This is a Class 1 exam

Lebanon Evangelical School
for Boys and Girls
Loueizeh - Baabda

Stage Exam 02

08DEC2023

Do NOT write in this box. Your MARK will be placed here.

Subject :	A Level : Biology 2
Class :	12A
Teacher :	Miss Rahmeh Hilal
Duration :	2 hours

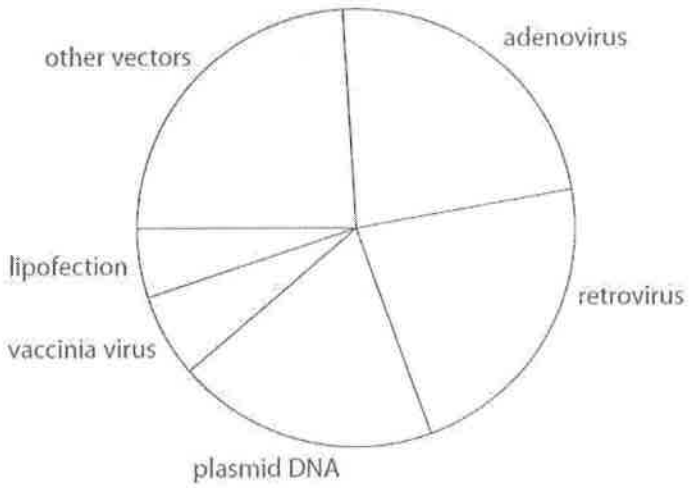
Your name :		*Time taken to complete exam*
Your Class :		
Exam Room :		
How many sheets, including cover sheet :		

- Do not open this paper until the teacher in charge instructs you to do so.
- The most important thing to remember in taking an exam is NEVER PANIC.
- If you are caught cheating in this exam, you will be awarded zero for ALL exams that are taken on this day.

Q1.

Viruses can be used as vectors in gene therapy.

The pie chart below shows the proportion of different vectors used in clinical trials for gene therapy.



(a) Retroviruses include Human Immunodeficiency Virus (HIV).

Describe the structure of HIV.

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(b) Explain why viruses are used as vectors in gene therapy.

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(Total for question = 4 marks)

Q2.

Feline panleukopenia virus (FPV) is a DNA virus. This virus infects cats and can be fatal.

(a) Most DNA viruses can activate DNA synthesis in their host cells but FPV cannot activate DNA synthesis.

Explain why FPV causes tissue damage only in host cells that are dividing rapidly.

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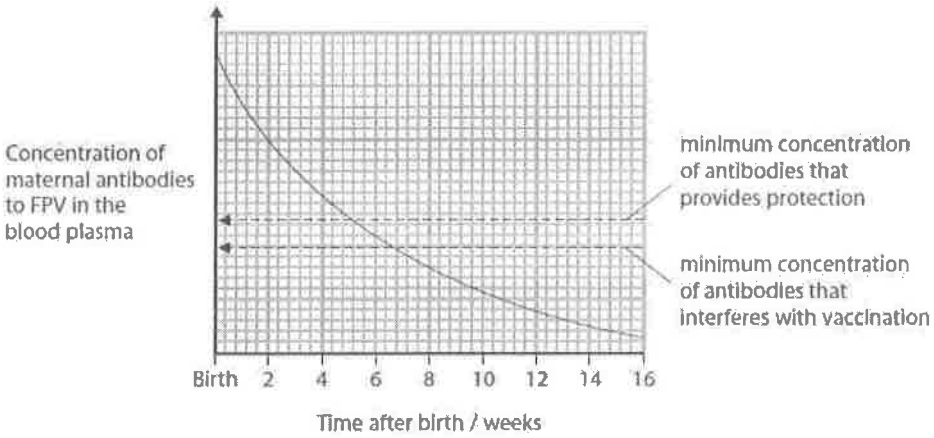
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(b) Kittens are born with maternal antibodies to FPV.

Maternal antibodies protect kittens from FPV only when these antibodies are above a certain concentration in the blood plasma.
It is therefore necessary to vaccinate kittens for FPV.
The presence of maternal antibodies, above a certain concentration in the blood plasma, can interfere with vaccination.
The graph below shows the changes in maternal antibodies to FPV in kittens.



(i) Put a cross (☒) in the box next to the type of immunity that maternal antibodies provide to the kittens.

(1)

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

(ii) Using the information in the graph, give the period of time after birth when the kittens will be most susceptible to FPV infection.

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(iii) Explain how vaccination leads to immunity of kittens to FPV.

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(iv) Suggest how the presence of maternal antibodies can interfere with vaccination.

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(Total for question = 10 marks)

Q3.

Cultures of bacteria and viruses can both be grown in a laboratory.

(a) Describe **one** way in which bacteria can be grown in a laboratory.

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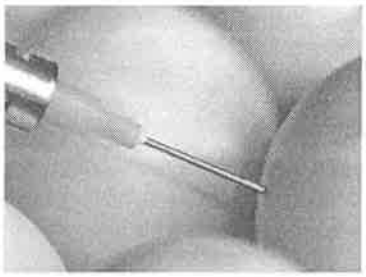
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(b) One way to culture viruses in a laboratory is to inject them into chicken embryos in eggs.

The photograph below shows an egg being injected with viruses.



www.alamy.com

Magnification ×2

(i) Name **two** structures found in all viruses.

(2)

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(ii) Explain why viruses have to be cultured in living cells.

(2)

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(iii) Put a cross ☒ in the box that names the host cell of Human Immunodeficiency Virus (HIV).

(1)

☐ **A** B memory cell
☐ **B** plasma cell
☐ **C** T helper cell
☐ **D** T killer cell

(iv) Suggest why different types of virus have to be injected into different parts of the chicken embryo.

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(Total for question = 10 marks)

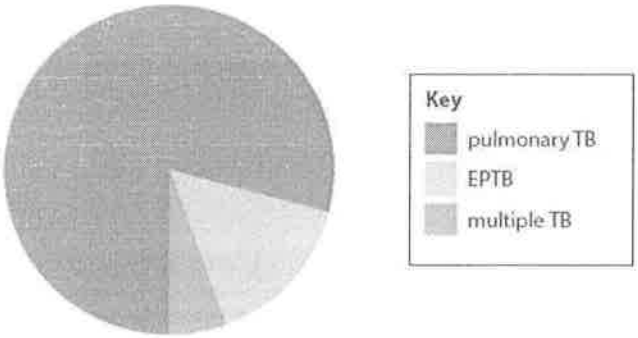
Q4.

Mycobacterium tuberculosis causes the disease tuberculosis (TB).

The table below shows one way of classifying TB.

Type of TB	Description of where the disease affects
pulmonary	lungs only
extra-pulmonary (EPTB)	organs other than the lungs
multiple	lungs and then at least one other organ

(a) The pie chart below shows the incidence of these three types of TB in one population of people.



Using the information in the pie chart, compare the incidence of these three types of TB.

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(b) (i) Explain the proportion of people with pulmonary TB.

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(ii) Explain the sequence of symptoms that may result in death from pulmonary TB.

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(c) Suggest how multiple TB occurs and results in death.

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(Total for question = 11 marks)

Q5.

Bacitracin is an antibiotic. It is one of a group of polypeptide antibiotics.

Bacitracin is effective against many types of bacteria, especially those that cause skin infections.

(a) Antibiotics affect bacteria.

(i) Below are some statements about bacteria.

1 Bacteria are eukaryotic organisms

2 Bacteria contain ribosomes

3 Bacteria have cellulose cell walls

4 Bacteria contain DNA and RNA

Place a cross ☒ in the box next to the correct pair of statements about bacteria.

(1)

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

(ii) Place a cross ☒ in the box next to the correct description of how antibiotics work.

(1)

☐ **A** antibiotics activate B cells
☐ **B** antibiotics join several bacteria together
☐ **C** antibiotics kill or prevent the growth of bacteria
☐ **D** antibiotics stimulate phagocytosis by macrophages

(b) Suggest how bacitracin is given to a patient with a skin infection.

Give a reason for your answer.

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(c) State **two** ways in which hospital codes of practice have influenced the prescription of antibiotics.

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(Total for question = 6 marks)

Q6.

Gut flora help to protect the body from infection.

(a) Explain the meaning of the term **infection**.

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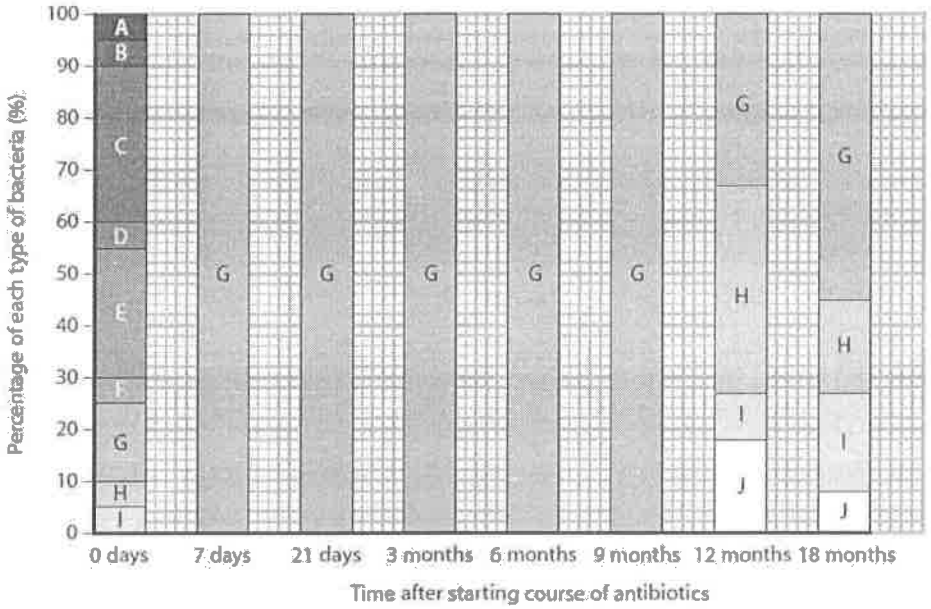
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(b) The diversity of the gut flora of a person was recorded. This person then took a course of antibiotics for seven days.

The percentage of each type of bacteria in the gut flora was recorded for a period of 18 months. Each type of bacteria is represented by a different letter in the chart below.



(i) Explain the meaning of the term **antibiotic**.

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*(ii) Using the information in the graph, describe the effect of this course of antibiotics on the diversity of gut flora. Suggest explanations for this effect.

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(Total for question = 10 marks)

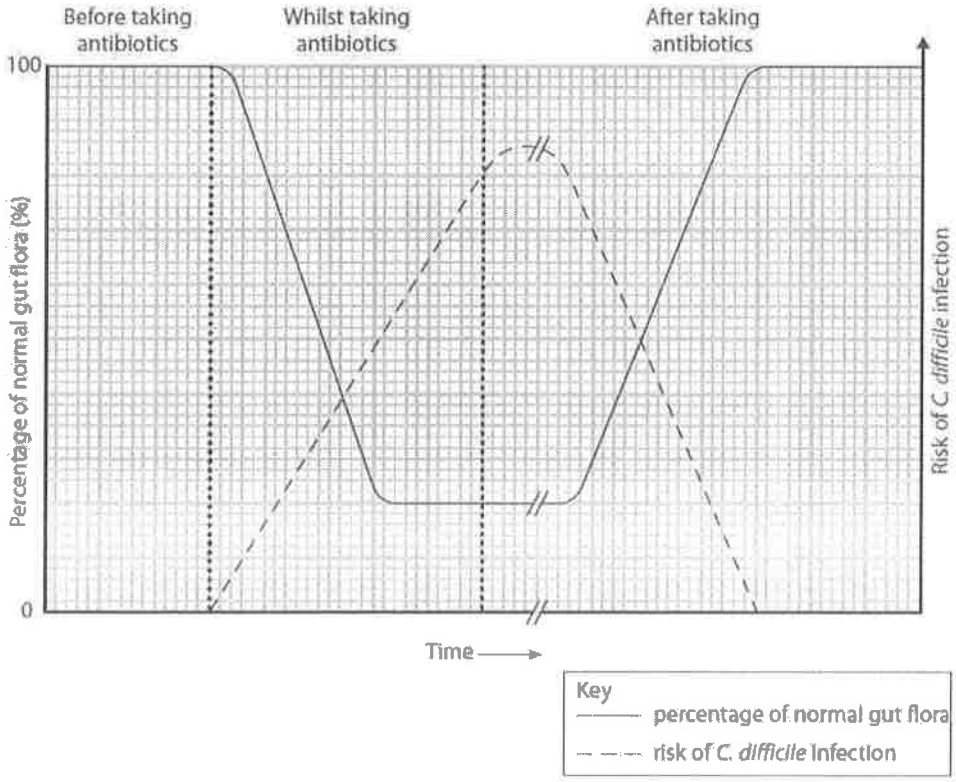
Q7.

Clostridium difficile (*C. difficile*) is a bacterium that is present in the gut flora of the human digestive system.

This bacterium does not cause any problems in healthy people.

People taking antibiotics are at risk of developing *C. difficile* infections.

The graph below shows the proportion of gut flora before, during and after taking antibiotics. The graph also shows the risk of *C. difficile* infection.



(a) Explain how gut flora protect the body from infection.

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(b) Using the information in the graph, explain why people taking antibiotics are at risk of developing *C. difficile* infections.

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(c) Some types of *C. difficile* are resistant to antibiotics.

Whilst the antibiotic is being taken, resistant *C. difficile* have an advantage over non-resistant *C. difficile*.
When the antibiotic is no longer being taken, the resistant *C. difficile* do not have this advantage.

(i) Explain why resistant *C. difficile* have an advantage whilst taking the antibiotic, but not afterwards.

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(ii) Explain why the development of *C. difficile* infections is an example of an 'evolutionary race'.

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(iii) Describe **two** ways in which codes of practice relating to antibiotic prescription could help to reduce this evolutionary race.

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(d) After taking antibiotics, the gut flora return to 100%.

The time taken for the gut flora to return to 100% is variable. This depends on the type of antibiotic being taken.
Suggest why the time taken for the gut flora to return to 100% depends on the type of antibiotic being taken.

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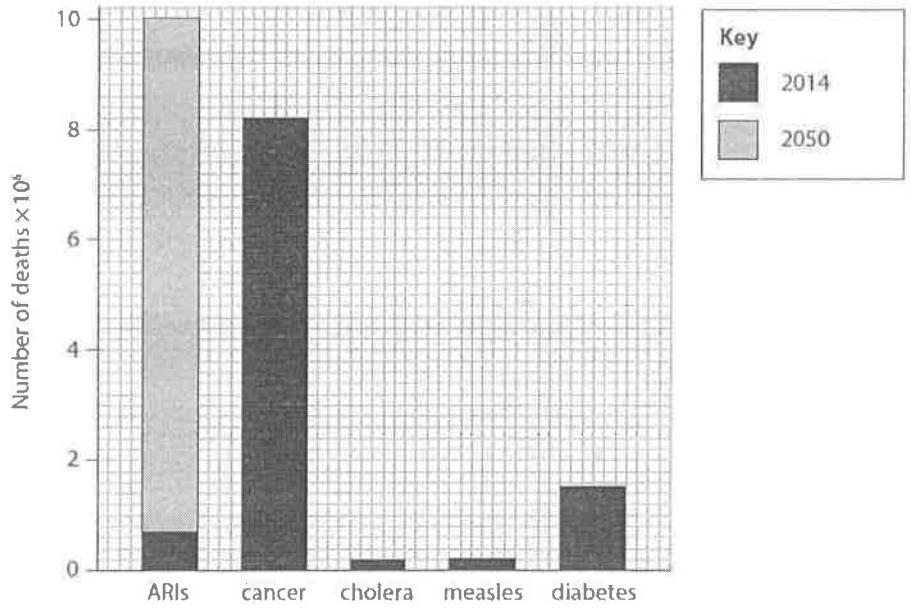
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(Total for question = 13 marks)

Q8.

The graph below shows the number of deaths in 2014 caused by antibiotic resistant infections (ARIs), cancer, cholera, measles and diabetes.

The graph also shows the estimated number of deaths in 2050, caused by ARIs.



(a) Measles is caused by a virus. Cholera is caused by bacteria.

(i) The table below shows some features of a virus and of a bacterium.
For each feature, put one cross (☒) in the appropriate box in each row, to show whether the feature is found in a virus only, a bacterium only, both a virus and a bacterium or not found in either.

(3)

feature	virus only	bacterium only	virus and bacterium	not found in either a virus or a bacterium
contains both DNA and RNA	☐	☐	☐	☐
has cytoplasm	☐	☐	☐	☐
DNA may be single-stranded	☐	☐	☐	☐

(ii) Vaccines produce artificial immunity in people. Vaccines can be used to protect people from measles and cholera.

Vaccines are partly responsible for the low number of deaths from measles and cholera.

Describe how vaccines produce artificial immunity.

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(b) Explain why antibiotics cannot be used to treat people with cancer.

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(c) Explain why the number of deaths from antibiotic resistant infections (ARIs) in 2050 is expected to be so high.

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(Total for question = 12 marks)

Q9.

Sepsis is caused when bacteria get into the bloodstream.

As a result, an inflammatory response occurs that can destroy body organs and result in death.

(a) Explain how inflammation is a response of the body to infection.

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(b) Sepsis is treated with antibiotics. However, scientists are developing alternative treatments.

(i) Explain the meaning of the term **antibiotic**.

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(ii) Explain why scientists need to develop alternative treatments for bacterial infections.

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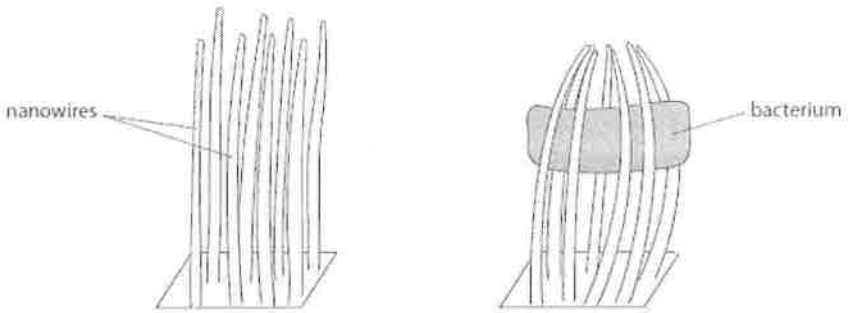
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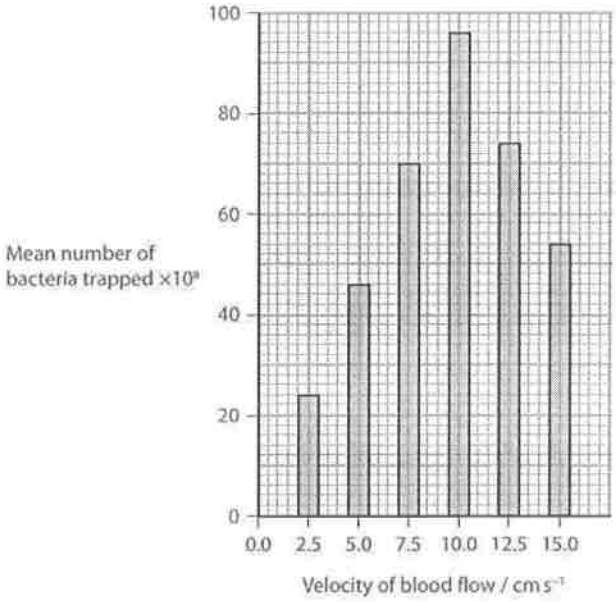
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(c) One alternative treatment that is being developed uses nanowires.

Nanowires are small lengths of wire with a very narrow diameter.
Blood is passed through a filter of nanowires.
Nanowires bend around the bacteria as they pass through the filter, trapping the bacteria.
The diagram below shows part of a filter of nanowires and a bacterium trapped by the nanowires.



The graph below shows the mean number of bacteria trapped as blood is passed through the filter of nanowires, at different velocities.



(i) Describe the relationship shown in the graph.

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(ii) Suggest why the velocity of blood flow through the filter affects the mean number of bacteria trapped.

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(Total for question = 10 marks)

Q10.

Individuals can develop natural immunity and artificial immunity.

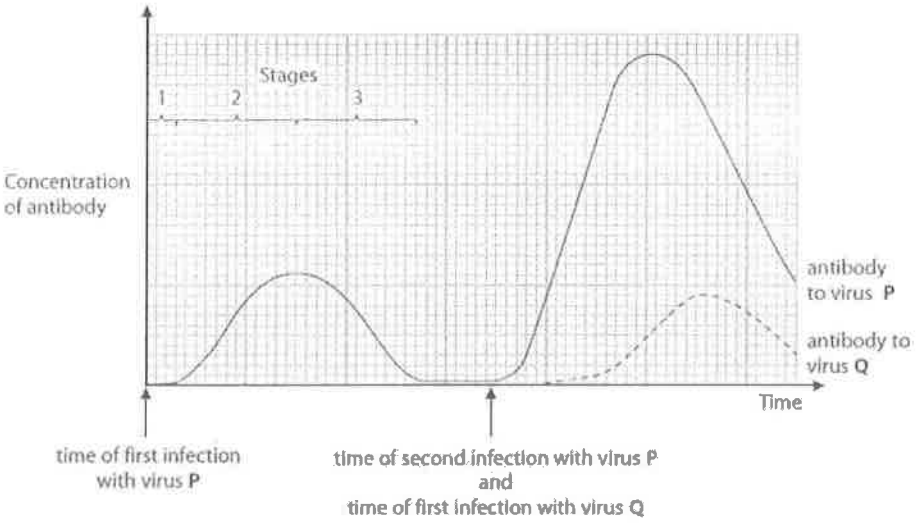
(a) The table below shows some features of artificial active immunity and artificial passive immunity.

For each feature, put one cross (☒) in the appropriate box in each row to show whether the feature is true for each type of artificial immunity.

(3)

Feature	Artificial immunity			
	active only	passive only	both active and passive	not true
antigen-specific	☐	☐	☐	☐
provides long-term immunity	☐	☐	☐	☐
antibodies injected	☐	☐	☐	☐

(b) The graph below shows the changes in concentration of antibodies in the blood of a person infected by two different types of virus, virus **P** and virus **Q**.



(i) Explain why there is a delay in the concentration of antibody following the **first** infection of virus **P**, in stage 1.

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(ii) Suggest why the concentration of the antibody to virus **P** falls in stage 3.

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(iii) Describe the differences in the changes in the concentration of both antibodies following the second infection with virus **P** and the first infection with virus **Q**.

(2)

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(iv) Explain the differences in the changes in the concentration of both antibodies following the second infection with virus **P** and the first infection with virus **Q**.

(3)

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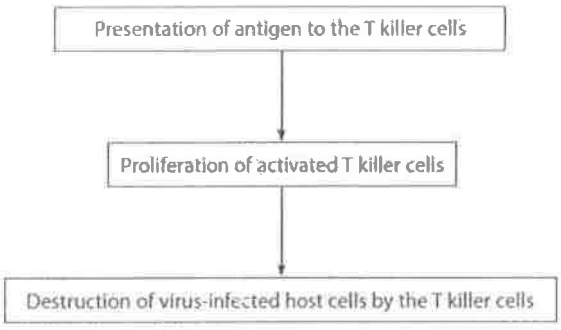
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(Total for question = 13 marks)

Q11.

Virus-infected host cells are destroyed by T killer cells.

(a) The flow chart below shows some of the steps that occur in this process.



(i) Put a cross (☒) in the box next to the name of the antigen-presenting cell involved in the activation of T killer cells.

(1)

- ☐ **A** B cell
- ☐ **B** plasma cell
- ☐ **C** T helper cell
- ☐ **D** virus-infected host cell

(ii) Explain the importance of mitosis in the proliferation of activated T killer cells.

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(b) Macrophages are involved in the immune response against virus infections.

(i) Describe the role of macrophages in the activation of T killer cells.

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(ii) Describe the role of macrophages in the destruction of viruses.

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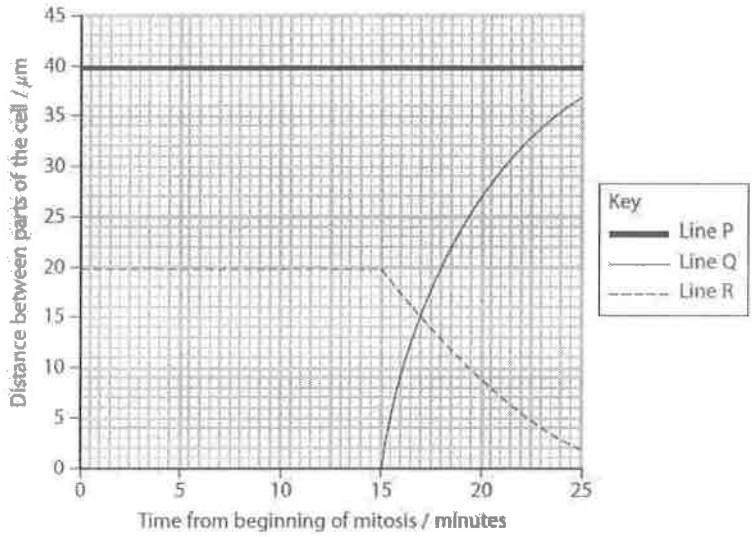
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(c) Mitosis takes place during the proliferation of T killer cells. EXTRA – ONLY SOLVE IF YOU HAVE TIME

The graph below shows the changes in distance that occur between the parts of the cell during mitosis.



(i) Complete the table to identify which line represents the distances between parts of the cell.

(2)

Distance between	Line
Two poles of the cell	
A chromosome and a pole	
Two identical chromosomes	

(ii) Put a cross (☒) in the box next to the time at which anaphase begins.

(1)

☒ **A** 0 minutes
☒ **B** 15 minutes
☒ **C** 17 minutes
☒ **D** 25 minutes

(Total for question = 8 marks)

Q1.

Question Number	Answer	Additional Guidance	Mark
(a)(i)	1. has (two single stranded molecules of) RNA ; 2. protein coat / capsid ; 3. has an envelope ; 4. has {reverse transcriptase / integrase} ; 5. has {glycoproteins / gp 120 / gp 41} ;	**1 DO NOT ACCEPT** DNA **3 ACCEPT** lipid layer **5 ACCEPT** any other appropriately named molecule	(2)
(b)(i)	1. idea that viruses {attach to / target / eq} (specific) cells ; 2. {nucleic acid / DNA / RNA / genes / genetic material} enters the cell / eq ; 3. idea that viruses are hollow so can carry the genes ;	**1 ACCEPT** tissues **2 ACCEPT** virus {enters / infects} cell	(2)

Q2.

Question Number	Answer	Additional Guidance	Mark
(a)	1. idea that the viral DNA will be replicated (only) when the cell is {replicating its own DNA / in S phase / eq} ; 2. therefore new viruses will be formed (only) in dividing cells / eq ; 3. idea that tissue damage is caused by the viruses leaving the host cell ;		(2)
(b)(i)	**D** natural passive	***A*** *is incorrect because antibodies from the mother is a natural occurrence and they do not stimulate the immune response* ***B*** *is incorrect because antibodies from the mother is a natural occurrence* ***C*** *is incorrect because antibodies from the mother do not stimulate the immune response*	(1)
(b)(ii)	5.2 to 6.5 weeks after birth ;	**ACCEPT** any pair of values in the range 5 - 7 weeks	(1)

Question Number	Answer	Additional Guidance	Mark
(b)(iii)	1. idea that kittens injected with {(FPV) antigens / attenuated FPV / eq} ; 2. which stimulate the (primary) immune response ; 3. resulting in the formation of (T / B) memory cells ; 4. idea that these memory cells are activated on infection with FPV ; 5. resulting in {higher / faster} production of antibodies (by plasma cells);	**1 IGNORE** dead virus **2 ACCEPT** correct description	(4)
(b)(iv)	1. idea that the (maternal) antibodies will bind to the {antigens / virus} (in the vaccine) ; 2. therefore macrophages will engulf the antigens / eq ; 3. idea that the antigens {cannot bind / will not be available to bind} to the B cells ;	**1 ACCEPT** agglutinate / opsonise **DO NOT ACCEPT** {destroy / kill} the {antigen / virus}	(2)

Q3.

Question Number	Answer	Additional Guidance	Mark
(a)	1. on agar / in a broth / in nutrients / eq ; 2. use of aseptic technique / description of aseptic technique ; 3. incubated at a stated temperature in the range of 25° C to 35°C ; 4. credit another detail of culture conditions needed ;	1 IGNORE grown in a petri dish 2 e.g. sterile equipment, autoclaved media, working by a bunsen burner 4. e.g. appropriate pH, appropriate growth factors, appropriate length of time in the range of 24 hours to 1 week, description of ensuring that conditions are not anaerobic	(3)

Question Number	Answer	Additional Guidance	Mark
(b)(i)	1. protein coat / capsid / capsomeres ; 2. nucleic acid / DNA or RNA / genetic material ;	IGNORE antigens IGNORE comments about the structure of the nucleic acids DO NOT ACCEPT envelope, glycoproteins, enzymes, named enzymes, egs of cell structures	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	1. because they are {not alive / non-living} ; 2. (need to use the host cell) to replicate / for synthesis of genetic material / for protein synthesis / eq ; 3. need to use (host) cell's {enzymes / named enzyme / monomers / named monomer / ribosomes } (to make protein / nucleic acids);	N.B. all points can be accepted in the context of a specific virus 1 **DO NOT ACCEPT** dead 2 **ACCEPT** cannot reproduce without a host cell **DO NOT ACCEPT** to grow	(2)

Question Number	Answer	Mark
(b)(iii)	*C* T helper cell *A is incorrect because the host cell of HIV is the T helper cell* *B is incorrect because the host cell of HIV is the T helper cell* *D is incorrect because the host cell of HIV is the T helper cell*	(1)

Question Number	Answer	Additional Guidance	Mark
(b)(iv)	1. idea that each virus has a {specific / host / target} cell ; 2. each virus has {attachment molecules / receptors / eq} for the host cell ; 3. host cells have (specific) {binding sites / receptors / eq} (that viruses bind to) ;	 2 **IGNORE** antigens 3 **IGNORE** antigens	(2)

Q4.

Question Number	Answer	Additional Guidance	Mark
(a)	1. pulmonary TB is greater than EPTB which is greater than multiple TB / eq ; 2. credit use of figures to support two types of TB ;	1 **ACCEPT** pulmonary is the highest andmultiple the lowest 2 **ACCEPT** eg PTB 80 – 85% EPTB 10 – 15% MTB 5 – 10 % but smaller than EPTB	**(2)**

Question Number	Answer	Additional Guidance	Mark
(b)(i)	1. because (easier to catch as) (breathed in / airborne disease / eq) ; 2. idea that people with pulmonary TB create aerosols containing TB ;	1 **ACCEPT** spreads in the air / droplet infection 2 **ACCEPT** coughing	**(2)**

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	1. bacteria engulfed by macrophages / eq ; 2. macrophages cannot destroy them / eq ; 3. presence of {plaques / tubercles} (in lungs) / eq ; 4. (persistent) coughing / eq ; 5. which {reduces / destroys / eq} the gas exchange surface ; 6. less oxygen can enter blood / breathing problems / eq ; 7. if brain does not get enough oxygen person will die / opportunistic(lung) infections / eq;	**6 ACCEPT** shortness of breath **7 IGNORE** death due to other organfailure	(4)

Question Number	Answer	Additional Guidance	Mark
(c)	1. coughing can rupture blood vessels (in lungs) / eq ; 2. bacteria {enter / carried in} blood (stream) ; 3. bacteria (become lodged in / infect / eq} other {tissues / organs} ; 4. resulting in {cell / tissue} destruction (in other organs) / eq; 5. resulting in loss of function (and death) ;	**3 IGNORE** lungs **5 ACCEPT** organ failure **IGNORE** lung problems	(3)

Q5.

Question Number	Answer	Additional guidance	Mark
(b)(i)	C 2 and 4		(1)

Question Number	Answer	Additional guidance	Mark
(b)(ii)	C antibiotics kill or prevent the growth of bacteria		(1)

Question Number	Answer	Additional guidance	Mark
(c)	1. ointment / cream / lotion / eq ; 2. can act fast / delivered in high quantities / not broken down in digestive tract / eq ;	**1. ACCEPT** topically **2. ACCEPT** localised / applied directly / produces few side effects / direct contact with bacteria / more effective / will not kill gut flora	(2)

Question Number	Answer	Additional guidance	Mark
(d)	1. idea of using only when necessary ; 2. idea that patients should finish the course ; 3. idea of using narrow {spectrum / range} antibiotics ; 4. idea of not using just in case infection occurs ; 5. idea of using appropriate antibiotic (for the infection) ; 6. idea of rotating the antibiotics ;	**IGNORE** irrelevant suggestions **1. ACCEPT** not using for viral infections **3. DO NOT ACCEPT** use broad spectrum **4. ACCEPT** not using prophylactically	**(2)**

Q6.

Question Number	Answer	Additional Guidance	Mark
(a)(i)	1. reference to {bacteria / virus / pathogen / microorganism } ; 2. idea of being inside {tissues / cells / named tissue / named cell } OR idea of evading {barriers / named barrier eg skin } ;	1 **IGNORE** disease / infection / foreign matter 2 **IGNORE** body **IGNORE** {infects / attaches / harms / attacks} cells	**(2)**

Question Number	Answer	Additional Guidance	Mark
(b)(i)	1. {substance / chemical / molecule} produced by {microorganisms / fungi / bacteria} / eq ; 2. that {kills / inhibits the growth of} (other) {microorganisms / bacteria / pathogens / eq} ;	1 **ACCEPT** artificially produced **IGNORE** drug 2 **DO NOT ACCEPT** viruses	**(2)**

Question Number	Answer	Additional Guidance	Mark
* (b)(ii)	QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence 1. credit a correct description of the immediate effect of taking antibiotics; 2. G is resistant to the antibiotics ; 3. all types, except G, are {susceptible / sensitive} to the antibiotics ; 4. G is the only type of bacteria (from 7 days) until 9 months ; 5. increase to 4 different types of bacteria at 12 months / eq ; 6. one new type of bacteria (J) at 12 months / eq ; 7. idea that the bacteria are in the diet ; 8. same (4) types of bacteria at 18 months ; 9. idea that G has the highest percentage at 18 months (compared to H, I and J) ; 10. because G can outcompete the others for {space / nutrients / eq}	**emphasis on clarity of expression** 1 ie they have compared the day 0 column to the day 7 column 2 **DO NOT ACCEPT** immune 4 **ACCEPT** in the first 9 months 5 **ACCEPT** 3 more types / H, I and J appeared 5 **DO NOT ACCEPT** reappear if includes J	(6)

Q7.

Question Number	Answer	Additional Guidance	Mark
(a)	1. competition for {space / nutrients / eq} (with bacteria / pathogen / microorganism / microbe) ; 2. production of anti-microbial chemicals / eq ;	**1 IGNORE** food **DO NOT ACCEPT** virus **2 ACCEPT** lactic acid / antibiotics / toxins **IGNORE** acid / pH **DO NOT ACCEPT** HCl	(2) EXP

Question Number	Answer	Additional Guidance	Mark
(b)	1. idea that taking antibiotics {reduces the number of / kills / eq) gut flora ; 2. less competition with the *C. difficile* / *C. difficile* have more {space / nutrients} / eq;	**1 IGNORE** any numerical qualification	(2) EXP

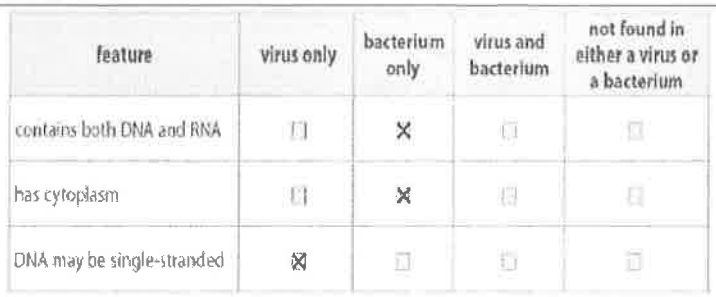
Question Number	Answer	Additional Guidance	Mark
(c)(i)	1. antibiotics act as a selection pressure ; 2. idea that when the antibiotic is being taken the resistant bacteria will {survive / reproduce / increase in number} ; 3. idea that when the antibiotic is not being taken the non-resistant bacteria will (also) survive ; 4. so there will be {more competition (with non-resistant bacteria) / less nutrients / less space} (for resistant bacteria) ;		(3) EXP

Question Number	Answer	Additional Guidance	Mark
(c)(ii)	1. idea that {the number of resistant *C. difficile* are increasing / new resistances are developing} ; 2. idea that new antibiotics {need developing / are being developed} ;	**1 DO NOT ACCEPT** immune **2 ACCEPT** idea that we need to increase our immunity to *C. difficile*	(2) EXP

Question Number	Answer	Additional Guidance	Mark
(c)(iii)	1. only prescribing antibiotics for bacterial infections / not prescribing antibiotics for {minor (bacterial) / viral} infections ; 2. idea of prescribing an appropriate antibiotic ; 3. idea of prescribing correct dosage ; 4. idea of education of patients to follow instructions for taking antibiotics exactly ; 5. idea of reduction in the prophylactic use of antibiotics ;	**2** e.g. one that affects *C. difficile*, one that will kill the resistant bacteria **4** e.g. correct timing, finishing course	(2) EXP

Question Number	Answer	Additional Guidance	Mark
(d)	1. idea that antibiotics affect gut flora in different ways / reference to bactericidal and bacteriostatic antibiotics ; 2. idea that bacteria affected by bacteriostatic antibiotics will recover faster ; 3. idea that bacteria affected by bacteriocidal antibiotics will recover more slowly ; 4. idea of length of time antibiotic remains in the body ;		(2) EXP

Q8.

Question Number	Answer	Mark
(b)(i)		(3)

feature	virus only	bacterium only	virus and bacterium	not found in either a virus or a bacterium
contains both DNA and RNA	☐	☒	☐	☐
has cytoplasm	☐	☒	☐	☐
DNA may be single-stranded	☒	☐	☐	☐

Question Number	Answer	Additional guidance	Mark
(b)(ii)	1. idea of injecting the antigen ; 2. antigen engulfed by macrophage / eq ; 3. macrophage {presents antigen / is an APC} to T helper cells ; 4. T helper cells activate {B / T killer} cells ; 5. formation of (B / T) memory cells ;	1 **ACCEPT** {attenuated / heat-destroyed} virus **DO NOT ACCEPT** killed / dead 3 **ACCEPT** B cells present antigen (to themselves) 4 **ACCEPT** {(primary) immune response / humoral response / cell mediated response} initiated	(3)

Question Number	Answer	Additional guidance	Mark
(c)	1. antibiotics used against (only) {bacteria / prokaryotic cells} ; 2. because antibiotics have target sites found only in bacteria / eq ;	**1 ACCEPT** do not target eukaryotic cells cancer cells are not {bacteria / prokaryotic cells} cancer is not caused by bacteria **IGNORE** cancer is caused by viruses **DO NOT ACCEPT** if clearly describing antibodies **2 ACCEPT** named target site e.g. cell wall **NB Antibiotics target bacterial cell walls = 2 marks**	(2)

Question Number	Answer	Additional guidance	Mark
(d)	1. reference to an **evolutionary race** ; 2. idea that the number of bacteria resistant to antibiotics is increasing ; 3. credit reason for increase in resistance ; 4. idea that the use of antibiotics acts as a selection pressure ; 5. idea that bacteria reproduce {rapidly / asexually / eq} ; 6. idea that new antibiotics are not being developed (fast enough) ;	**2 DO NOT ACCEPT** immune **3** e.g. over-prescription, not finishing the course, prescribing for viral infections , prophylactic use, use in animal feeds	(4)

Q9.

Question Number	Answer	Additional Guidance	Mark
(a)	1. (infection / damage) increases blood flow / results in vasodilation / eq ; 2. so {white blood cells / antibodies / eq} {are brought to / leak out into} the site of infection ; 3. credit role of white blood cells in infection ;	1 ACCEPT histamine increases {blood flow / permeability of capillaries} IGNORE capillaries / veins dilate 2 IGNORE macrophages if present in the blood 3 e.g. antibodies for opsonisation, phagocytosis	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(i)	1. {substance / chemical / drug / medicine} ; 2. that {kills / inhibits the growth of / eq} {(a different) bacteria / microorganism / prokaryote} ;	1 **DO NOT ACCEPT** produced by a virus 2 **ACCEPT** bacteriostatic / bactericidal **DO NOT ACCEPT** virus **IGNORE** pathogens	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	1. because bacteria are becoming resistant (to antibiotics) ; 2. caused by mutation ; 3. idea that {we will not have anything to treat bacterial infections / antibiotic will no longer be effective} ;	1 **DO NOT ACCEPT** immune 3 **ACCEPT** there is an evolutionary race	(2)

Question Number	Answer	Additional Guidance	Mark
(c)(i)	1. as the velocity increases up to 10 (cm s^{-1}) the number of bacteria trapped increase / eq ; 2. as the velocity increases above to 10 (cm s^{-1}) the number of bacteria trapped decrease / eq ;	NB 'as the velocity increases the number of bacteria trapped increase and then decrease' = 1 mark	(2)

Question Number	Answer	Additional Guidance	Mark
(c)(ii)	1. (as the velocity increases) more bacteria going into the {filter / nanowires}; 2. (above a velocity of 10 cm s^{-1}) the bacteria get pushed out of the nanowires / nanowires bend too much / nanowires do not respond fast enough / eq ;	1 **ACCEPT** more get trapped 2 **ACCEPT** nanowires break	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(iii)	1. antibody P increases sooner (than antibody Q) / eq; 2. antibody P increases faster (than antibody Q) / eq; 3. more antibody P (produced than antibody Q) / eq;	**DO NOT piece together** **ACCEPT converse throughout for antibody Q** 1 **ACCEPT** less of a delay 3 **ACCEPT** higher concentration / increases more	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(iv)	1. primary (immune) response to virus Q but secondary (immune) response to virus P; 2. memory cells (for virus P) present; 3. idea that memory cells (quickly) result in presence of plasma cells; 4. idea that immune response is specific to {antigen / virus};	**1 PIECE TOGETHER** **2 ACCEPT** converse **4 ACCEPT** idea that there are many steps to produce antibodies to virus Q	(3)

Q11.

Question Number	Answer	Mark
(a)(i)	D - virus-infected host cell **The only correct answer is D** ***A** is not correct because B cells bind to antigen and present it to themselves* ***B** is not correct because plasma cells produce antibody* ***C** is not correct because T helper cells produce cytokines to activate the T killer cells*	(1)

Question Number	Answer	Additional Guidance	Mark
(a)(ii)	1. to increase the number of T killer cells ; 2. so that T killer cells { are antigen-specific /will only bind to (specific) infected host cells } ; 3. so that (host-)infected cells can be destroyed faster ;	**2 Accept** will only destroy (specific) infected host cell **Ignore** CD4 receptors **3 Accept** infected cells destroyed quickly / more infected cells destroyed	(2)

Q10.

Question Number	Answer	Mark
(a)	<table><tr><th rowspan="2">Feature</th><th colspan="4">Artificial immunity</th></tr><tr><th>active only</th><th>passive only</th><th>both active and passive</th><th>not true</th></tr><tr><td>antigen-specific</td><td>☒</td><td>☒</td><td>X</td><td>☒</td></tr><tr><td>provides long-term immunity</td><td>X</td><td>☒</td><td>☒</td><td>☒</td></tr><tr><td>antibodies injected</td><td>☒</td><td>X</td><td>☒</td><td>☒</td></tr></table>	(3)

Question Number	Answer	Additional Guidance	Mark
(b)(i)	1. idea that this is the first infection, so no memory cells present; 2. idea of time taken for {macrophages / phagocyte} to {bind / engulf / process / eq} virus; 3. idea of time taken for presentation of antigen (by macrophages) to T helper cells; 4. idea of time needed for T helper cells to {activate / stimulate} B cells; 5. idea that B cells {need to) **differentiate** into plasma cells; 6. idea that plasma cells (need to) {synthesise / produce / make} antibody;	**NB** answer must be linked with a {time delay / many-staged process / slow process} for max 4 marks to be awarded 4 **ACCEPT** cause B cells to {divide / proliferate} **IGNORE** activate T killer cells	(4)

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	antibody {broken down / excreted / engulfed (by phagocyte) / eq} ;	**IGNORE** how or where the antibodies are broken down	(1)

Question Number	Answer	Additional Guidance	Mark
(b)(i)	1. macrophages present antigen to T helper cells ; 2. credit detail of antigen presentation ; 3. idea that T helper cells are needed to activate T killer cells ;	**1 Accept** macrophages become APC to T helper cells **2** e.g. binding to CD4 antigen on T helper cells **3 Accept** T helper cells release cytokine to stimulate T killer cells	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	1. phagocytosis (of virus) / eq ; 2. (destruction of virus) with enzymes /eq ; 3. (enzymes breakdown) {protein coat / envelope / genetic material / eq} ;	**2 Do not accept** kill viruses Lysozyme **Ignore** interferons	(3)

Question Number	Answer	Additional Guidance	Mark
(c)(i)		All correct = 2 marks ;; 1 correct = 1 mark ;	(2)

Parts of the cell	Line
Two poles of the cell	P
A chromosome and a pole	R
Two identical chromosomes	Q

Question Number	Answer	Mark
(c)(ii)	B 15 minutes **The only correct answer is B** *A is not correct because there is no change in the distance between chromosomes and the poles* *C is not correct because the distance between chromosomes and the poles is already decreasing* *D is not correct because the distance between chromosomes and the poles has been decreasing for a while*	(1)