primary immune response has not produced enough antibodies.

D The secondary immune response has not produced enough antibodies.

1564. 9700_s18_qp_11 Q: 38

Hybridomas are used as a basis for the production of large numbers of monoclonal antibodies.

Which statement describes how hybridomas are made?

A fusing activated T-lymphocytes with cancer cells

B fusing B-lymphocytes with cancer cells

C fusing memory cells with cancer cells

D fusing T-lymphocytes with cancer cells

1565. 9700_s18_qp_11 Q: 40

The statements describe ways in which different types of monoclonal antibodies can work.

1 binding to proteins on cell surfaces and triggering the immune system

2 blocking molecules on cell surfaces that inhibit T-cells

3 blocking cell signalling receptors that trigger cell division

4 blocking cell signalling receptors that trigger the immune response

Which types of monoclonal antibody could be used to treat cancer?

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 1 and 4 only

D 2, 3 and 4 only

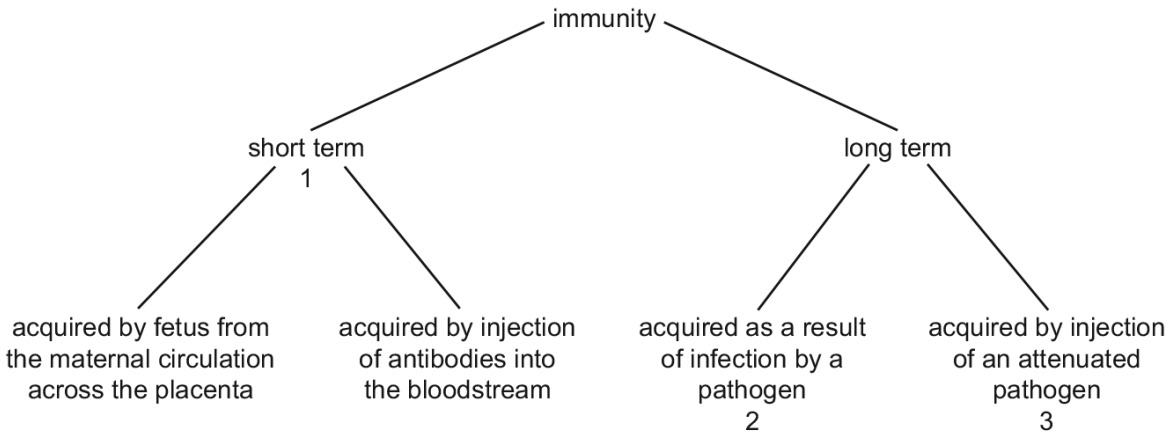
1566. 9700_s18_qp_12 Q: 38

How many variable regions are there on a typical Y-shaped antibody molecule?

A 2 **B** 3 **C** 4 **D** 6

1567. 9700_s18_qp_13 Q: 40

The diagram allows the identification of different types of immunity.



Which row correctly identifies the types of immunity labelled 1, 2 and 3?

	1	2	3
A	active	artificial	natural
B	active	natural	artificial
C	passive	artificial	natural
D	passive	natural	artificial

1568. 9700_w18_qp_11 Q: 38

A vaccine is available against most common strains of the influenza virus.

The virus that causes influenza often undergoes mutation in the gene coding for its antigenic protein.

Which statements explain why vaccinated people are not immune to a mutated influenza virus?

1 They will not have primary immune response to the mutated antigen.

2 They will not have a secondary immune response to the mutated antigen.

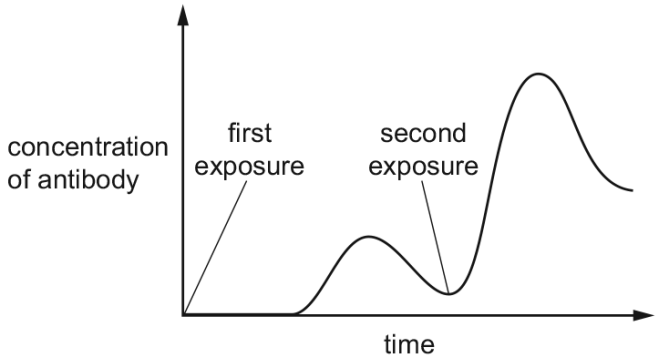
3 Their memory cells do not recognise the mutated antigen.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

---

1569. 9700_w18_qp_12 Q: 39

The graph shows how the body reacts following exposure to an antigen for the first and second time.



What is the direct cause of the increase in antibody production after the second exposure to antigens?

A B-memory cells

B macrophages

C plasma cells

D T-memory cells

1570. 9700_w18_qp_12 Q: 40

Why has it proved difficult to develop an effective vaccine against malaria?

A Mosquitoes have many stages in their life cycles.

B The human immune system does not recognise the antigens of the parasite.

C The parasites can only be attacked when outside the liver cells and red blood cells.

D Vaccines are rapidly broken down by proteases in the stomach.

1571. 9700_w18_qp_13 Q: 37

A West African country introduced a measles vaccination during a measles epidemic.

Later, it was realised that vaccinated children were more likely to survive childhood than unvaccinated children, even when there were no measles epidemics.

The vaccine had given the children some protection against other pathogenic infections.

Which statement could account for this extra protection?

A B-lymphocytes produced memory cells which gave the children passive immunity to these infections.

B Memory cells produced plasma cells which secreted anti-measles antibodies that bound to antigens that closely resembled measles antigens.

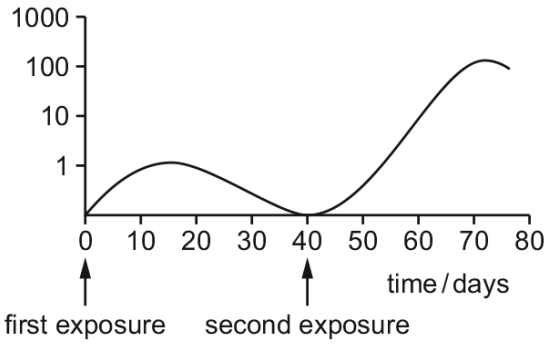
C Memory cells produced plasma cells which secreted anti-measles antibodies that bound to any antigen.

D T-lymphocytes produced memory cells which gave the children natural immunity against these other infections.

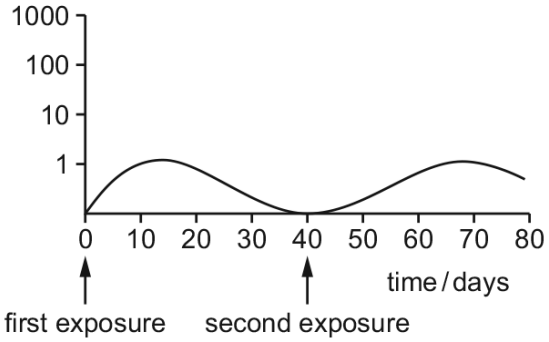
1572. 9700_w18_qp_13 Q: 38

Which graph shows the changes in antibody concentration following a second exposure to the same infection?

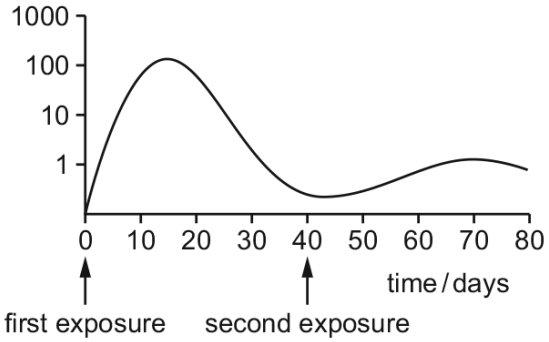
A



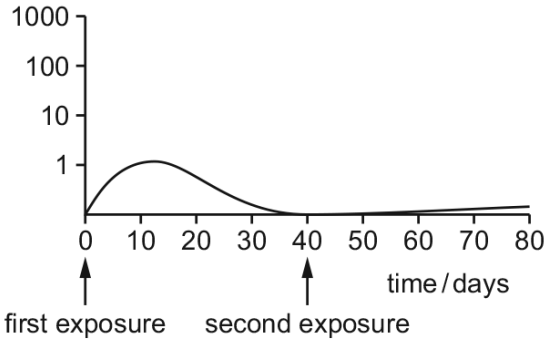
B



C



D



1573. 9700_w18_qp_13 Q: 40

Whooping cough is a highly infectious disease of the gas exchange system, caused by the bacterium *Bordetella pertussis*.

Which method provides protection to infants against whooping cough and reduces the chance of developing this disease later in life?

A a short course of more than one type of antibiotic

B a six month course of one type of antibiotic

C injections of antibody specific to *Bordetella pertussis*

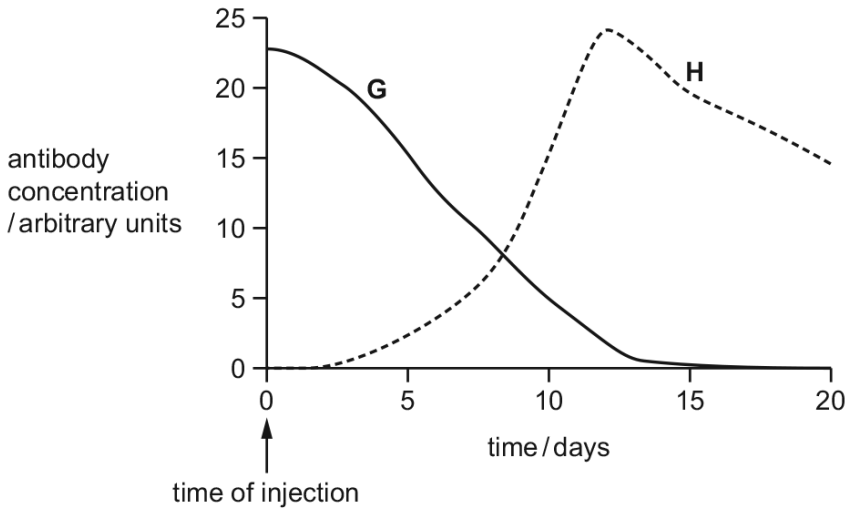
D injections of dead *Bordetella pertussis* bacteria

1574. 9700_m17_qp_12 Q: 40

Two people, **G** and **H**, were each given an injection to protect them against a particular pathogen.

One person was injected with antibodies. The other person was injected with a vaccine.

The graph shows the concentrations of the antibody against this pathogen in the blood of the two people, **G** and **H**, over a period of 20 days following the injection.



Which row correctly describes the type of immunity shown by **G** and **H**?

	G	H
A	artificial active immunity	artificial passive immunity
B	artificial passive immunity	artificial active immunity
C	natural active immunity	natural passive immunity
D	natural passive immunity	artificial active immunity

1575. 9700_s17_qp_12 Q: 39

When a person is given a vaccination immunity to certain pathogens develops.

Which of the effects of vaccination are correct?

1 production of antibodies to protect against future infections

2 results in artificial active immunity

3 stimulation of appropriate lymphocytes

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

---

1576. 9700_s17_qp_13 Q: 38

Which type of new vaccine production would be most important in the fight to eradicate measles in **developing** countries?

A a combined vaccine to combat it and other diseases

B a single vaccine, without the need for boosters

C a vaccine containing only live measles pathogens

D a vaccine containing monoclonal antibodies

1577. 9700_s17_qp_13 Q: 40

A monoclonal antibody specific for a virus was produced.

This antibody was treated with an enzyme to break the bonds between the variable and constant regions.

The separated variable and constant regions were then added to cells infected with the virus.

Which statements are correct?

1 The constant regions would bind to different parts of the virus antigens.

2 The viruses could be engulfed by phagocytes if they were present.

3 The variable regions would all bind to the same part of the virus antigens.

A 1 and 2 **B** 1 and 3 **C** 2 only **D** 3 only

1578. 9700_w17_qp_11 Q: 36

Which factors contribute to outbreaks of measles after natural disasters?

1 contamination of drinking water with untreated sewage

2 lack of effective vaccination coverage in the population before the disaster

3 people living in overcrowded accommodation

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

---

1579. 9700_w17_qp_11 Q: 37

Which of these statements explain why some vaccines can be taken by mouth but tuberculosis (TB) vaccine has to be injected?

1 Macrophages present antigens in vaccines to stimulate an immune response.

2 The TB antigens necessary to produce an immune response are proteins which would be digested in the stomach and small intestine.

3 There are no B-lymphocytes and T-lymphocytes in the stomach.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 only

---

1580. 9700_w17_qp_11 Q: 38

Which method of gaining immunity can be described as natural active immunity?

A feeding on colostrum

B inhaling the chicken pox virus

C injection with antibodies

D through the placenta

1581. 9700_w17_qp_11 Q: 40

The statements refer to vaccination programmes for each of the diseases cholera, measles, smallpox and tuberculosis (TB).

Which statement is correct for TB?

A Most children are vaccinated before their first birthday.

B The pathogen has not mutated or changed its antigens.

C The pathogen lives in the intestine where antibodies cannot get to it.

D The vaccine is not effective against some strains of the pathogen.

1582. 9700_w17_qp_12 Q: 40

An influenza vaccine can be made by growing the viruses in chicken eggs.

The viruses are extracted in liquid from the eggs and inactivated. The purified egg extract containing the viruses is then used as the vaccine.

What is a side-effect of using this vaccine in some people?

A An auto-immune condition could occur.

B An immune response to egg antigens could occur.

C The egg antigens could cause infections.

D The influenza viruses could cause infections.

1583. 9700_w17_qp_13 Q: 40

Smallpox was eradicated from the human population by a worldwide preventative programme.

Which type of immunity was triggered in people who were treated as part of this programme?

A artificial active immunity

B artificial passive immunity

C natural active immunity

D natural passive immunity

1584. 9700_m16_qp_12 Q: 39

A person's blood group is determined by antigens present on the red blood cells. The table shows the antigens and antibodies in the blood of people with different blood groups.

blood group	antigens on red blood cells	antibodies in plasma
A	A	anti-B
B	B	anti-A
AB	A and B	neither
O	neither	anti-A and anti-B

During a blood transfusion, it is essential that the recipient's blood does **not** contain antibodies to the donor's blood.

Which blood groups can be given to a person with blood group B?

A A and B **B** AB and B **C** AB and O **D** B and O

1585. 9700_m16_qp_12 Q: 40

An enzyme hydrolyses the two heavy polypeptide chains of an antibody molecule. The hydrolysis occurs at the hinge region and breaks the antibody into three fragments.

How many of these fragments are able to bind to antigens?

A 0 **B** 1 **C** 2 **D** 3

1586. 9700_s16_qp_11 Q: 39

Rabies is a viral disease which can be spread to humans by a bite from an infected animal.

One method of treatment is to inject the patient with antibodies specific to the rabies virus.

Which statements about this treatment are correct?

1 The patient will have natural passive immunity to rabies.

2 The injected antibodies will be broken down by the patient.

3 The patient's memory cells will be able to produce this antibody more rapidly in the future.

4 The immunity provided will only be of short duration.

A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

1587. 9700_s16_qp_12 Q: 38

Which statement describes how passive natural immunity is obtained?

A A vaccination containing dead microorganisms is given.

B An immunisation containing specific antigens is given.

C Antibodies are passed from mother to developing baby.

D Antibodies from another individual are injected.

1588. 9700_s16_qp_12 Q: 40

What explains why monoclonal antibodies can be used to target cancer cells?

A Cancer cells have different antigens from normal body cells.

B Specific cancer drugs can be attached to the monoclonal antibody.

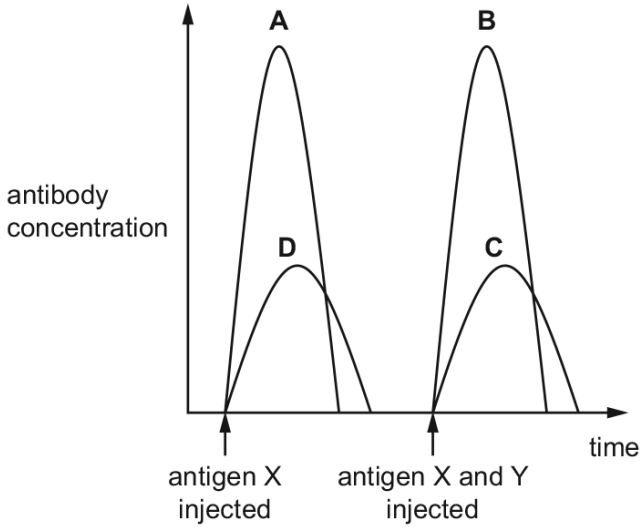
C They are one type of a specific antibody that binds to an antigen.

D They are secreted by hybridomas of cancer cells and B-lymphocytes.

1589. 9700_s16_qp_13 Q: 39

The graph shows the antibody response when a person is injected first with antigen X and later with antigens X and Y.

Which curve shows the primary response to antigen Y?



1590. 9700_s16_qp_13 Q: 40

Which row describes passive immunity?

	triggered by an antigen	involves an immune response	memory cells produced	permanent protection
A	✓	✓	✓	✓
B	✓	✓	✗	✗
C	✗	✗	✓	✓
D	✗	✗	✗	✗

key
✓ = true
✗ = false

1591. 9700_w16_qp_11 Q: 39

A person's blood group is determined by antigens present on the red blood cells.

The table shows the antigens and antibodies in the blood of people with different blood groups.

blood group	antigens on red blood cells	antibodies in plasma
A	A	antibodies to B
B	B	antibodies to A
AB	A and B	neither
O	neither	antibodies to A and B

During a blood transfusion, it is essential that the recipient's blood does not contain antibodies to the donor's blood.

Which blood group can be given to a person with blood group AB?

A AB only

B O only

C B and A only

D A, B, AB and O

1592. 9700_w16_qp_11 Q: 40

Which statement about immunity is correct?

A Antibody donation, but not antibody production, occurs with artificial active and artificial passive immunity.

B Artificial active immunity lasts for a greater length of time than natural passive immunity.

C Natural active immunity provides a faster response to infection than artificial active immunity.

D Recognition and binding by specific B-lymphocytes only occurs with natural immunity.

1593. 9700_w16_qp_12 Q: 40

What occurs when active immunity is artificially induced?

A Non-self antibodies attack self antigens.

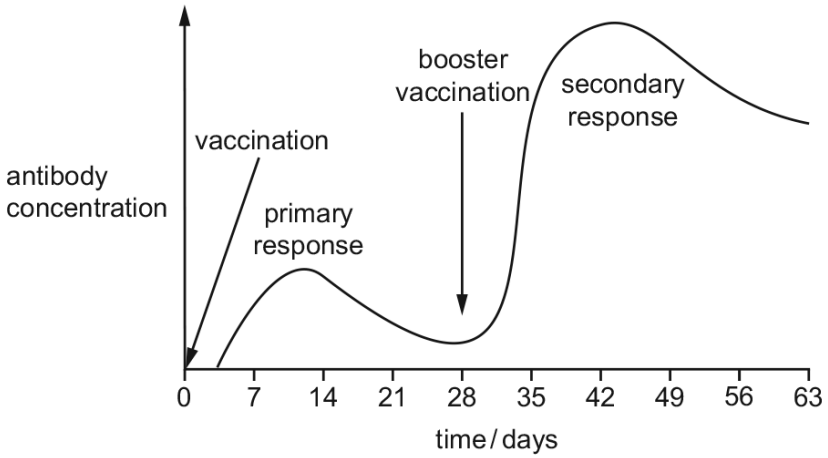
B Non-self antigens attack self antibodies.

C Self antibodies attack non-self antigens.

D Self antigens attack non-self antibodies.

1594. 9700_w16_qp_13 Q: 40

The graph shows the antibody concentration in blood following vaccination and a booster vaccination 28 days later.



Which statements about the changes in antibody concentration are correct?

1 Antibody concentration falls after the primary response because antibodies are broken down and are no longer being produced.

2 The secondary response is more rapid due to memory B cells produced from activated B cells in the primary response.

3 The secondary response lasts longer than the primary response because memory B cells live longer than plasma B cells.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

---

1595. 9700_s15_qp_11 Q: 36

During an outbreak of a very infectious disease, vulnerable people need immediate protection.

Which type of immunity would be given to these people?

	natural	artificial
active	**A**	**B**
passive	**C**	**D**

1596. 9700_s15_qp_12 Q: 37

The synthesis of specific antibodies in response to vaccination is an example of which type of immunity?

	natural	artificial
active	**A**	**B**
passive	**C**	**D**

1597. 9700_s15_qp_13 Q: 36

What describes natural passive immunity?

A protection against a pathogen by an injection of antibodies

B protection against a pathogen by drinking colostrum containing antibodies

C stimulation of lymphocytes by antigens contained in a vaccine

D stimulation of lymphocytes by antigens on the surface of invading pathogens

---

1598. 9700_w15_qp_11 Q: 37

There has been an increase in the number of cases of the disease whooping cough.

A pregnant woman is vaccinated against whooping cough to protect the new born baby from this disease.

How does the immune response of the mother help to protect a new born baby from whooping cough?

	before birth, baby receives from mother	type of protection gained by baby
A	antibodies	natural passive
B	antigens	artificial active
C	memory cells	artificial passive
D	pathogens	natural active

1599. 9700_w15_qp_12 Q: 36

What describes artificial passive immunity?

A protection against a pathogen by an injection of antibodies

B protection against a pathogen by drinking colostrum containing antibodies

C stimulation of lymphocytes by antigens contained in a vaccine

D stimulation of lymphocytes by antigens on the surface of invading pathogens

---

1600. 9700_w15_qp_13 Q: 36

What describes natural active immunity?

A protection against a pathogen by an injection of antibodies

B protection against a pathogen by drinking colostrum containing antibodies

C stimulation of lymphocytes by antigens contained in a vaccine

D stimulation of lymphocytes by antigens on the surface of invading pathogens

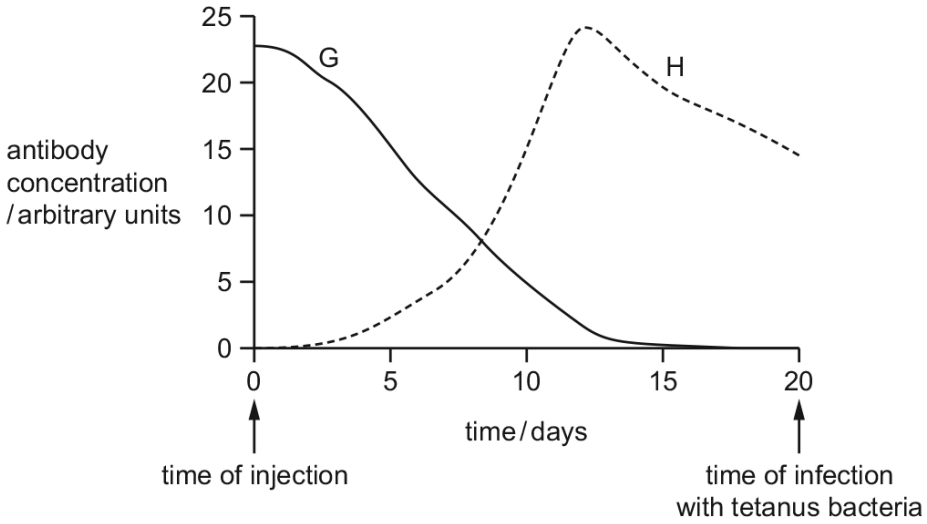
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1601. 9700_w15_qp_13 Q: 37

The bacterium that causes the disease tetanus produces a toxin that acts as an antigen.

The graph shows the concentration of an antibody in the blood of two people, G and H.

On day 0, G was injected with antibodies to the tetanus toxin and H was injected with the vaccine for tetanus.



What would be the result after G and H were infected with the tetanus bacteria on day 20?

A concentration of antibodies in H would remain constant

B G would fail to produce tetanus antibodies

C G would peak in antibody production 12 days after infection

D H would produce a new antibody peak 12 days after infection

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Paper 1 Multiple Choice Answers: Immunity

Question	Paper	Q. No.	Answer
1494	9700_m20_qp_12	38	D
1495	9700_s20_qp_11	39	C
1496	9700_s20_qp_12	38	A
1497	9700_s20_qp_12	39	B
1498	9700_w20_qp_11	38	C
1499	9700_w20_qp_11	40	D
1500	9700_w20_qp_12	38	A
1501	9700_w20_qp_12	40	D
1502	9700_w20_qp_13	38	A
1503	9700_m19_qp_12	38	B
1504	9700_m19_qp_12	39	B
1505	9700_s19_qp_11	39	A
1506	9700_w19_qp_11	38	B
1507	9700_w19_qp_12	39	C
1508	9700_s18_qp_11	39	D
1509	9700_s18_qp_12	39	A
1510	9700_s18_qp_12	40	D
1511	9700_w18_qp_11	39	D
1512	9700_w18_qp_11	40	A
1513	9700_w18_qp_12	38	B
1514	9700_w18_qp_13	39	B
1515	9700_m17_qp_12	39	A
1516	9700_s17_qp_11	40	C
1517	9700_s17_qp_12	40	A
1518	9700_s17_qp_13	39	D
1519	9700_w17_qp_11	39	C
1520	9700_w17_qp_12	39	D
1521	9700_w17_qp_13	39	B
1522	9700_m16_qp_12	38	A
1523	9700_s16_qp_11	40	A
1524	9700_s16_qp_12	39	C
1525	9700_w16_qp_11	38	B
1526	9700_w16_qp_12	39	A
1527	9700_w16_qp_13	14	D
1528	9700_w16_qp_13	38	A
1529	9700_w16_qp_13	39	A
1530	9700_s15_qp_11	37	B
1531	9700_s15_qp_12	36	B
1532	9700_s15_qp_13	37	A
1533	9700_s15_qp_13	39	C
1534	9700_w15_qp_11	36	A
1535	9700_w15_qp_12	35	B
1536	9700_w15_qp_12	37	C
1537	9700_m20_qp_12	39	B
1538	9700_m20_qp_12	40	A
1539	9700_s20_qp_11	40	A

Paper 1 Multiple Choice Answers: Immunity (continued)

Question	Paper	Q. No.	Answer
1540	9700_s20_qp_12	40	D
1541	9700_s20_qp_13	39	B
1542	9700_s20_qp_13	40	A
1543	9700_w20_qp_11	39	B
1544	9700_w20_qp_12	39	B
1553	9700_w19_qp_11	40	C
1554	9700_w19_qp_11	40	C
1555	9700_w19_qp_12	38	A
1556	9700_w19_qp_12	40	A
1557	9700_w19_qp_13	37	D
1558	9700_w19_qp_13	38	B
1559	9700_w19_qp_13	39	C
1560	9700_w19_qp_13	40	D
1561	9700_m18_qp_12	38	B
1562	9700_m18_qp_12	39	C
1563	9700_m18_qp_12	40	A
1564	9700_s18_qp_11	38	B
1565	9700_s18_qp_11	40	B
1566	9700_s18_qp_12	38	C
1567	9700_s18_qp_13	40	D
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1569	9700_w18_qp_12	39	C
1570	9700_w18_qp_12	40	C
1571	9700_w18_qp_13	37	B
1572	9700_w18_qp_13	38	A
1573	9700_w18_qp_13	40	D
1574	9700_m17_qp_12	40	B
1575	9700_s17_qp_12	39	A
1576	9700_s17_qp_13	38	B
1577	9700_s17_qp_13	40	D
1578	9700_w17_qp_11	36	D
1579	9700_w17_qp_11	37	D
1580	9700_w17_qp_11	38	B
1581	9700_w17_qp_11	40	D
1582	9700_w17_qp_12	40	B
1583	9700_w17_qp_13	40	A
1584	9700_m16_qp_12	39	D
1585	9700_m16_qp_12	40	C
1586	9700_s16_qp_11	39	D
1587	9700_s16_qp_12	38	C
1588	9700_s16_qp_12	40	A
1589	9700_s16_qp_13	39	C
1590	9700_s16_qp_13	40	D
1591	9700_w16_qp_11	39	D
1592	9700_w16_qp_11	40	B
1593	9700_w16_qp_12	40	C

Paper 1 Multiple Choice Answers: Immunity (continued)

Question	Paper	Q. No.	Answer
1594	9700_w16_qp_13	40	A
1595	9700_s15_qp_11	36	D
1596	9700_s15_qp_12	37	B
1597	9700_s15_qp_13	36	B
1598	9700_w15_qp_11	37	A
1599	9700_w15_qp_12	36	A
1600	9700_w15_qp_13	36	D
1601	9700_w15_qp_13	37	C

Chapter 11

Immunity

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11.1 The immune system

200. 9700_s19_qp_22 Q: 3

Fig. 3.1 is a photomicrograph of human blood cells from a healthy individual who lives at sea level. The cells labelled **C**, **D** and **E** are white blood cells.

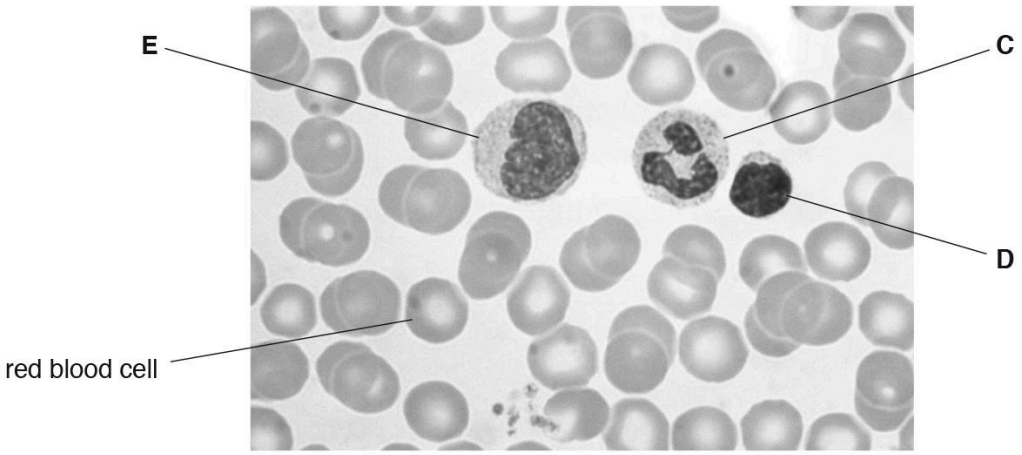


Fig. 3.1

(a) Name cells **C**, **D** and **E**.

C .....

D .....

E ..... [3]

(b) In humans, an increase in the white blood cell count can be associated with leukaemias and with infectious diseases, such as measles.

Chronic lymphocytic leukaemia (CLL) is a type of cancer that starts in the bone marrow. In the early stages, many people with CLL feel well. The disease is sometimes diagnosed by chance during a routine blood analysis, when a high white blood cell count is noticed. Many of these white blood cells are only partially mature.

(i) Suggest why CLL starts in the bone marrow and **not** in any other location in the body.

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..... [2]

STEMUP.CO.UK

(ii) Explain why a high white blood cell count is a feature of measles and of CLL.

measles .....

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CLL .....

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..... [3]

(c) Most of the oxygen that enters the mammalian circulatory system is transported by red blood cells.

(i) Describe **and** explain the passage of oxygen across the cell surface membrane of the red blood cell.

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..... [2]

(ii) At a high altitude, the partial pressure of oxygen in the atmosphere is lower than at sea level. If a person travels from low altitude to high altitude and remains there for a few weeks, the red blood cell count increases.

Explain why the body needs to respond to high altitude by increasing the number of red blood cells.

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..... [3]

(d) Polypeptide synthesis occurs before a red blood cell is released into the circulation.

The *HBB* gene codes for the β-globin polypeptide of haemoglobin.

There are two alleles of *HBB*, known as Hb^A and Hb^S.

Describe the difference between the Hb^A allele and the Hb^S allele **and** state how this difference affects:

- the β-globin polypeptide
- the haemoglobin molecule.

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..... [4]

[Total: 17]

201. 9700_s19_qp_23 Q: 3

Cholera is an infectious disease caused by the bacterium *Vibrio cholerae*. The pathogen causes disease by disrupting the activity of the epithelial cells in the human intestine.

(a) Complete Table 3.1 to compare the structure of *V. cholerae* and an epithelial cell from the human intestine.

Use a tick (✓) to indicate the presence of the structure.

Use a cross (✗) to indicate the absence of the structure.

The first row has been completed for you.

Table 3.1

cell structure	*V. cholerae*	epithelial cell from the human intestine
cell wall	✓	✗
cell surface membrane		
ribosomes		
large permanent vacuole		
organelles surrounded by a double membrane		

[4]

(b) Describe the methods that can be used to prevent the spread of cholera.

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..... [5]

(c) The World Health Organization has suggested that people with HIV/AIDS take a longer time to recover from cholera and are at an increased risk of death from cholera.

The human immunodeficiency virus (HIV) only infects certain types of cell. These cells have CD4 receptor proteins in their cell surface membrane. Helper T-lymphocytes have CD4 receptor proteins.

(i) Fig. 3.1 is a diagram of HIV showing the glycoprotein gp120.

This glycoprotein is embedded in a membrane envelope which surrounds the viral protein coat.

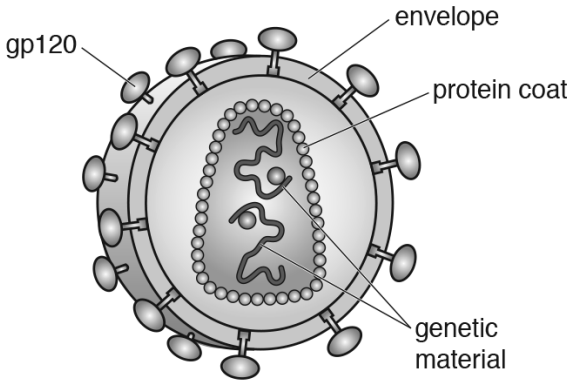


Fig. 3.1

The glycoprotein gp120 is important in allowing HIV to only infect certain types of cell.

Suggest the role of gp120.

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..... [2]

(ii) People with HIV/AIDS have a low helper T-lymphocyte count.

Explain how a low helper T-lymphocyte count could reduce the body's ability to produce antibodies against *V. cholerae*.

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..... [2]

[Total: 13]

202. 9700_m18_qp_22 Q: 2

The main cause of tuberculosis (TB) in humans is the bacterium *Mycobacterium tuberculosis*. Most cases of the disease involve the lungs. The bacterium can enter cells and remain inactive in a latent (dormant) state. However, the bacterium can become active to produce symptoms of the disease.

In a person with active TB, the pathogen can be present in airborne droplets that are exhaled. Generally, a healthy person who inhales these droplets has effective defence mechanisms in the gas exchange system to prevent infection.

(a) One example of a defence mechanism against pathogens in the gas exchange system involves the action of macrophages.

(i) State the location in the body where macrophages have their origin.

..... [1]

(ii) Describe the mode of action of a macrophage.

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..... [3]

(iii) It is sometimes possible for *M. tuberculosis* to survive within macrophages.

Suggest **one** way in which *M. tuberculosis* may survive within a macrophage.

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..... [1]

(b) A healthy person has other defence mechanisms in the gas exchange system to prevent bacteria entering cells.

Describe these defence mechanisms **and** explain how bacteria in inhaled air are prevented from entering cells of the gas exchange system.

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..... [3]

(c) In people with a weakened immune system, *M. tuberculosis* can infect other organs and tissues, such as the kidneys and joints.

Suggest how the bacteria may spread from the lungs to other organs.

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..... [1]

(d) TB in humans can be caused by another species of bacterium, *M. bovis*.

State the mode of transmission of this pathogen to humans.

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..... [1]

(e) The standard treatment for TB continues for six months and initially involves the use of four different antibiotics.

If no antibiotic resistance is detected, the treatment is reduced to two of the four antibiotics. The two antibiotics used are rifampicin and isoniazid.

Suggest the benefits of beginning the treatment with four different antibiotics.

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..... [2]

Multidrug-resistant TB (MDR-TB) occurs if resistance develops to rifampicin and isoniazid.

The treatment for MDR-TB can last up to 30 months and involves different antibiotics to the standard treatment.

Table 2.1 shows the number of reported cases of TB and MDR-TB in the South-East Asia region between 2005 and 2014, as published by the World Health Organization (WHO).

Table 2.1

year	total number of reported cases of TB	total number of reported cases of MDR-TB
2005	1947603	68
2006	2104673	779
2007	2202149	918
2008	2287803	1717
2009	2328230	2560
2010	2332779	4263
2011	2358127	6615
2012	2331455	14957
2013	2297033	18384
2014	2580605	17386

(f) State the trends shown in Table 2.1.

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..... [2]

(g) TB is a disease of global importance.

Discuss the factors influencing the trends shown in Table 2.1.

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..... [3]

[Total: 17]

203. 9700_s18_qp_21 Q: 5

(a) The toxins released by some pathogenic bacteria can be altered chemically so that they are harmless. These harmless toxins are called toxoids.

Toxoids are used in vaccines to provide protection against some infectious diseases.

Describe the response of the immune system to the injection of a toxoid.

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.....[5]

(b) Myasthenia gravis (MG) is described as an autoimmune disease. It is a long-term condition that results from a failure of the immune system.

(i) Explain why MG is known as an autoimmune disease.

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.....[3]

(ii) Suggest why MG is a long-term condition.

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.....[2]

[Total: 10]

204. 9700_s18_qp_22 Q: 3

Bacteria may be classified according to differences in cell wall structure. The differences are shown by using the Gram stain.

- A Gram-positive bacterium has a cell wall mainly composed of a thick layer of peptidoglycan (murein).
- A Gram-negative bacterium has a more complex cell wall. This wall is composed of a much thinner layer of peptidoglycan and an outer layer known as the outer membrane.

Escherichia coli is a Gram-negative bacterium.

Fig. 3.1 is a diagram through the cell surface membrane **and** the cell wall of *E. coli*.

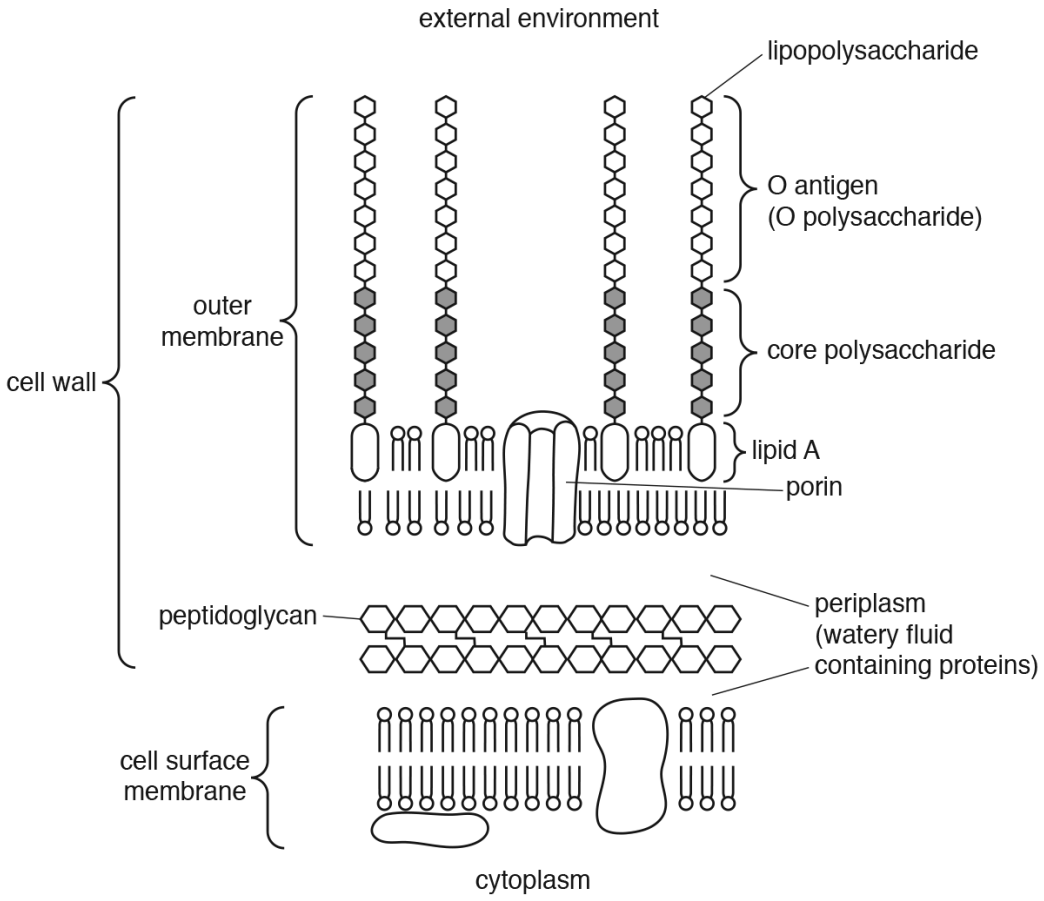


Fig. 3.1

(a) The antibiotic penicillin kills bacteria by causing them to lyse (burst). It is more effective in treating diseases caused by Gram-positive bacteria than diseases caused by Gram-negative bacteria.

Outline how penicillin acts on bacteria **and** use Fig. 3.1 to suggest why penicillin has little or no effect at treating diseases caused by Gram-negative bacteria, such as some strains of *E. coli*.

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.....[3]

(b) The outer membrane contains transport proteins called OmpF porins. These porins allow the passive movement of water, ions and small, polar molecules across the outer membrane. Each OmpF porin is formed from three identical polypeptides.

(i) Explain what is meant by the term *passive*.

.....[1]

(ii) Suggest **and** explain the features of an OmpF porin as a membrane transport protein.

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.....[4]

(iii) *E. coli* can regulate the number of OmpF porins in the outer membrane to adapt to changing conditions. One control mechanism used by *E. coli* involves the production of a small mRNA molecule known as micF.

MicF binds to the part of the mRNA molecule containing the START codon for the OmpF polypeptide.

Suggest **and** explain how the presence of micF prevents production of OmpF porins.

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.....[2]

(c) Fig. 3.1 shows that the outer membrane of the cell wall of *E. coli* contains lipopolysaccharides. These are not present in the cell surface membrane. Each lipopolysaccharide (LPS) consists of a lipid and a polysaccharide portion.

The O antigen is the outer part of the polysaccharide portion of the LPS. It faces the aqueous external environment.

(i) Define the term *polysaccharide*.

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.....[2]

(ii) Some strains of *E. coli* are pathogenic. Different pathogenic strains have different O antigens.

Suggest **and** explain why infection with one pathogenic strain of *E. coli* does not provide immunity to a different pathogenic strain.

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.....[3]

[Total: 15]

205. 9700_w17_qp_22 Q: 4

Fig. 4.1 is a transmission electron micrograph of the bacterium that causes cholera, *Vibrio cholerae*.

The flagellum shown in Fig. 4.1 allows movement of the bacterium within the gut and may also function to help it to bind to an intestinal epithelial cell. The organism does not enter the cell but the toxin it releases can enter and cause damage. Large quantities of water, chloride ions and sodium ions are lost from the cell.

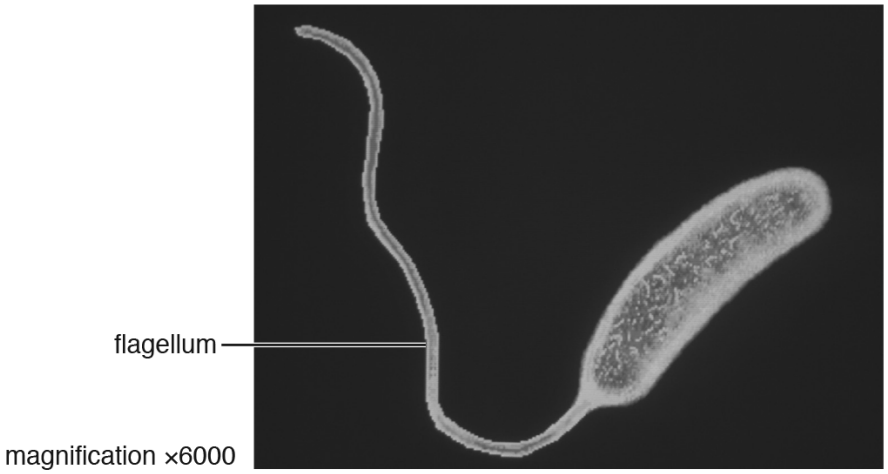


Fig. 4.1

People with symptoms of cholera have severe watery diarrhoea and as a result can become very dehydrated.

(a) Explain how a loss of chloride ions and sodium ions from the intestinal epithelial cell will cause a loss of water from the cell.

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.....[2]

(b) The main treatment for cholera is oral rehydration therapy (ORT) using oral rehydration salts (ORS). This involves drinking a solution of electrolytes (mineral ions) and glucose.

Fig. 4.2 summarises the movement of glucose and sodium ions across an intestinal epithelial cell.

Fig. 4.2 includes three different types of cell surface membrane proteins:

- SGLT1 is a cotransporter protein
- GLUT2 and Na^+/K^+ pump are two types of carrier protein.

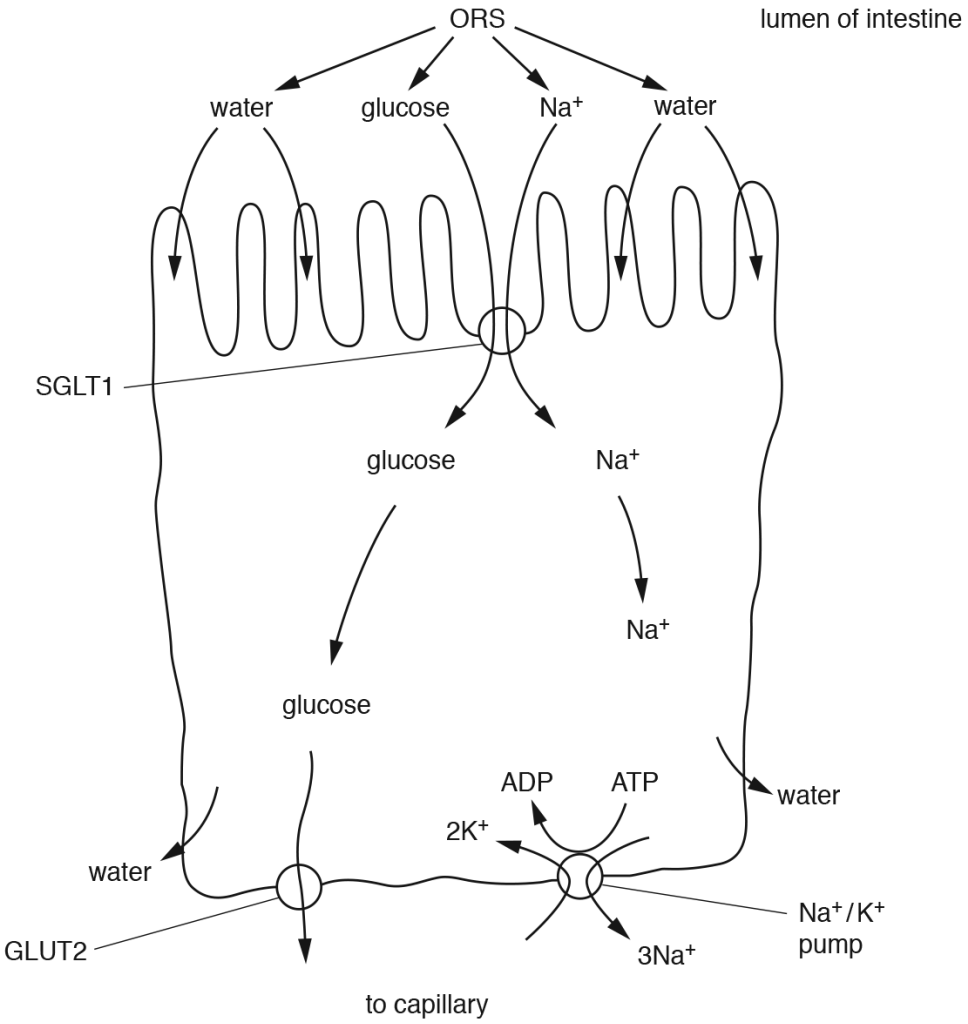


Fig. 4.2

The first rehydrating solution developed for the treatment of cholera did not contain glucose. Using ORS, patients absorb a higher concentration of sodium ions and there is an increase in water uptake.

With reference to Fig. 4.2:

- outline the transport mechanisms that result in the movement of glucose and sodium ions across the intestinal epithelial cell
- suggest how the movement of glucose and sodium ions increases water uptake by the cell.

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.....[4]

(c) In severe cases of cholera, the rehydrating solution is given intravenously, as a drip directly into a vein.

Suggest **one** reason why the rehydrating solution is given as a drip directly into a vein rather than into an artery.

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.....[1]

In very severe cases of cholera, antibiotics are also prescribed. The preferred antibiotic for treatment of cholera is a single dose of doxycycline, a form of tetracycline antibiotic.

(d) Tetracycline binds to a ribosomal subunit.

Suggest what effect this will have on the metabolism of *V. cholerae*.

.....

.....[1]

(e) A study was carried out to compare the effectiveness of the antibiotic tetracycline in the treatment of 118 patients with cholera. The patients were divided into four different treatment groups:

- Group **A**, given one dose of 1 g tetracycline
- Group **B**, given one dose of 2 g tetracycline
- Group **C**, given a multiple dose (one dose of 500 mg tetracycline every 6 hours for 24 hours)
- Group **D**, no antibiotic given.

Following treatment, the volume of diarrhoea collected from each patient was measured every 16 hours for 128 hours. Fig. 4.3 shows the mean volume collected for each group.

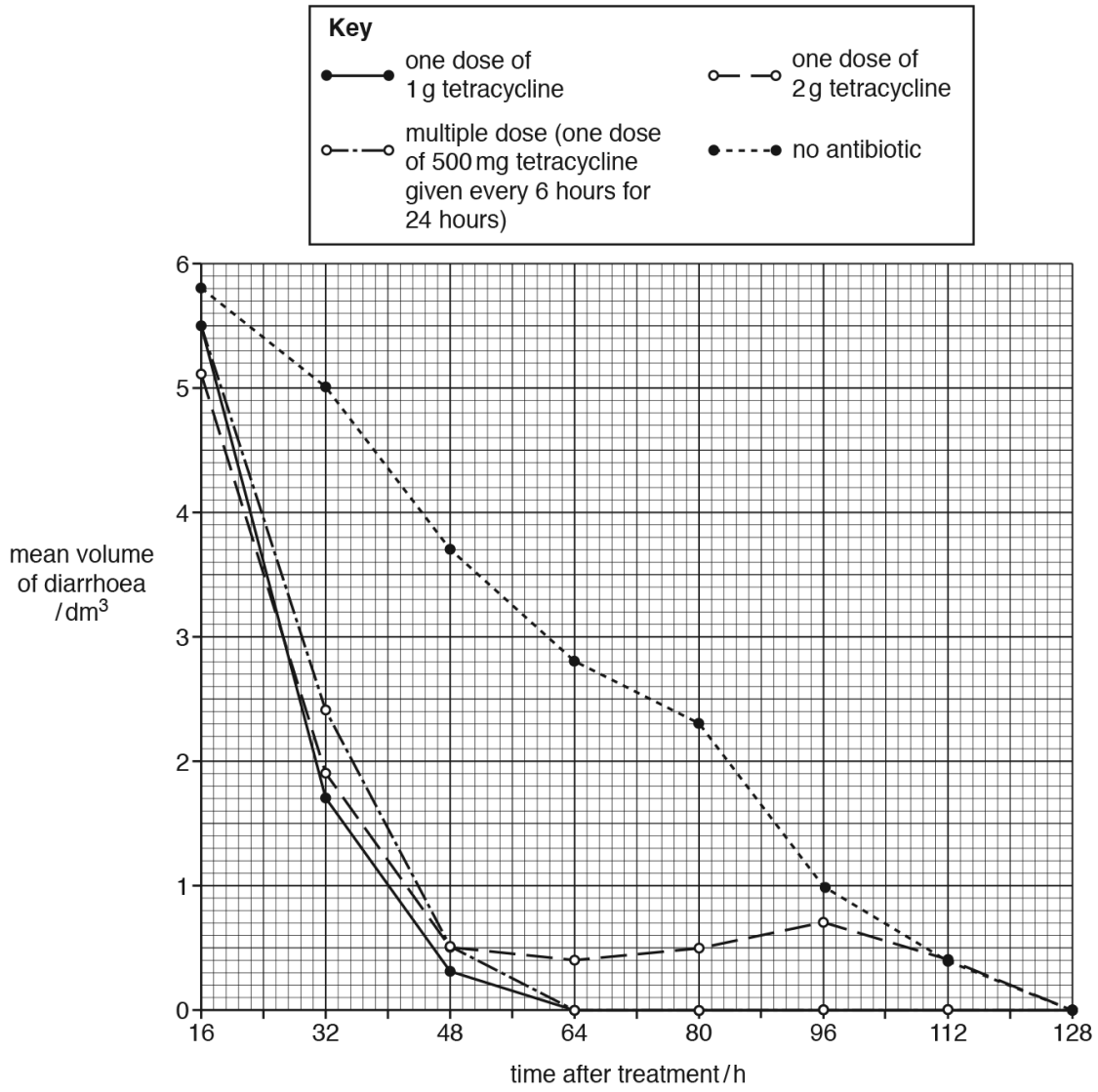


Fig. 4.3

(i) Describe the trends shown in Fig. 4.3.

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.....[3]

(ii) Explain whether the results support, or do not support, treating very severe cases of cholera with tetracycline.

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.....[2]

(f) Some strains of *V. cholerae* are antibiotic resistant.

Explain why this means that medical practitioners prefer to treat cholera with a single dose of antibiotic, rather than a multiple dose of the same antibiotic.

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.....[2]

(g) Most people who have recovered from cholera rarely become ill again from the disease. In these people, antibodies have been identified that will bind either to the cholera toxin, or to the bacterial flagellum, or to the main bacterial cell.

Explain why the antibodies are different, each one specific to its target.

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.....[3]

(h) Evidence suggests that newborn babies of mothers who have had cholera have immunity to the disease.

State **precisely** the type of immunity these babies are likely to have.

.....[1]

[Total: 19]

206. 9700_w17_qp_23 Q: 3

Fig. 3.1 shows the structure of an alveolus and surrounding structures in a mammalian lung. The lining of each alveolus is formed by two types of epithelial cell, alveolar type 1 and alveolar type 2.

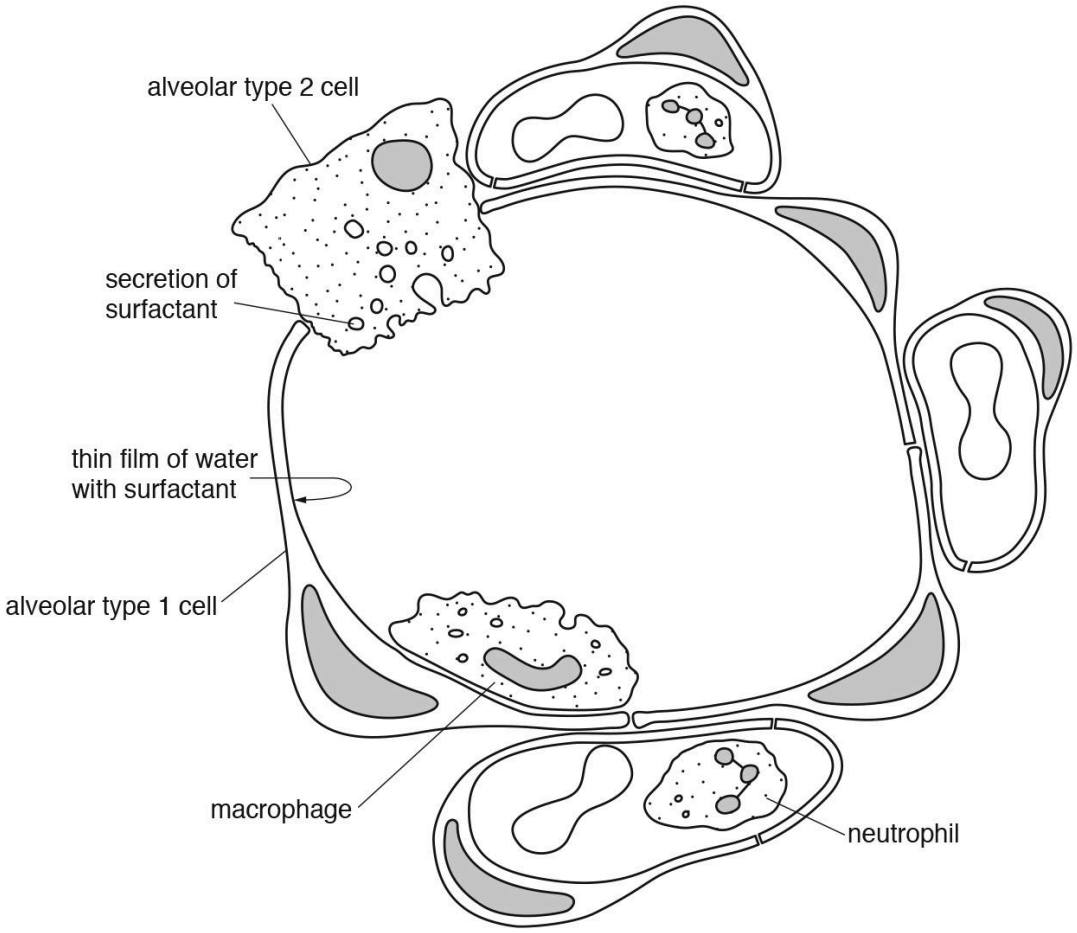


Fig. 3.1 not to scale

(a) Explain how the structure of an alveolar type 1 cell is adapted to its function.

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.....[2]

(b) Alveolar type 2 cells secrete pulmonary surfactant into the watery fluid that lines the alveolus. The surfactant reduces the surface tension of the fluid so that the alveolus does not collapse.

Pulmonary surfactant is a mixture of phospholipids and proteins. The phospholipids form a monolayer on the surface of the fluid.

Explain how phospholipids interact with water to form a monolayer on the surface of the fluid.

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.....[2]

Macrophages and neutrophils are found in the lungs, as shown in Fig. 3.1.

(c) Describe the role of macrophages in the lungs.

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.....[3]

(d) Neutrophils leave the blood and secrete the extracellular enzyme, elastase.

(i) Suggest why neutrophils secrete elastase.

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.....[2]

(ii) The protein alpha-1 antitrypsin is produced in cells in the liver and is transported to the lungs, where it inhibits the action of elastase.

Some people produce a different form of this protein that remains within liver cells. These people are at an increased risk of developing emphysema, in which alveolar walls break down. Emphysema is one of the conditions associated with chronic obstructive pulmonary disease (COPD).

Explain why these people are at increased risk of developing emphysema.

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.....[3]

[Total: 12]

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207. 9700_s16_qp_21 Q: 2

Macrophages synthesise intracellular enzymes.

Fig. 2.1 is a summary diagram of events that occur in a macrophage.

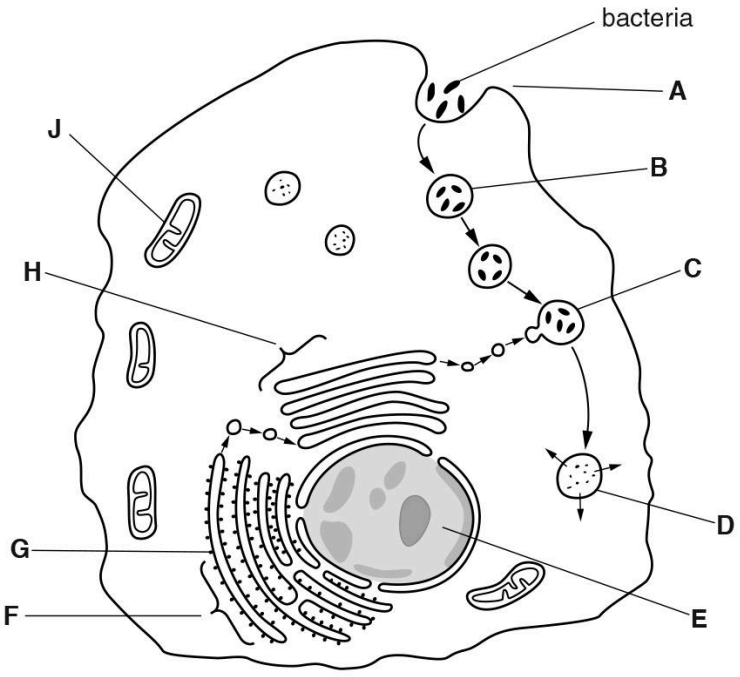


Fig. 2.1

(a) **(i)** Name the process at **A**.

.....[1]

(ii) Name the stages of protein synthesis that occur at **E** and at **F**.

E .....

F .....[2]

(iii) Name organelles **B**, **G**, **H** and **J**.

B .....

G .....

H .....

J .....[4]

(b) Describe what happens to the bacteria between **C** and **D**.

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.....[3]

(c) Macrophages are antigen presenting cells (APCs). Antigens from pathogens such as the bacteria shown in Fig. 2.1 are presented to helper T-lymphocytes as shown in Fig. 2.2.

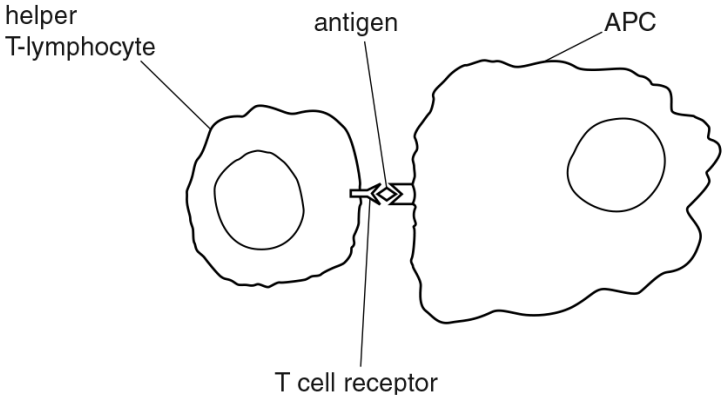


Fig. 2.2

Very few helper T-lymphocytes respond to the presence of APCs by binding in the way shown in Fig. 2.2.

Suggest why this is so.

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.....[2]

[Total: 12]

208. 9700_s15_qp_21 Q: 2

Pathogens enter the body in a variety of ways, including through the gas exchange system. The body has several defence mechanisms against the entry of pathogens and their spread throughout the body.

Fig. 2.1 is an electron micrograph of a cross section of the lining of a bronchiole.

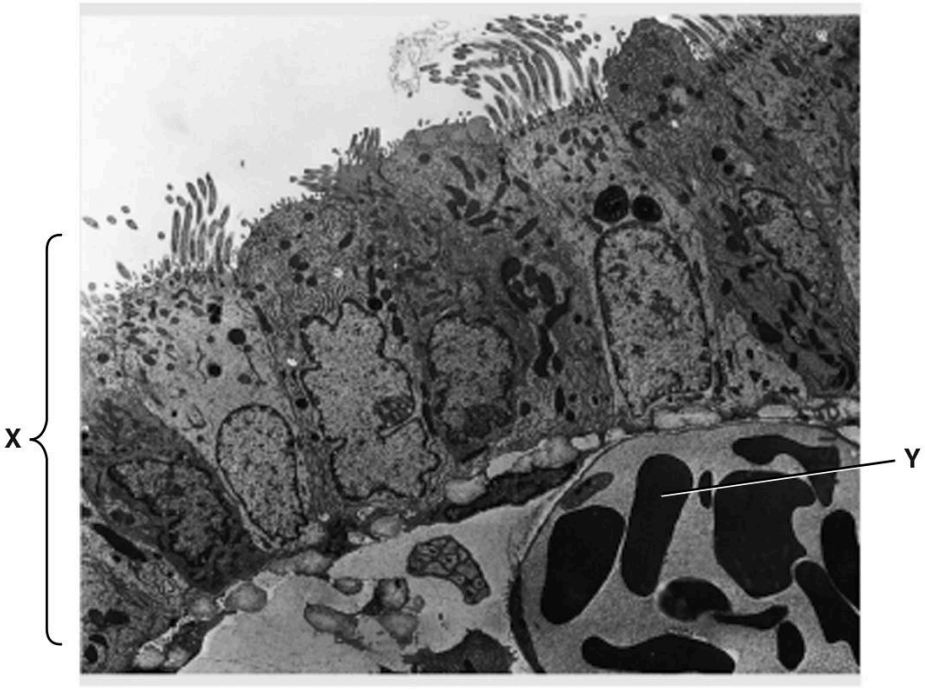


Fig. 2.1

(a) (i) Name tissue **X** and cell **Y**.

X .....

Y .....[2]

(ii) With reference to the structures visible in Fig. 2.1, state three ways in which the lining of the trachea, bronchus and bronchioles provides protection against the entry of bacterial pathogens.

1 .....

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2 .....

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3 .....

.....[3]

Fig. 2.2 shows part of the immune response to the first infection by a bacterial pathogen that has entered the body through the lining of a bronchiole. **J** and **K** are stages in the immune response.

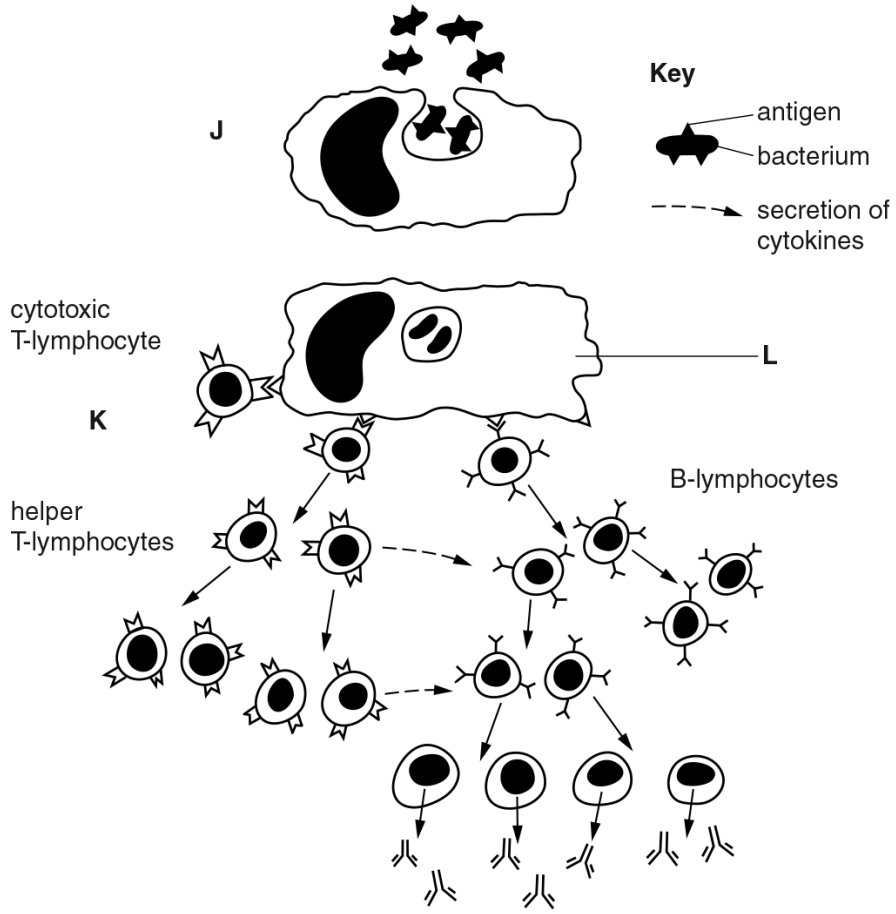


Fig. 2.2

(b) (i) State what is happening at stage **J**.

.....

.....[1]

(ii) Explain the role of cell **L** at stage **K** in the immune response.

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.....[2]

(c) With reference to Fig. 2.2, explain how the response to a second infection by this bacterial pathogen differs from the first.

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.....[3]

(d) There are various ways in which the effectiveness of immune responses can be reduced.

Suggest how each of the following reduces the effectiveness of an immune response.

(i) The number of T-lymphocytes is reduced in a person with HIV/AIDS.

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.....[1]

(ii) Some pathogens are covered in cell surface membranes from their host.

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.....[1]

(iii) B-lymphocytes do not mature properly and do not recognise any antigens.

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.....[1]

[Total: 14]

209. 9700_w15_qp_21 Q: 5

(a) State the name of the causative organism (pathogen) of measles.

..... [1]

(b) Describe how the measles pathogen is transmitted.

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..... [2]

(c) The measles pathogen contains a single stranded RNA molecule and no DNA.

The cells that the measles pathogen infects contain double stranded DNA molecules.

State two **other** ways in which the RNA in the measles pathogen differs from the DNA in the infected cells.

1. .....

.....

2. .....

.....
[2]

(d) The measles pathogen must carry out RNA replication to make new RNA molecules for the new pathogens. This happens inside the infected cell.

The pathogen carries its own enzyme for RNA replication, but no other enzymes.

Explain why the measles pathogen cannot use an enzyme from the cell to carry out RNA replication.

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..... [2]

(e) The outer part of the measles pathogen contains an antigen called the H-protein. This antigen appears on the surface of cells infected with the measles pathogen.

Describe the role played by T-lymphocytes in a primary immune response to an infection by the measles pathogen.

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..... [5]

[Total: 12]

210. 9700_w15_qp_22 Q: 2

Tobacco smoking is known to be associated with atherosclerosis and emphysema.

(a) Outline ways in which tobacco smoking can contribute to atherosclerosis.

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..... [3]

(b) Fig. 2.1 is a scan of the lungs of a person with emphysema. One common feature in the damaged areas labelled is a loss of the elastic fibres of the alveoli. Another feature is an increased number of macrophages and neutrophils.

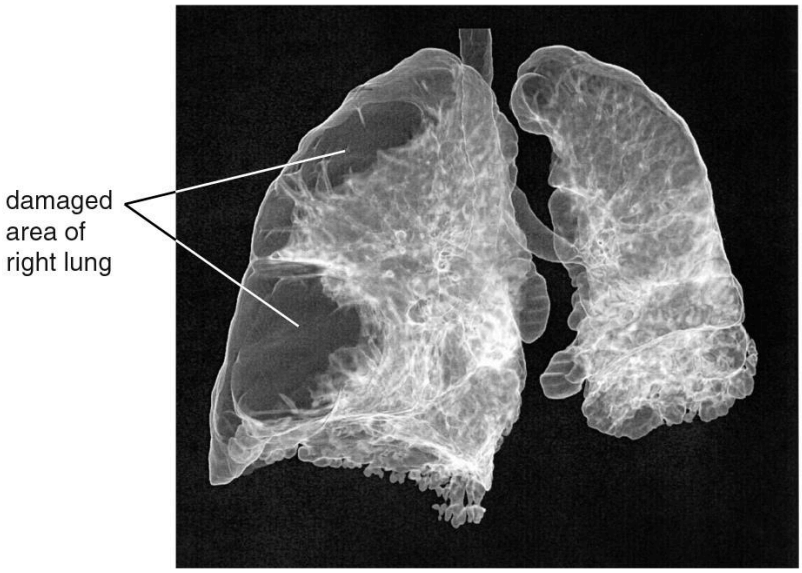


Fig. 2.1

(i) State the general role shared by macrophages and neutrophils.

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..... [1]

(ii) Suggest how the loss of the elastic fibres would cause the enlargement of the lung shown in Fig. 2.1.

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..... [2]

(c) The synthesis and release of elastase enzymes by macrophages and neutrophils is an important feature in the development and progression of emphysema. Elastase causes the breakdown of the protein elastin, the main component of elastic fibres.

(i) Explain what is meant by an enzyme.

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..... [2]

(ii) Elastase has an active site with a specific shape. The mode of action of this enzyme supports the lock and key hypothesis.

Explain the mode of action of elastase.

You may use the space below to draw a diagram or diagrams to help your answer.

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..... [3]

(d) There are two inhibitors of elastase that are produced in the body, TIMP-1 and A1AT:

- macrophage elastase is inhibited by TIMP-1
- neutrophil elastase is inhibited by A1AT.

The inhibitors can be inactivated by the elastase enzymes:

- macrophage elastase can inactivate A1AT
- neutrophil elastase can inactivate TIMP-1.

In healthy lungs, the activity of elastase enzymes is regulated. Tobacco smoke can disrupt this regulation.

(i) One effect of tobacco smoke is to cause changes in the structure of A1AT, a competitive inhibitor.

Suggest how structural changes to A1AT will affect its mode of action.

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..... [1]

(ii) A1AT is a protein. Some non-smokers have a mutation in the gene coding for A1AT and are at risk of developing emphysema as there is a lack of A1AT in the lung tissue.

Explain why a lack of A1AT in these non-smokers means that they are at risk of developing emphysema.

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..... [3]

(e) Tobacco smoke is known to cause increased production of macrophage elastase. *MMP12* is the gene coding for macrophage elastase. Copies of this gene are produced as messenger RNA (mRNA).

Describe how this mRNA is used in translation to produce macrophage elastase.

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..... [5]

[Total: 20]

211. 9700_w15_qp_22 Q: 4

(a) Table 4.1 describes three examples of substances moving into or out of cells.

Complete Table 4.1 by identifying the transport mechanism involved for each example.

Table 4.1

example	transport mechanism involved
uptake of magnesium ions from a lower concentration in the soil solution to a higher concentration in the cytoplasm of a root hair cell	
release of antibodies from an active B-lymphocyte (plasma cell)	
movement of sucrose from a companion cell into a phloem sieve tube element via plasmodesmata	

[3]

(b) Oxygen moves into and out of red blood cells. Fig. 4.1 shows an oxygen dissociation curve for adult human haemoglobin.

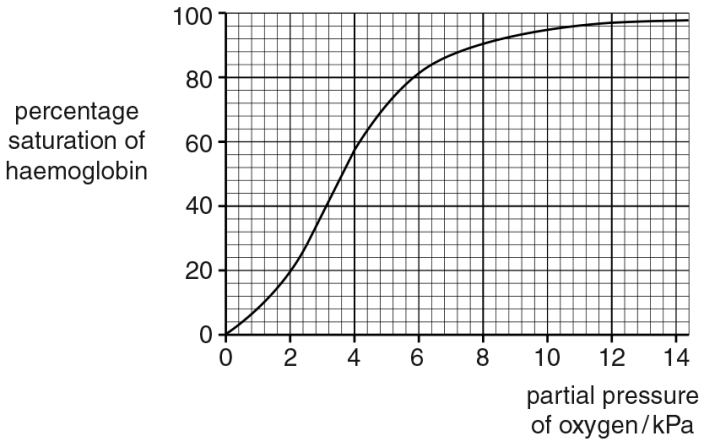


Fig. 4.1

The steepest part of the curve is between 2.6 kPa and 4.2 kPa.

Explain the importance of this for respiring tissues.

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..... [2]

[Total: 5]

11.2 Antibodies and vaccination

212. 9700_m20_qp_22 Q: 5

Myasthenia gravis and HIV/AIDS both involve disorders of the immune system.

(a) Outline why myasthenia gravis is described as a disorder of the immune system.

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..... [2]

A person with HIV/AIDS has a weakened immune system. This is because HIV infects cells of the immune system, in particular T-helper lymphocytes (T_h cells). The pathogen can remain inactive within host cells. In some people, the pathogen becomes active and causes the number of T_h cells to decrease.

Antiretroviral therapy (ART) is used to treat people who are infected with HIV (living with HIV). ART aims to keep the number of T_h cells at a healthy level.

(b) State the full name of the pathogen known as HIV.

..... [1]

(c) Explain why it is important that ART maintains a healthy number of T_h cells in a person living with HIV.

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..... [3]

(d) Fig. 5.1 shows global estimates of:

- the percentage of people living with HIV who received treatment with ART in each year from 2000 to 2015
- the number of people who died from HIV/AIDS in each year from 2000 to 2015.

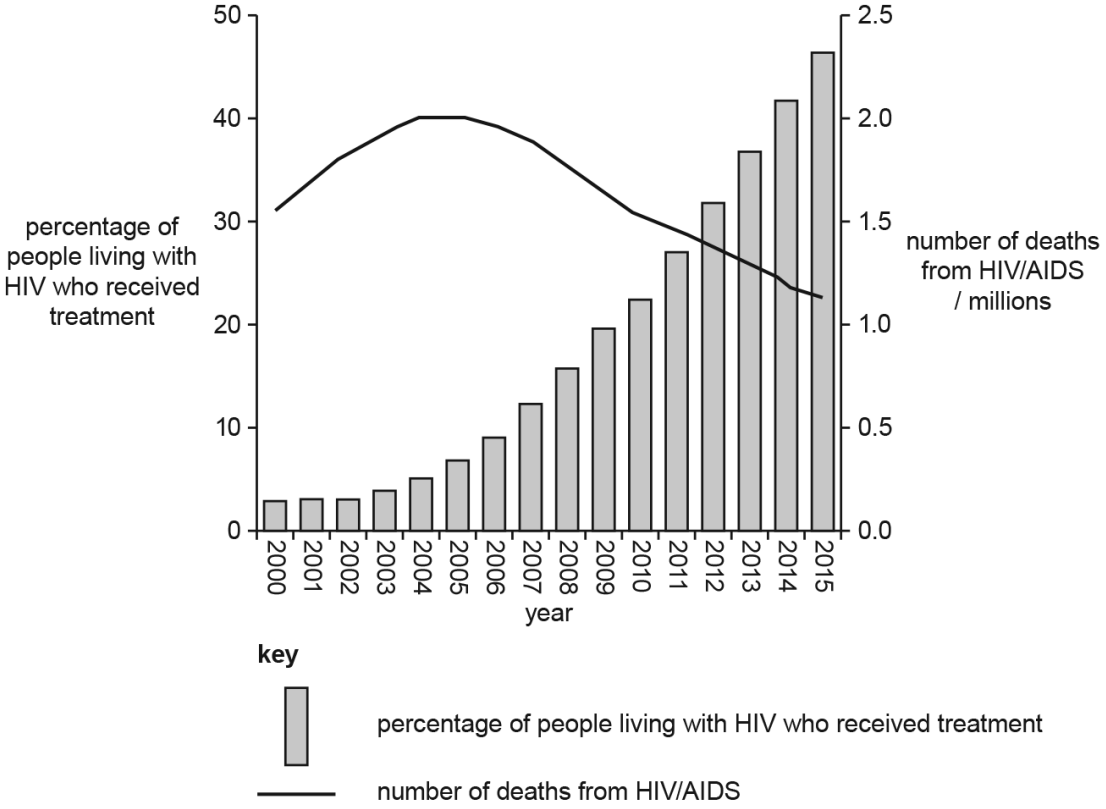


Fig. 5.1

(i) Describe the trends shown in Fig. 5.1.

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..... [3]

(ii) It is recommended that ART is given to all people living with HIV.

Some countries that support this recommendation find it difficult to provide ART to everyone living with HIV.

Other than the high cost of treatment, suggest **two** reasons why it is difficult to provide ART to everyone living with HIV.

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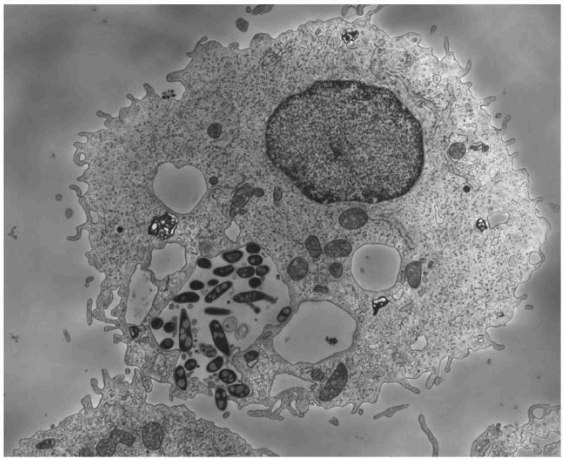
..... [2]

[Total: 11]

213. 9700_s20_qp_21 Q: 5

The vaccine used to control tuberculosis (TB) is known as Bacillus Calmette-Guérin (BCG). The vaccine contains live bacteria that have been selected so that they do not cause disease in humans.

Fig. 5.1 shows a macrophage that is in the process of engulfing the bacteria in the vaccine.



magnification ×4400

Fig. 5.1

(a) (i) Name the pathogen that causes TB.

..... [1]

(ii) Describe how this pathogen is transmitted.

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..... [2]

(b) Describe the events that occur in the body after the macrophage has engulfed the bacteria until the production of antibodies in response to the BCG vaccine.

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..... [5]

(c) Vaccines, such as BCG, stimulate the formation of memory cells.

Explain the role of memory cells in the body's defence against the TB pathogen.

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..... [3]

(d) Suggest why vaccination with BCG has not yet eradicated TB.

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..... [3]

[Total: 14]

214. 9700_s20_qp_22 Q: 3

The Bacillus Calmette-Guérin (BCG) vaccine is the only vaccine used to provide protection against the infectious bacterial disease tuberculosis (TB). Most countries of the world have a BCG vaccination programme.

(a) TB is most commonly transmitted from person to person by aerosol infection. The causative organism is present in airborne droplets.

Name the species of causative organism of TB commonly passed from person to person by aerosol infection.

..... [1]

(b) In general, the countries that do not have a BCG vaccination programme are high-income countries that have a low number of cases of TB. In most of these countries, the vaccine is given only to babies and children at high risk of developing TB.

Suggest **one** reason why a child in a country with a low number of cases of the disease could be at a high risk of developing TB.

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..... [1]

(c) Countries are classified by the World Bank into one of four income groups.

Table 3.1 shows the estimated incidence of TB for 2012 to 2016 for these income groups.

The incidence represents the number of new cases of TB occurring per 100 000 people in one year. The new cases include the number of cases that have occurred again after a period of recovery (relapse TB).

Table 3.1

	incidence per 100 000 people				
year / **income group**	**2012**	**2013**	**2014**	**2015**	**2016**
low	253	244	238	231	224
lower middle	244	240	236	232	227
upper middle	84	81	78	76	74
high	14	13	13	12	12

Describe the patterns and trends shown in Table 3.1.

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..... [3]

(d) There is evidence that the BCG vaccine has also provided protection against the disease leprosy.

Leprosy is caused by a bacterium that is closely related to the bacteria that cause TB.

Suggest why the BCG vaccine can also provide protection against leprosy.

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..... [2]

(e) A baby can gain artificial active immunity to TB after having the BCG vaccine. A baby can also gain natural passive immunity to TB.

State the differences between **artificial active** immunity and **natural passive** immunity.

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..... [3]

[Total: 10]

215. 9700_s20_qp_23 Q: 2

In 2016, the highest number of cases of malaria and deaths caused by the disease were in sub-Saharan Africa. In many areas of sub-Saharan Africa, malaria is endemic (continually present) and people are at high risk of becoming infected with the *Plasmodium* pathogen.

In high risk areas it is recommended that:

- homes are provided with insecticide-treated nets (ITN)
- the surfaces inside homes where *Anopheles* mosquitoes may rest are sprayed with insecticide. This is known as indoor residual spraying (IRS).

(a) Explain how the use of ITN and IRS can help break the transmission cycle of malaria.

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..... [3]

(b) Fig. 2.1 shows the proportion of the population in sub-Saharan Africa at risk of malaria that is protected by using IRS or ITN, or both, in the years 2010 to 2016.

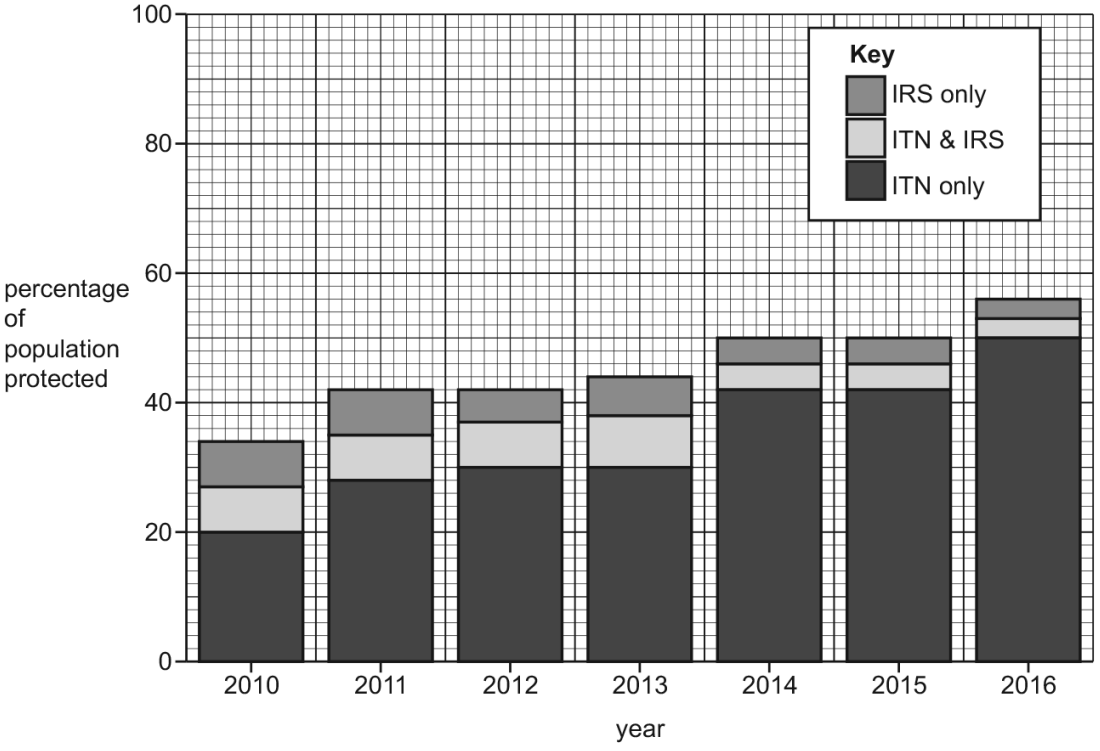


Fig. 2.1

The main trend in Fig. 2.1 shows that there is an increase in the percentage of the population protected over time.

(i) State **one** other trend shown in Fig. 2.1.

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..... [1]

(ii) Explain why the main trend shown in Fig. 2.1 could be a concern for the World Health Organization.

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..... [1]

(iii) With reference to Fig. 2.1, suggest a reason for the difference in trends shown for ITN only compared with IRS only.

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..... [1]

(c) In a primary immune response, antibodies against *Plasmodium* are produced within one to two weeks following infection. In some people, the pathogen is eliminated and the concentration of antibodies in the circulation decreases over time.

Infection again by *Plasmodium* with the same antigens causes a secondary response that also involves antibody production.

State **and** explain how the antibody response following a second infection will differ from the primary immune response.

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..... [3]

(d) In malaria, the production of antibodies is beneficial to recovery, whereas in the disease myasthenia gravis the production of antibodies is harmful.

Explain why the production of antibodies in a person with myasthenia gravis is harmful.

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..... [2]

[Total: 11]

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216. 9700_w20_qp_22 Q: 4

In the immune system, a plasma cell develops from an activated B-lymphocyte. Mature plasma cells synthesise and secrete antibody molecules.

(a) Fig. 4.1 is a diagram of a transmission electron micrograph of a plasma cell.

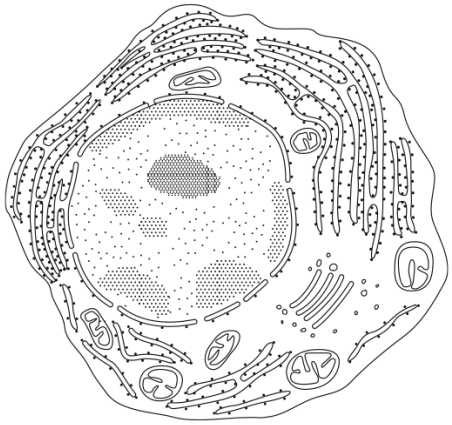


Fig. 4.1

The plasma cell can be seen in greater detail using an electron microscope compared with using a light microscope.

(i) Describe the **extra** detail of the nucleus that can be seen using an electron microscope.

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..... [3]

(ii) Explain why cell structures, such as ribosomes and the rough and smooth endoplasmic reticulum, cannot be seen using a light microscope.

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..... [2]

(b) The transition from the activated B-lymphocyte to the fully mature plasma cell requires a number of mitotic cell cycles to occur. This process, which is known as clonal expansion, results in a large number of genetically identical plasma cells.

Fig. 4.2 describes events, **A** to **F**, that occur during the mitotic cell cycle of the B-lymphocyte.

A	centrioles replicate
B	DNA polymerase catalyses the formation of phosphodiester bonds
C	condensation of chromosomes
D	nuclear envelope reassembles around each set of daughter chromosomes
E	centromeres move towards poles
F	chromosomes line up at spindle equator

Fig. 4.2

Table 4.1 lists the stages occurring during one cell cycle of the B-lymphocyte. These stages are not in the correct order.

Table 4.1

stage of cell cycle	correct letter from Fig. 4.2
G_2 phase	
metaphase	**F**
cytokinesis	
prophase	
S phase	
anaphase	
G_1 phase	
telophase	

Complete Table 4.1 by writing the letter of the event described in Fig. 4.2 that correctly matches the stage of the cell cycle listed.

Leave a **blank space** if there is **no** matching description for the stage in the list. Use each letter **once** only.

One of the letters in Table 4.1 has already been added for you.

[5]

(c) Clonal expansion also results in the production of memory B-lymphocytes.

Explain the importance of clonal expansion **and** the production of memory B-lymphocytes in providing protection for a person against an infectious disease.

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..... [3]

(d) Myasthenia gravis is an example of a disease where the immune system fails to distinguish between self and non-self.

Explain what is meant by this statement.

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..... [2]

[Total: 15]

217. 9700_m19_qp_22 Q: 3

In 2015, the World Health Organization (WHO) published the Global Technical Strategy for Malaria 2016–2030. The aim of this global strategy, which follows on from the 2008 Global Malaria Action Plan (GMAP), is to make progress in the control and elimination of malaria.

Both the global strategy and GMAP aim to reduce:

- the case incidence (number of new cases each year) of malaria
- the mortality rate (number of deaths each year) from malaria.

(a) Fig. 3.1 shows data for the four countries in the WHO Western Pacific Region that had the highest proportion of cases of malaria in 2015.

For each of these four countries, the percentage change in the case incidence and the percentage change in the mortality rate over the five-year period from 2010 to 2015 are shown.

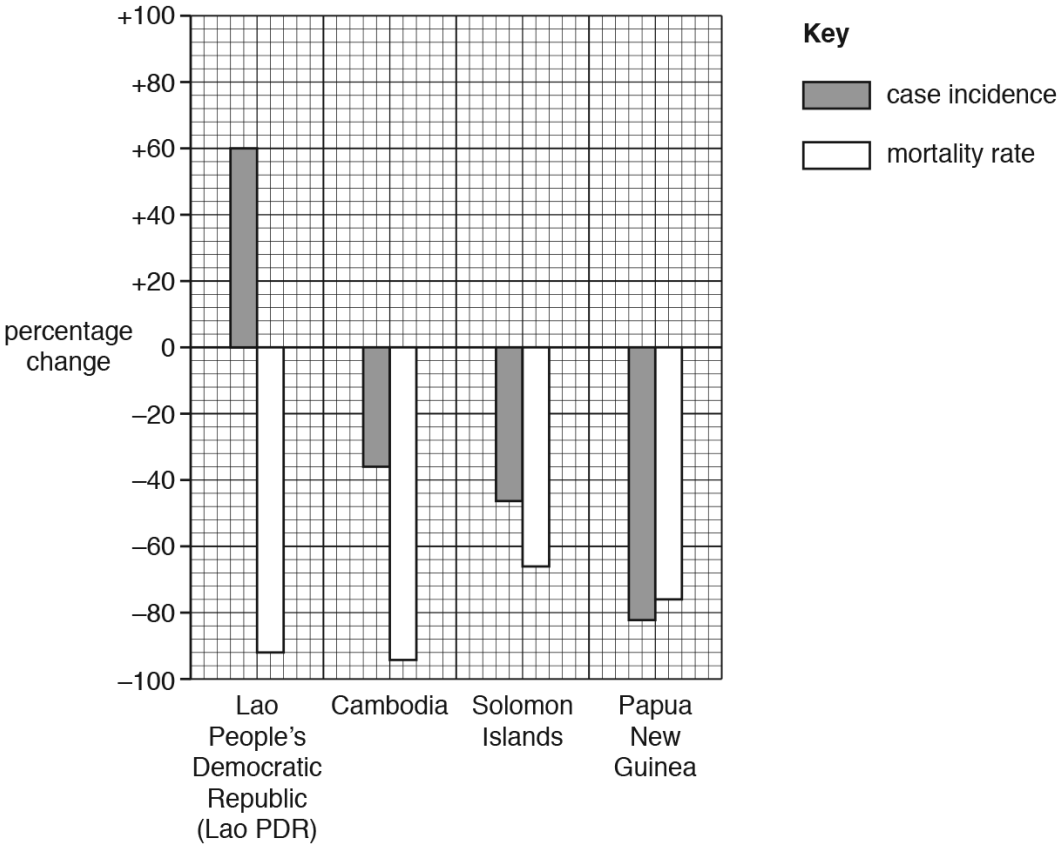


Fig. 3.1

(i) With reference to Fig. 3.1, describe the progress made in the control of malaria in the four countries between 2010 and 2015.

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..... [4]

(ii) All the countries shown in Fig. 3.1 supplied households at risk of malaria with insecticide-treated nets (ITNs). This is one of the recommendations in the GMAP and the global strategy.

Describe **and** explain the role of ITNs.

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..... [2]

(b) Another recommendation of the global strategy is to carry out rapid diagnostic testing (RDT) of individuals who may have malaria. This involves testing human blood samples for the presence of proteins specific to *Plasmodium*. Test sticks can be used.

Table 3.1 contains information about two RDT test sticks.

Table 3.1

test stick	***Plasmodium* protein tested for**	**species of *Plasmodium* that produce the protein**
1	pLDH (parasite lactate dehydrogenase)	*P. vivax* *P. falciparum* *P. ovale* *P. malariae*
2	HRP-2 (histidine-rich protein 2)	*P. falciparum* only

Some details of the design of these RDT test sticks are shown in Fig. 3.2.

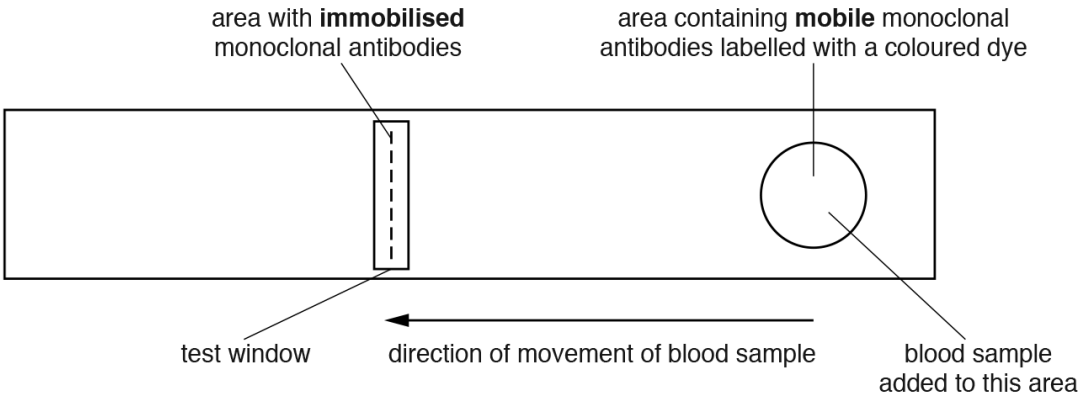


Fig. 3.2

The **immobilised** monoclonal antibodies in the test window are not visible.

If the blood sample contains a *Plasmodium* protein that can be detected by the RDT test stick:

- the **mobile** monoclonal antibodies bind to one part of the protein
- the **immobilised** monoclonal antibodies bind to another part of the protein
- a coloured line in the test window indicates a positive result for the protein.

(i) With reference to Table 3.1 and Fig. 3.2, explain why test stick 1 and test stick 2 will contain **different** mobile monoclonal antibodies.

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..... [2]

(ii) Two blood samples were removed from a person. One sample was added to test stick 1 and the other sample was added to test stick 2.

With reference to Table 3.1 and Fig. 3.2, explain what can be diagnosed for this person from a **positive** result for test stick 1 and a **negative** result for test stick 2.

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..... [2]

[Total: 10]

218. 9700_s19_qp_21 Q: 1

(a) Antibody molecules are proteins that show primary structure, secondary structure, tertiary structure and quaternary structure.

Fig. 1.1 shows a ribbon diagram of an antibody molecule.

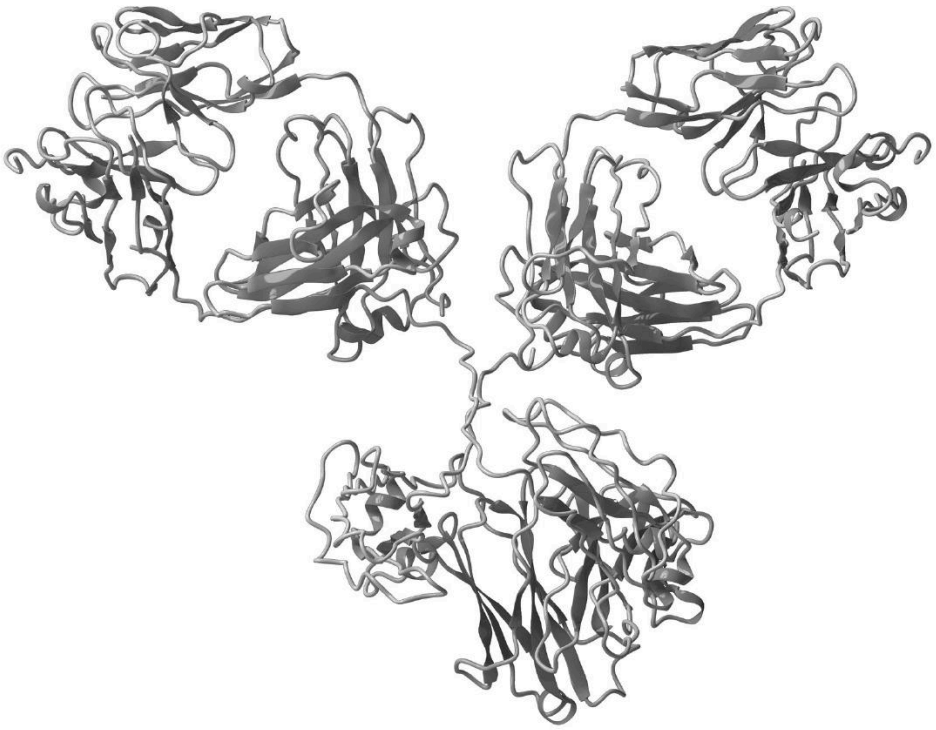


Fig. 1.1

Describe how Fig. 1.1 shows the secondary structure **and** tertiary structure of the antibody molecule.

secondary structure .....

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tertiary structure .....

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[3]

(b) Fig. 1.2 is a transmission electron micrograph of a hybridoma cell.

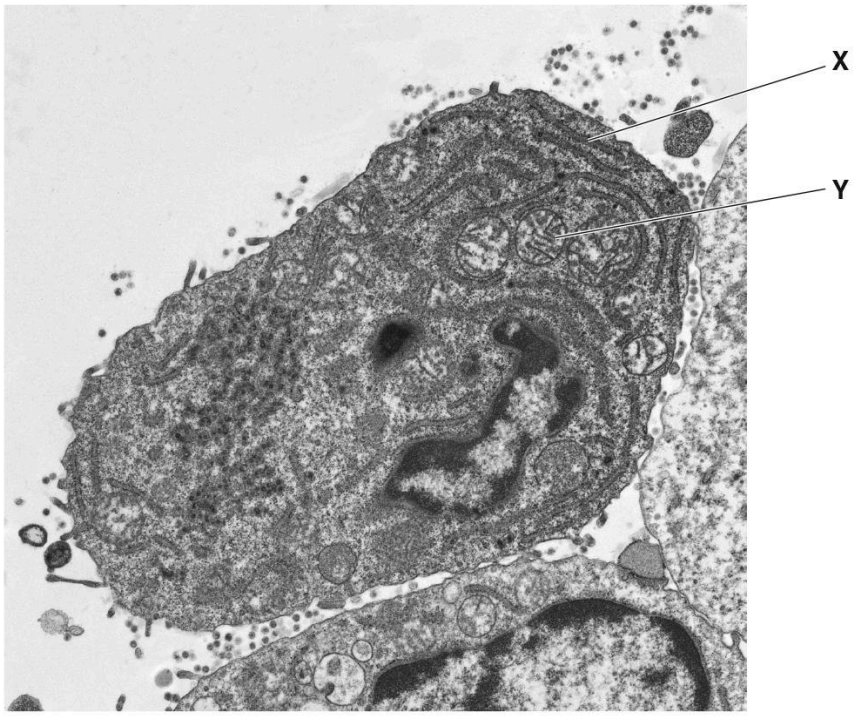


Fig. 1.2

(i) The hybridoma cell in Fig. 1.2 synthesises and secretes molecules of a monoclonal antibody.

State the roles of the structures labelled **X** and **Y** in the production of antibody molecules in the hybridoma cell.

X .....

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Y .....

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[2]

(ii) The hybridoma method for the production of monoclonal antibodies involves a number of stages. One of these stages is the formation of hybridoma cells.

Outline the stage in which hybridoma cells are formed.

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..... [3]

(iii) Outline the use of monoclonal antibodies in the treatment of disease.

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..... [3]

[Total: 11]

219. 9700_w19_qp_21 Q: 2

Fig. 2.1 is a transmission electron micrograph showing the bacterial pathogen that causes tuberculosis (TB).

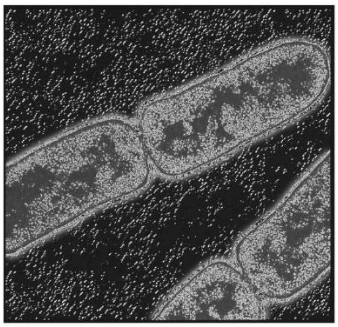


Fig. 2.1

(a) (i) Name the pathogen shown in Fig. 2.1 that causes TB.

..... [1]

The World Health Organization (WHO) introduced a strategy in 2015 to end the global TB epidemic.

An important part of the strategy is to:
- identify people at risk of becoming infected with TB
- use methods to prevent transmission of TB.

The BCG vaccination is one method of prevention recommended for use in countries where TB is common. The BCG vaccine contains a non-pathogenic, living form of the microorganism that causes TB.

(ii) Complete Table 2.1 by using a tick (✓) to identify the type of immunity that develops in a person who has been given the BCG vaccination.

Table 2.1

artificial active immunity	
artificial passive immunity	
natural active immunity	
natural passive immunity	

[1]

(b) Rifampicin is one of the antibiotics used to treat TB.

Rifampicin inhibits RNA polymerase in bacterial cells by binding to a site other than the active site. This prevents polypeptide synthesis.

(i) Suggest **and** explain how rifampicin prevents polypeptide synthesis in bacterial cells.

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..... [3]

Some bacteria have developed resistance to rifampicin. However, they are still susceptible to the other antibiotics that can be used to treat TB.

Multi-drug resistant bacteria have developed resistance to at least two drugs, including rifampicin.

WHO collects data from all countries on the number of cases of TB caused by rifampicin-resistant bacteria (RR-TB) and multi-drug resistant bacteria (MDR-TB).

Fig. 2.2 shows the reported number of cases of TB between 2009 and 2013.

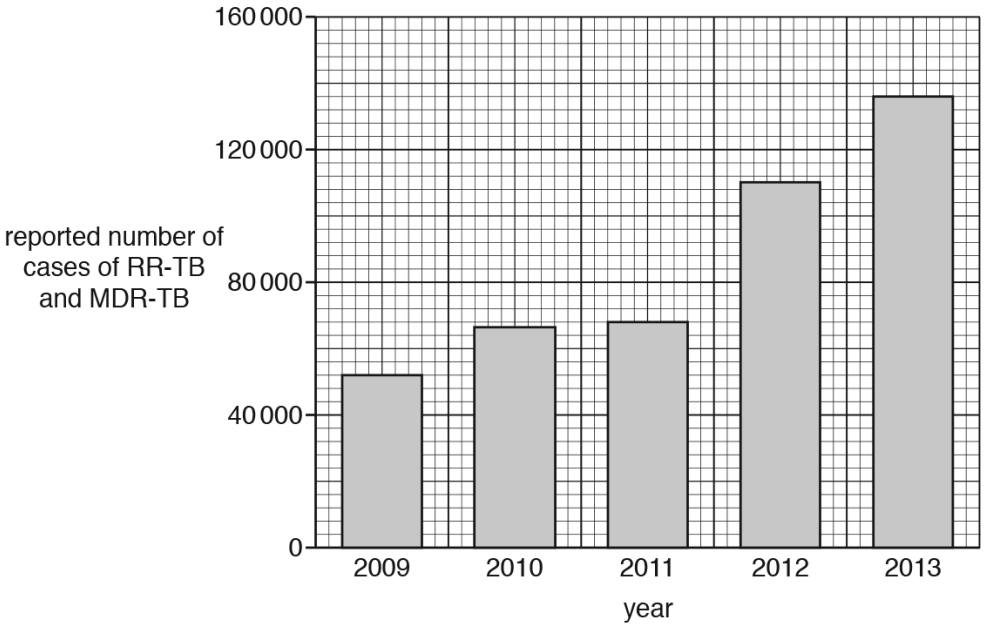


Fig. 2.2

(ii) Describe the trend shown by the data in Fig. 2.2.

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..... [2]

(iii) Explain how resistance to drugs such as rifampicin develops.

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..... [4]

[Total: 11]

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220. 9700_w19_qp_21 Q: 4

(a) Fig. 4.1 is a photomicrograph of a human blood smear.

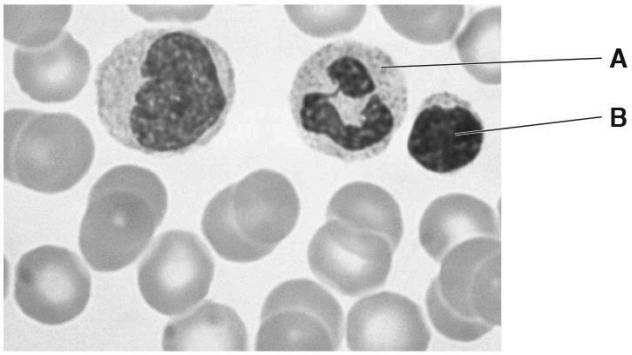


Fig. 4.1

Name the cells labelled **A** and **B** in Fig. 4.1.

A .....

B .....

[2]

(b) Blood and lymph are both fluids that transport substances within the human body.

(i) Table 4.1 shows components found in both blood and lymph.

Complete Table 4.1 to show whether the concentration of each of these components is **higher** or **lower** or the **same** in the lymph, when compared with the concentration in the blood in the aorta.

You may use the words **higher** or **lower** or **same** once, more than once or not at all.

Table 4.1

component	concentration **in lymph** compared to the concentration in blood in the aorta
oxygen	
carbon dioxide	
red blood cells	

[2]

(ii) The presence of a pathogen infecting the body leads to an increase in the concentration of protein in lymph.

Suggest an explanation for this increase in protein concentration.

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..... [2]

(c) Blood is circulated around the body by the heart.

The action of the heart is coordinated and controlled by structures located in its walls, such as the sinoatrial node (SAN) and the atrioventricular node (AVN).

(i) Describe the role of the SAN.

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..... [2]

(ii) In a healthy heart, the AVN provides the only pathway for electrical impulses to travel from the atria to the ventricles.

The bundle of Kent is a structure found in the heart in a small number of people.

Some electrical impulses do not pass through the AVN but travel directly from the atria to the ventricles through the bundle of Kent.

Suggest **and** explain the effects that the presence of the bundle of Kent may have on heart rate.

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..... [3]

[Total: 11]

221. 9700_w19_qp_21 Q: 5

Myasthenia gravis is a condition that results in muscle weakness by affecting the immune response.

(a) Explain what is meant by the term *immune response*.

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..... [2]

(b) Myasthenia gravis is an autoimmune disease which disrupts a cell signalling pathway involving muscle cells.

(i) Suggest how the immune system acts to disrupt this cell signalling pathway.

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..... [3]

Enzyme **Y** is found in the cell surface membrane of muscle cells. Enzyme **Y** acts to break down the cell signalling molecules which trigger muscle contraction when they are no longer needed.

(ii) Using the induced fit hypothesis of enzyme action, explain how enzyme **Y** breaks down the cell signalling molecules.

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..... [4]

(c) Rituximab is a monoclonal antibody used in the treatment of myasthenia gravis.

Rituximab acts against the cell surface membrane protein CD20. This protein is found on the surface of the B-lymphocytes that cause myasthenia gravis.

Explain the advantages of using monoclonal antibodies in the treatment of diseases such as myasthenia gravis.

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..... [3]

[Total: 12]

222. 9700_w19_qp_22 Q: 5

Countries that have a high number of cases of malaria also have problems with diseases caused by bacteria. This means that many people in these countries are prescribed antibiotics, such as penicillin, for the treatment of bacterial infections.

(a) Outline how penicillin acts on bacterial cells.

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..... [3]

The female *Anopheles* mosquito is the vector of the *Plasmodium* pathogen that causes malaria. The insect takes in *Plasmodium* when feeding on blood from an infected person. At a later stage the insect can transmit the pathogen when taking a blood meal from an uninfected person.

(b) Name **one** of the four species of *Plasmodium* that can cause malaria.

..... [1]

(c) The male *Anopheles* mosquito does not feed on blood and so does not act as a vector.

Suggest why there is a difference in this feeding behaviour between male and female *Anopheles*.

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..... [1]

(d) Research has shown that *Plasmodium* is not always transmitted to uninfected people.

Two main reasons for this have been suggested.

- The immune system of mosquitoes kills *Plasmodium* while it is still in the gut.
- Bacteria living in the gut of mosquitoes compete with *Plasmodium* so it does not survive to continue its life cycle.

A study was carried out to see if taking antibiotics affects the risk of transmission of malaria.

Some observations and results of the study are summarised in Fig. 5.1.

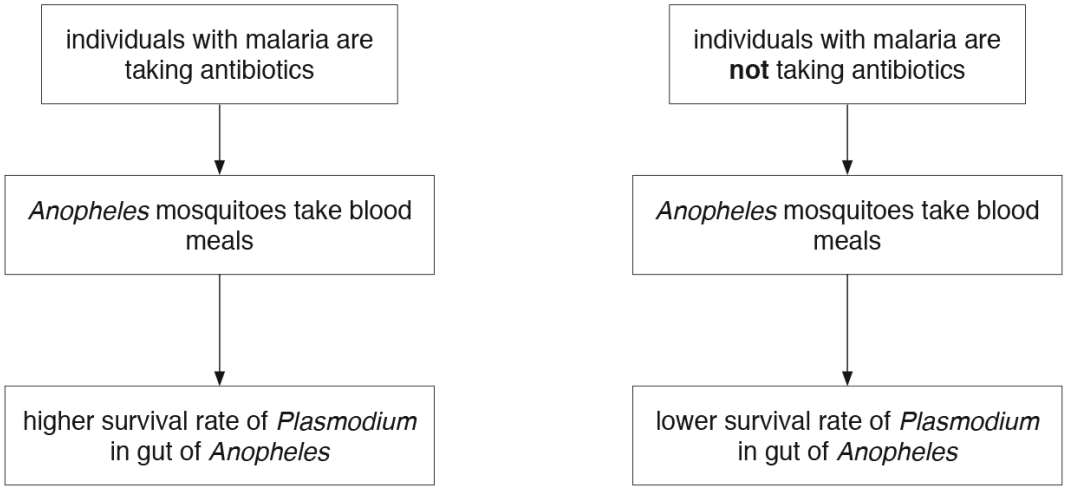


Fig. 5.1

Suggest explanations for the results shown in Fig. 5.1 **and** comment on the importance of these results for doctors working in countries that have malaria and a high number of bacterial infections.

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..... [3]

(e) After many years of intense research and development, WHO reported in 2016 that a pilot vaccination programme would be trialled between 2017 and 2020.

The programme uses a vaccine acting against the most widespread species of *Plasmodium*.

Explain the difficulties faced by researchers in developing a malaria vaccine.

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..... [4]

[Total: 12]

223. 9700_w19_qp_23 Q: 5

Influenza is an infectious disease caused by the influenza A virus. This virus causes influenza in birds and mammals.

Fig. 5.1 is a diagram of an influenza A virus.

Haemagglutinin allows the virus to attach to host cells by binding to receptors on the cell surface membrane of the host cells.

Neuraminidase is an enzyme that helps the virus to leave host cells after the virus has replicated.

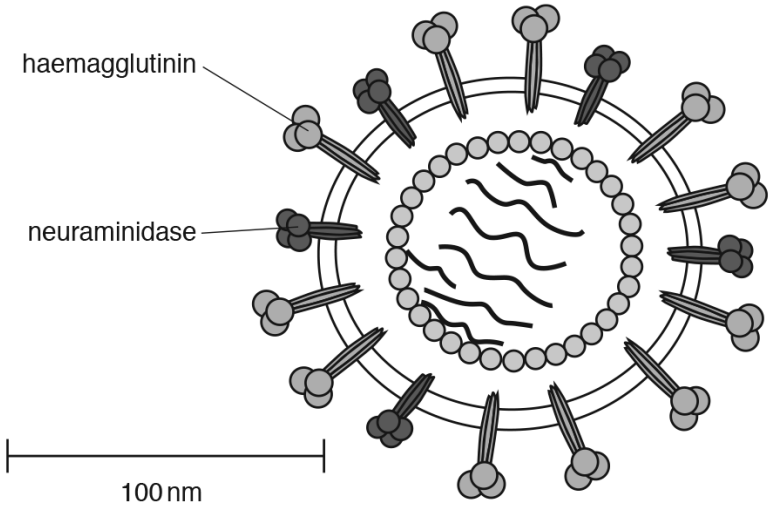


Fig. 5.1

(a) State **two** features of all viruses that are visible in Fig. 5.1.

1 .....

2 .....
[2]

(b) Neuraminidase removes parts of the host cell receptors that bind to haemagglutinin. This helps newly-formed viruses to leave host cells.

Drugs have been developed to act on neuraminidase. These drugs prevent viruses from leaving host cells.

Suggest **and** explain how these drugs act to prevent viruses leaving cells.

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..... [3]

(c) The human immune system produces antibodies in response to the presence of antigens, such as neuraminidase and haemagglutinin.

Outline the events that occur during an immune response leading to the production of antibodies against an antigen, such as haemagglutinin.

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..... [4]

(d) Researchers are developing methods to produce antibodies to give artificial passive immunity to influenza.

(i) Suggest the advantages **and** disadvantages of artificial passive immunity.

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..... [3]

(ii) State **two** ways in which mammals can acquire **natural** passive immunity to infectious diseases, such as influenza.

1 .....

2 .....
[2]

[Total: 14]

224. 9700_s18_qp_22 Q: 6

Enzyme inhibitors and monoclonal antibodies can be used in the treatment of disease.

(a) Mevinolin is an enzyme inhibitor that can be prescribed as a drug to reduce the concentration of cholesterol in blood plasma.

High concentrations of cholesterol in the blood have been linked to an increased risk of cardiovascular disease.

Mevinolin acts as a competitive inhibitor of the enzyme HMG CoA reductase. This enzyme catalyses one of the first steps in the synthesis of cholesterol, as shown in Fig. 6.1.

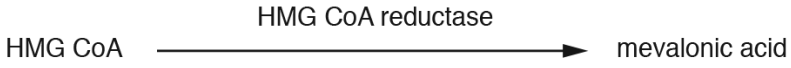


Fig. 6.1

Explain how mevinolin inhibits the enzyme HMG CoA reductase.

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.....[3]

(b) Outline the use of monoclonal antibodies in the treatment of disease.

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.....[2]

[Total: 5]

225. 9700_s18_qp_23 Q: 3

Nerium oleander is a xerophytic plant. A photomicrograph of a section through the leaf of *N. oleander* is shown in Fig. 3.1.

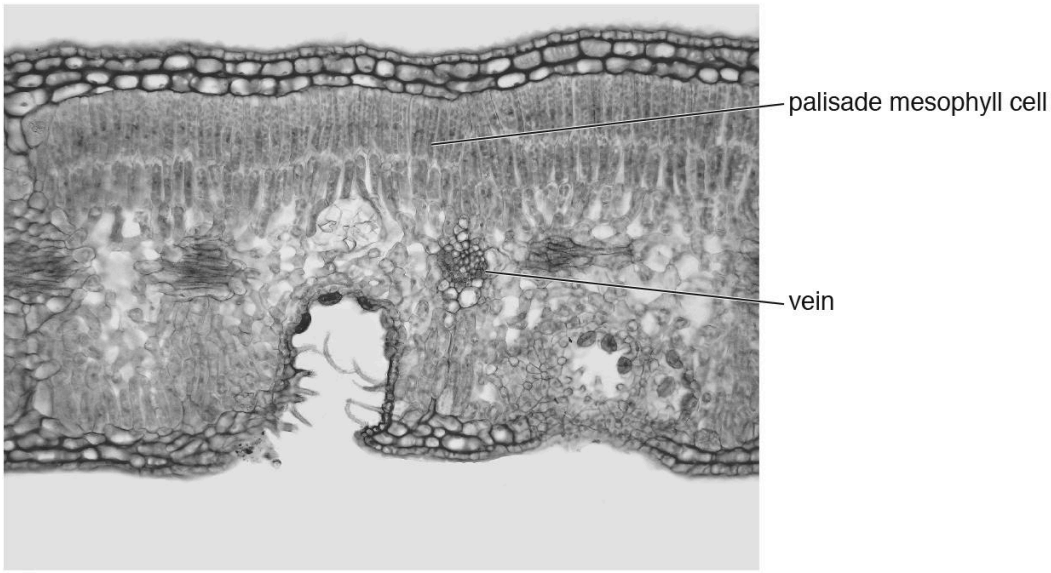


Fig. 3.1

(a) The leaf shown in Fig. 3.1 has a number of adaptations to reduce water loss by transpiration. Two of these adaptations are:

- a multilayered epidermis
- stomata only found in depressions, known as stomatal crypts, on the lower surface of the leaf.

Explain how a multilayered epidermis **and** stomatal crypts will help to reduce water loss in *N. oleander*.

multilayered epidermis .....

.....

.....

.....

stomatal crypts .....

.....

.....

.....[3]

Sucrose, amino acids and other assimilates synthesised in palisade mesophyll cells of *N. oleander* pass to the vein, where they can be transported within specialised cells from the source to the sink.

(b) Name the cells specialised for the transport of assimilates in *N. oleander.*

.....[1]

(c) Explain the difference between a source and a sink.

.....

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.....[2]

One of the enzymes involved in the synthesis of sucrose in the cytoplasm of palisade mesophyll cells is known as cyFBPase. The gene coding for this enzyme is *cyFBP*.

The importance of cyFBPase in plant growth can be investigated using plants with a mutation in gene *cyFBP*. These plants cannot synthesise cyFBPase.

(d) **(i)** State what is meant by a gene mutation.

.....

.....[1]

(ii) Suggest **one** way in which the mutation of *cyFBP* prevents the synthesis of cyFBPase.

.....

.....

.....[1]

(e) Monoclonal antibody can be produced that is specific to cyFBPase. This antibody is used by investigators to check that the plants with the *cyFBP* mutation do not synthesise this enzyme.

(i) In monoclonal antibody production, a small mammal is inoculated with cyFBPase and several weeks later cells are removed from the spleen. Some of these cells are required for the production process.

Describe the events occurring within the body of the small mammal that lead to the formation of the cells needed for monoclonal antibody production.

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.....[4]

(ii) Anti-cyFBPase monoclonal antibody is added to extracts taken from the leaves of the plants with the *cyFBP* mutation.

State the expected results following addition of the monoclonal antibody that would confirm the **absence** of cyFBPase in the leaf extracts.

.....

.....[1]

(f) Investigations have shown that plants with the *cyFBP* mutation grow to a much smaller height and have proportionately far less starch stored in their roots than normal plants.

Suggest why plants with the *cyFBP* mutation will store less starch in their roots.

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.....[2]

[Total: 15]

226. 9700_w18_qp_21 Q: 1

Fig. 1.1 shows the human gas exchange system.

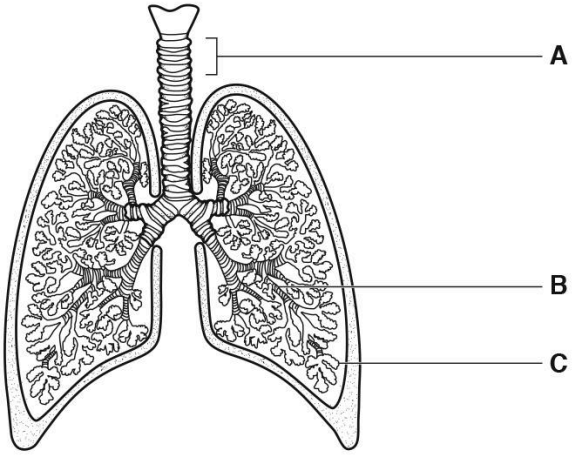


Fig. 1.1

(a) Name the structures labelled **A**, **B**, and **C** in Fig. 1.1.

A .....

B .....

C ..... [3]

(b) Name a **non-infectious** disease that affects the human gas exchange system.

..... [1]

(c) Malaria is an infectious disease.

Name the pathogen that causes malaria.

..... [1]

(d) There are a number of vaccines being developed to help control the spread of malaria.

Explain why vaccination programmes have **not** been able to eradicate malaria.

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..... [3]

(e) Fig. 1.2 shows the distribution of malaria in the Americas in 2012.



Fig. 1.2

Suggest the factors, **other than** lack of vaccines, that could be restricting the distribution of malaria to area **P**.

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..... [4]

[Total: 12]

227. 9700_w18_qp_21 Q: 4

Fig. 4.1 is a photomicrograph of a cross-section of a tubular structure in the kidney made from epithelial cells.

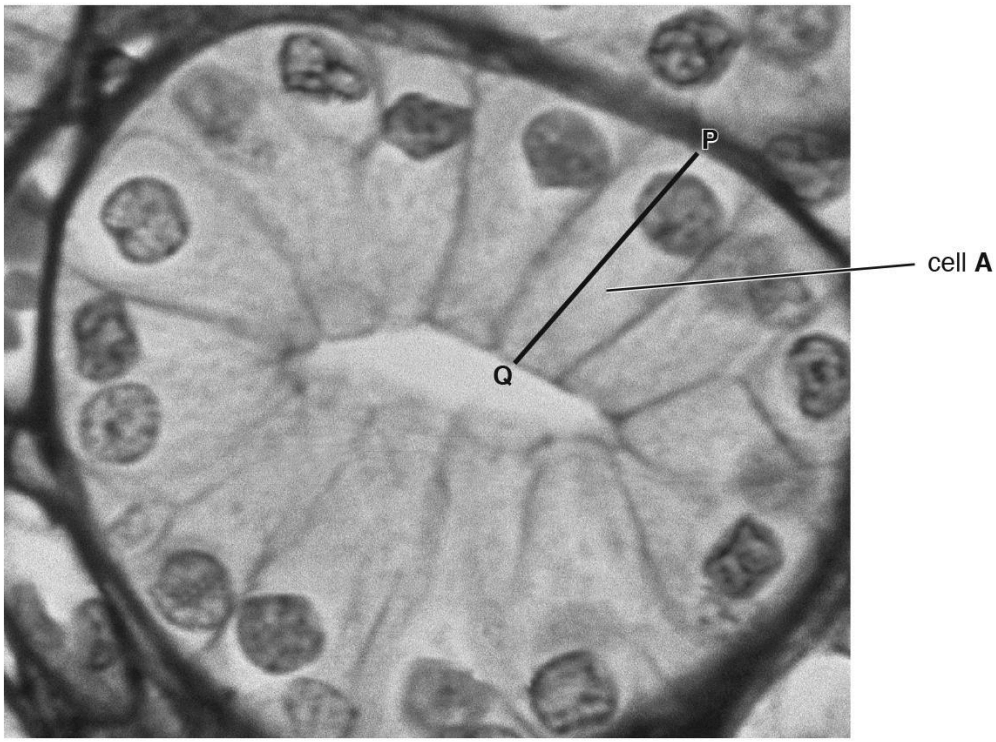


Fig. 4.1

(a) The actual length of epithelial cell **A** along the line **P–Q** is 35 μm.

Calculate the magnification of the image shown in Fig. 4.1. Write down the formula and use it to make your calculation. Show your working.

formula

magnification × ..... [2]

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(b) Some epithelial cells in the kidney release the protein vascular endothelial growth factor (VEGF). This protein is a cell signalling molecule that stimulates cell division in endothelial cells in blood vessels.

(i) State what occurs during interphase to prepare a cell for division.

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..... [2]

(ii) Explain how a cell signalling molecule, such as VEGF, can lead to a response in a cell.

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..... [2]

(c) Uncontrolled cell division may result in a tumour. Tumour cells in the kidney respond to VEGF.

Kidney cancer can be treated with monoclonal antibodies. These monoclonal antibodies bind to VEGF.

Outline the hybridoma method for the production of monoclonal antibodies that will target the VEGF protein.

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..... [4]

(d) Monoclonal antibodies used as a treatment need to be given more than once. Repeated treatment can cause side effects to the person or can become less effective.

Suggest why repeated treatment with monoclonal antibodies may have these effects.

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..... [1]

[Total: 11]

228. 9700_w18_qp_22 Q: 4

Viruses share common structural features. Some viruses, such as human immunodeficiency virus (HIV), also have an outer envelope as part of their structure.

(a) Outline the key structural features of viruses.

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..... [3]

HIV can remain in a dormant state within infected immune system cells for many years. A person diagnosed as HIV-positive (HIV+) has the virus but does not have symptoms of HIV/AIDS.

The chances of an HIV+ person developing HIV/AIDS can be greatly reduced with a drug treatment programme known as anti-retroviral therapy (ART).

(b) In 2010, the World Health Organization (WHO) published recommendations for the treatment of pregnant women living with HIV. This includes both HIV+ women and women who have developed HIV/AIDS.

The publication recommended that **all** pregnant and breastfeeding women living with HIV should be provided with ART.

Fig. 4.1 shows the number of pregnant women living with HIV, and the number of these receiving ART, between 2005 and 2013, in low and middle income countries.

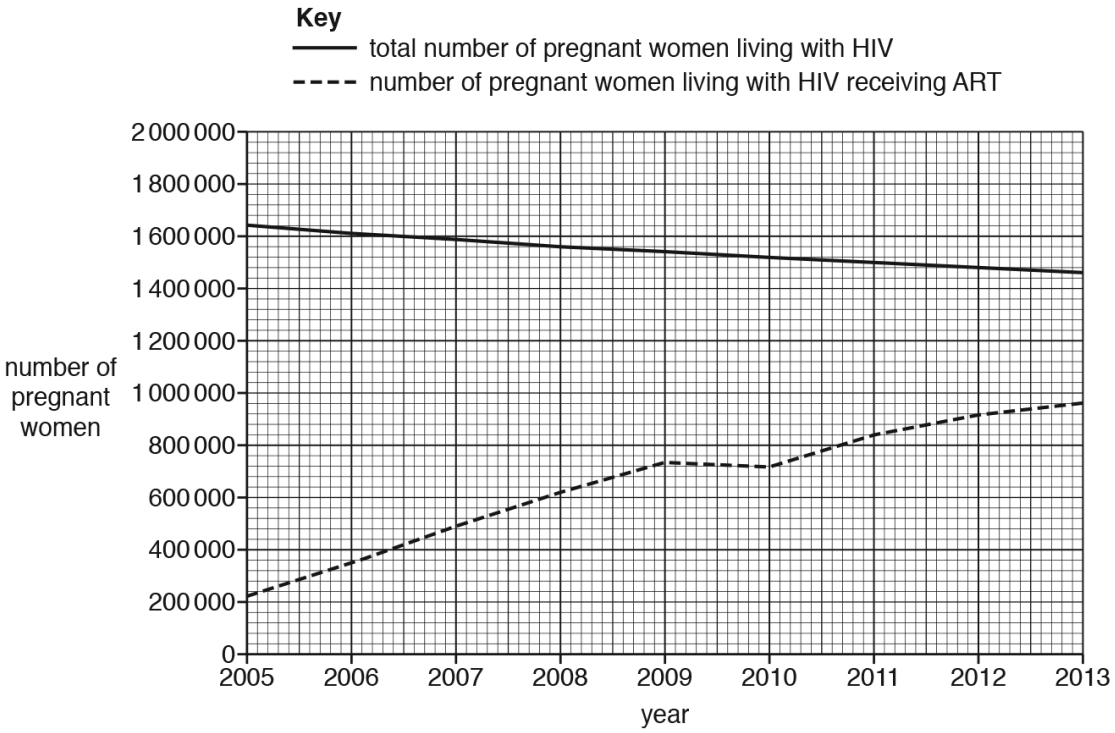


Fig. 4.1

(i) From the data in Fig. 4.1, it can be calculated that 13% of pregnant women living with HIV received ART in 2005.

Calculate the percentage of pregnant women living with HIV that received ART in 2013.

answer = ... % [1]

(ii) Describe the trends shown in Fig. 4.1.

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..... [3]

(iii) Suggest **and** explain the global importance of providing ART to all pregnant and breastfeeding women living with HIV.

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..... [3]

(c) In a person who has been infected with HIV-1, the most common strain of HIV, a sample of blood can be tested for the presence of the virus.
One test that can only be used in the early stages of infection involves a monoclonal antibody specific for p24, a structural protein present in the virus.

Fig. 4.2 is a flow chart outlining the steps in the production of anti-HIV p24 monoclonal antibody.

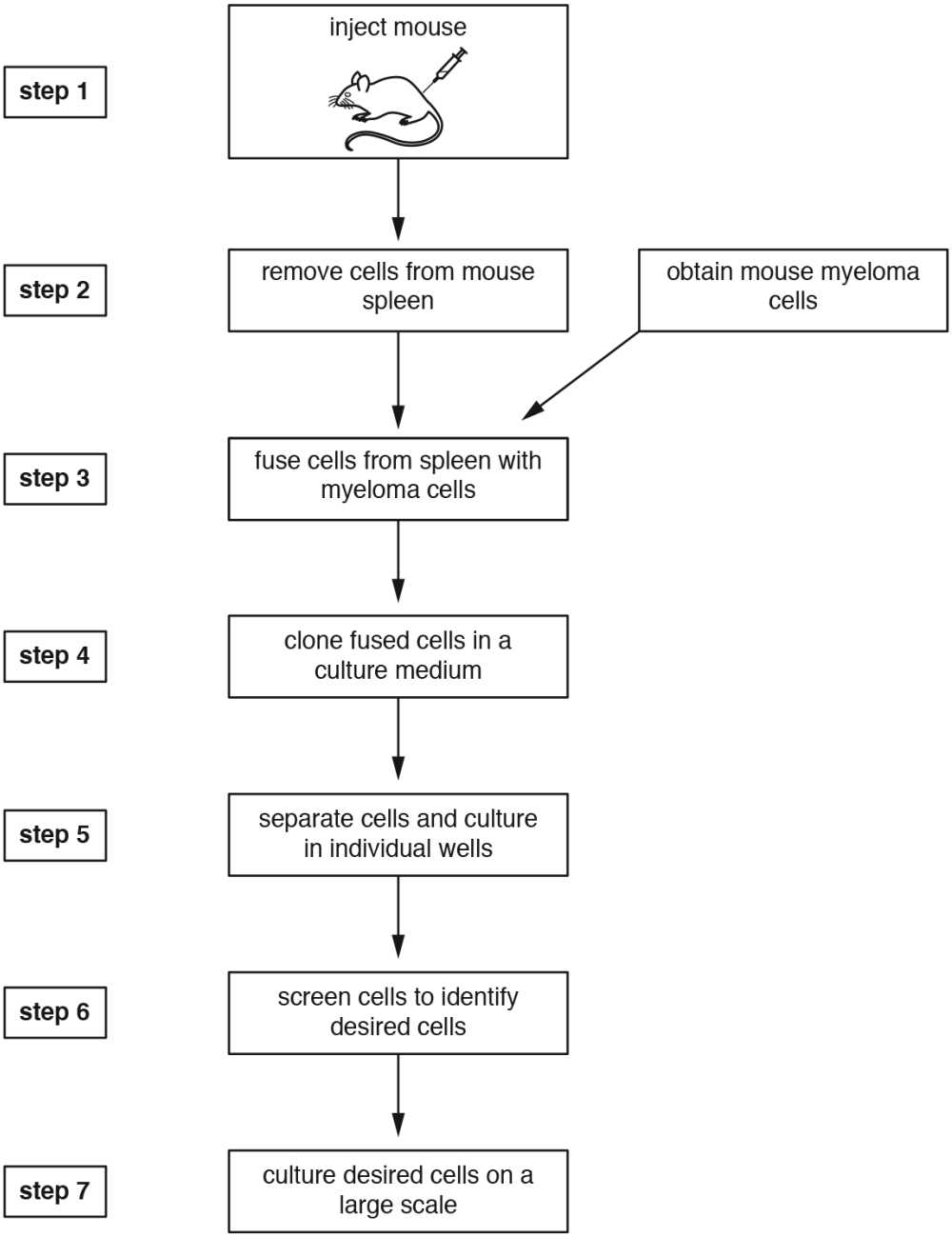


Fig. 4.2

(i) State what is being injected into the mouse in **step 1**.

..... [1]

(ii) Explain why several weeks, rather than several days, separates **step 1** and **step 2**.

.....

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..... [1]

(iii) State **one** feature of the myeloma mouse cells, used in **step 3**, that is essential for this production process.

.....

.....

..... [1]

(iv) Name the fused cells formed in **step 4**.

..... [1]

(v) Suggest why **step 6** is necessary.

.....

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..... [1]

[Total: 15]

229. 9700_w18_qp_23 Q: 6

(a) As part of a study of the mitotic cell cycle, a student made stained sections of a root tip of onion, *Allium cepa*, and observed them with a light microscope.

The student made drawings of six of the cells, **A** to **F**, using the high power of the microscope, as shown in Fig. 6.1.

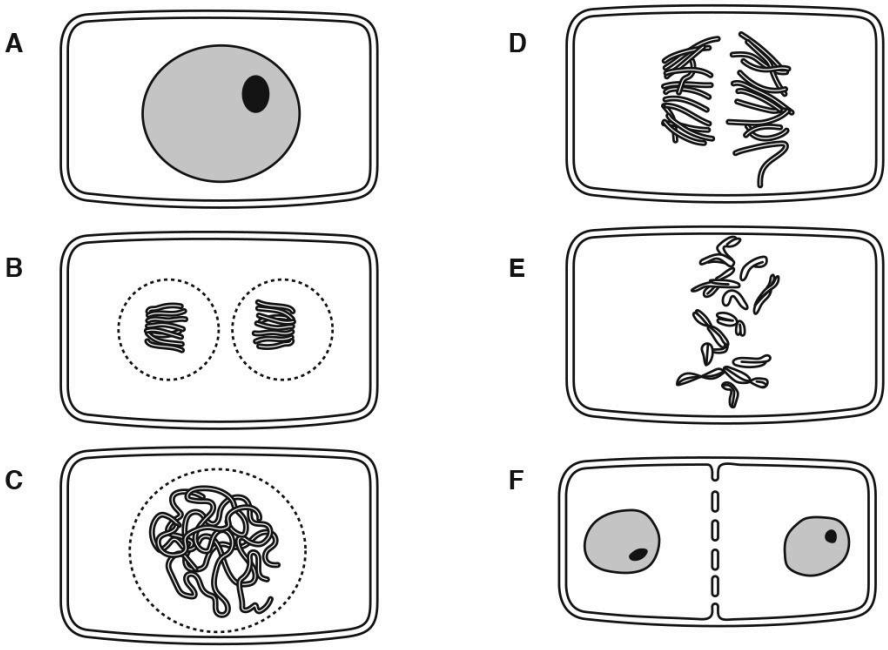


Fig. 6.1

(i) Complete Table 6.1 to show the sequence of stages in the mitotic cell cycle, using the letters, **A** to **F**, as shown in Fig. 6.1.

Table 6.1

sequence of stages	cell
1	**A**
2	
3	
4	
5	
6	

[1]

(ii) Table 6.2 shows some events that occur during the mitotic cell cycle in *A. cepa*.

Complete Table 6.2 by naming the stage of the cell cycle when each event occurs.

Table 6.2

event in the cell cycle	name of the stage in the cell cycle
DNA replication	
division of centromeres	
condensation of chromatin	
contraction of spindle fibres	
organisation of chromosomes at the equator	metaphase

[4]

(b) Explain the importance of mitosis in the immune response.

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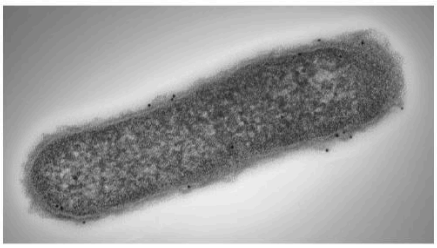
..... [3]

[Total: 8]

230. 9700_m17_qp_22 Q: 2

The infectious disease cholera is caused by a bacterium.

(a) Fig. 2.1 shows a transmission electron micrograph of this bacterium.



×30 000

Fig. 2.1

(i) Name the bacterium that causes cholera.

..... [1]

(ii) The bacterium in Fig. 2.1 is an example of a prokaryotic cell.

Each of the descriptions **A** to **C** describes a cell structure found in prokaryotic cells **and** in plant cells.

For each of the descriptions **A** to **C**:

- name the cell structure described
- state **one** difference in this structure between a prokaryotic cell and a plant cell.

A the site of polypeptide synthesis

cell structure .....

difference .....

.....

B the genetic material of the cell

cell structure .....

difference .....

.....

C the structure that provides a rigid shape to the cell and prevents osmotic lysis

cell structure .....

difference .....

.....

[6]

(b) Cholera is an example of an infectious disease.

Explain what is meant by an infectious disease.

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..... [2]

The symptoms of cholera are caused by choleragen, a toxin released by the bacterium.

Choleragen is a protein made up of six polypeptides:

- a single copy of a polypeptide known as the A subunit that includes an extended alpha helix
- five polypeptides that together make the B subunit.

The B subunit of choleragen binds to a cell surface membrane component, known as GM1, of an intestinal epithelial cell. The complete choleragen protein then enters the cell by endocytosis. Once inside the cell, the A subunit of the protein acts as an enzyme, disrupting the normal functioning of the cell.

(c) List the levels of protein structure present in choleragen.

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..... [2]

(d) Outline the mechanism by which choleragen enters the cell.

You may use the space for annotated diagrams.

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..... [3]

(e) Using genetic engineering, it is possible to produce a form of choleragen consisting of only subunit B. This can be combined with inactivated bacterial cells to produce a vaccine against cholera.

(i) Suggest why subunit B, rather than subunit A, is used in the vaccine.

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..... [1]

(ii) Outline how this vaccine can give protection against cholera.

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..... [5]

[Total: 20]

231. 9700_s17_qp_21 Q: 3

Fig. 3.1 is a diagram that shows the structure of an antibody molecule.

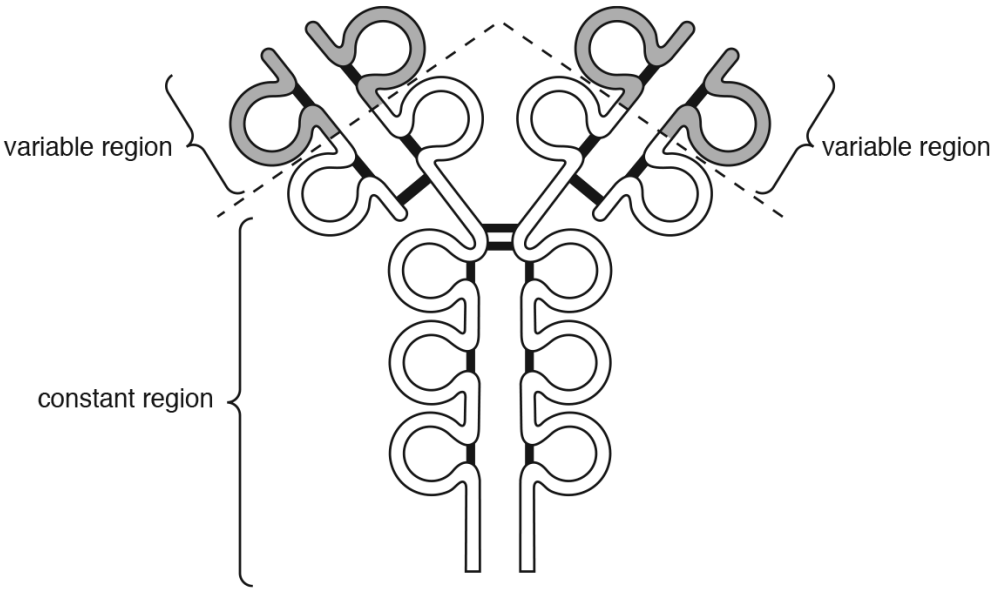


Fig. 3.1

(a) State why the antibody molecule shown in Fig. 3.1 has quaternary structure.

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.....[1]

(b) **(i)** Use Fig. 3.1 to explain how the structure of the variable region of an antibody molecule is related to its function.

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.....[3]

(ii) State the role of the constant region of an antibody.

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.....[1]

(c) Monoclonal antibodies are used both in diagnosis and in treatment of disease.

(i) Outline how monoclonal antibodies are produced.

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.....[4]

(ii) Suggest the advantages of using monoclonal antibodies in diagnosis of disease.

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.....[2]

[Total: 11]

232. 9700_w17_qp_21 Q: 3

Cells of the immune system function to protect the body against infectious diseases.

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

.....[1]

(ii) The virus that causes the infectious disease influenza has two antigens, **H** and **N**. Antibodies are produced in response to an infection by this virus. The antibodies are specific for either antigen **H** or for antigen **N**.

Describe how the structure of an antibody molecule allows it to be specific for **one** antigen, such as **H** or **N**.

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.....[3]

(b) Cholera is a disease caused by a bacterial pathogen.

(i) Name the pathogen that causes cholera.

.....[1]

(ii) Describe how the pathogen that causes cholera is transmitted.

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.....

.....[2]

(c) Viruses that infect bacteria are called bacteriophages. Some bacteriophages that infect the cholera pathogen cause lysis of the bacterium.

(i) Suggest what happens to the structure of a bacterial cell to cause lysis.

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.....[2]

(ii) Some scientists believe that bacteriophages could be used to treat people who are infected with cholera.

Suggest the properties of the bacteriophages that would make this possible.

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.....[2]

(iii) Antibiotics can be used to treat people with cholera.

State why antibiotics are **not** effective against measles.

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.....[1]

[Total: 12]