

PEARSON EDEXCEL A-LEVEL BIOLOGY B • 9B10

BIOLOGY



EXAM QUESTION PACK

TOPIC 6: MICROBIOLOGY AND PATHOGENS
PROBLEMS OF CONTROLLING ENDEMIC DISEASES

SCORE

/58

PERCENTAGE

%

STEMUP

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Q1. Human diseases can be caused by many different types of organism, such as bacteria and viruses.

(a) Give **two** differences between the genetic material of bacteria and viruses.

(2)

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(b) Tuberculosis (TB) is caused when droplets, containing the bacterium *Mycobacterium tuberculosis*, are inhaled into the lungs.

In the lungs, large numbers of the bacterium are formed rapidly. These can be ingested by macrophages. Eventually, tubercles (tissue masses), containing dormant bacteria inside macrophages, may form.

(i) Describe how macrophages ingest the bacteria.

(2)

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(ii) Suggest why treatment with antibiotics may not be effective against the dormant bacteria in the tubercles.

(2)

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(iii) TB can be prevented by vaccination. Explain how a person can develop artificial active immunity following vaccination.

(3)

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(c) In a person with TB, the dormant bacteria in tubercles may be activated after several years. The bacteria multiply rapidly, resulting in severe lung damage.

The bacteria are released from the tubercles. These bacteria can inhibit the activity of T cells and infect other organs.

Explain why the activity of these bacteria and the inhibition of T cells means that a person may quickly develop severe symptoms leading to death.

(4)

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(Total for Question = 13 marks)

Q2.

In 2015, the number of cases of malaria was 211 million. This increased to 216 million cases in 2016.

Give the change in the number of cases of malaria in standard form.

(1)

Answer

(Total for question = 1 mark)

Q3.

The Human Immunodeficiency Virus (HIV) infects cells of the human immune system.

(a) (i) Place a cross (☒) in the box next to the name of the type of cell in the human immune system that is infected by HIV.

(1)

☐ **A** B effector cell

☐ **B** B memory cell

☐ **C** T helper cell

☐ **D** T killer cell

(ii) Place a cross (☒) in the box next to the name of the enzyme used to produce DNA from viral RNA in an infected cell.

(1)

☐ **A** DNA polymerase

☐ **B** RNA polymerase

☐ **C** restriction endonuclease

☐ **D** reverse transcriptase

(b) An antibody, known as 2G12, has been isolated from the blood of an HIV patient.

(i) State **two** characteristic features of antibodies.

(2)

Using the information, suggest how this may enable scientists to develop a means of producing **active** immunity to HIV infection.

This image shows a full page of white paper with horizontal dashed lines, typical of primary school writing paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Group	Numbers in the United Kingdom
People newly-diagnosed with HIV infection	6 630
People unaware of their HIV infection	21 625
People receiving treatment for HIV infection	65 000

Suggest why data about HIV infections are often estimates.

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(Total for question = 11 marks)

Q4. Bacteria and viruses can cause human diseases.

(a) Distinguish between the structure of bacteria and viruses

(3)

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(b) Infection with a bacterium can result in the development of active immunity to that bacterium. This results in the production of antibodies by plasma cells.

(i) Describe how infection with a bacterium results in the production of plasma cells.

(4)

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(ii) Explain how antibodies help a person to recover from an infection.

(2)

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(iii) A person who has had an organ transplant has to take immunosuppressive drugs. This prevents the immune system from destroying the organ transplant. Some of these drugs work by inhibiting the production of cytokines.

Suggest what effect these drugs could have on a person infected with a bacterium or a virus.

(4)

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(Total for Question = 13 marks)

Q5.

From 2010 to 2015 there was a 29% decrease in the number of deaths from malaria. This was due to prevention and control measures.

(i) Explain **one** implication of a named method of controlling malaria.

(2)

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(ii) In 2015, the number of deaths from malaria was 429 000.

Calculate the number of deaths from malaria in 2010.

(2)

Answer

(Total for question = 4 marks)

Q6.

The table below shows how much carbon is being transferred by each of the processes in the diagram.

Process	A	B	C	D	E
Mass of carbon transferred / au	338	332	23	444	450

(i) Calculate how much more carbon is entering the air than is leaving it.

Show your working.

(2)

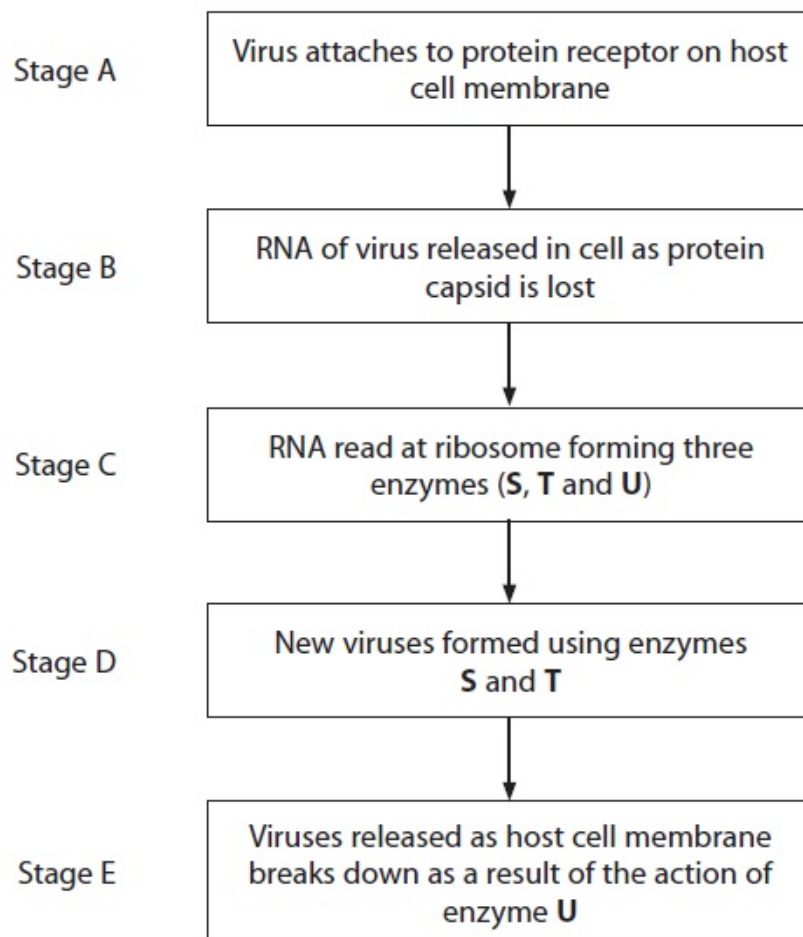
Answer

(ii) Suggest why more carbon is entering the air than is leaving it.

(3)

Q7. The common cold is a disease caused by a variety of viruses.

The flow diagram below describes how common cold viruses attack the cells on the inside of the nose.



(a) Common cold viruses infect only the cells inside the nose.

(i) Suggest why common cold viruses cannot infect cells if they land on unbroken skin.

(2)

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(ii) Suggest why common cold viruses cannot infect cells if they enter the blood through a cut in the skin.

(2)

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(b) Compare the action of the RNA in the common cold virus with that found in HIV.

(2)

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(c) At Stage C, three enzymes are formed.

(i) Suggest why two of these enzymes, **S** and **T**, are needed at Stage D.

(2)

(ii) Suggest how enzyme **U** might catalyse the breakdown of the host cell membrane at Stage E.

(3)

(Total for Question = 11 marks)

Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
(a)	1. bacteria have DNA, viruses have DNA or RNA ; 2. idea that bacteria have {circular / eq} genetic material, viruses have {linear / straight} ; 3. bacterial DNA is double-stranded, viral {DNA / RNA} is single (or double) stranded / eq; 4. bacteria (may) have plasmids, viruses do not have plasmids / eq;	NB piece answers together throughout Do not accept in context of plasmid	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(i)	- reference to {phagocytosis / endocytosis / engulfing} ; - credit details of phagocytosis ; - reference to bacterium inside a {vacuole / vesicle / phagolysosome} ;	eg formation of {pseudopodia / membrane extensions around bacteria} / cytoplasmic streaming / binding to bacteria Not phagolysosome	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	- idea that bacteria need to be accessible to antibiotics ; - idea of bacteria inside macrophages ; - reference to waxy layer of (these) bacteria ; - idea that (bacteriostatic) antibiotics affect dividing bacteria; - reference to antibiotic resistance (of these bacteria) ;	Not bacteriocidal antibiotics	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(iii)	- idea of {dead / attenuated / eq} {organisms / pathogen / bacterium / eq} put into person; - reference to (stimulation of) {specific / primary} (immune) response ; - credit details of T helper cell activation ; - credit details of B cell activation ; - credit details of T killer cell activation ; - reference to production of memory cells ;	NB not simply crediting ref to vaccination as in stem of question Accept antigen eg macrophages as APCs eg involvement of cytokines, B cells as APCs eg involvement of cytokines, infected cells as APCs	(3)

Question Number	Answer	Additional Guidance	Mark
(c)	- reference to {further lung damage / severe breathing problems / eq} ; - idea that the <i>Mycobacterium</i> get into the {blood / lymph}; - idea that organ failure (leads to death) ; - idea of {reduced / weakened} immune response (due to a loss of T cells) ; - credit detail of role of T (helper) cells ; - credit detail of effect of no T killer cells ; - credit detail of effect of no B cells ; - ref to {secondary / opportunistic / other} infections (causing death) ;	eg cannot obtain enough oxygen eg production of cytokines eg infected cells will not be destroyed eg no antibody produced	(4)

Q2.

Question Number	Answer	Additional Guidance	Mark
	answer in standard form	e.g. 0.5×10^7 / 5×10^6	(1)

Q3.

Question Number	Answer	Mark
(a)(i)	C T helper cells ;	(1)

Question Number	Answer	Mark
(a)(ii)	D reverse transcriptase ;	(1)

Question Number	Answer	Additional guidance	Mark
(b)(i)	- reference to glycoprotein ; - credit detail of structure e.g. specific (3D) shape, L and H regions, Y-shape, 4 (peptide) chains, disulphide bridges between peptides, hinge region ; - reference to {antigen-binding site / variable region / Fab (region) / eq }; - idea of antibodies have a {similar / constant / Fc / eq } region; - produced by plasma cells / present on B cells ; - role of antibody described e.g. opsonisation, immobilisation, agglutination, lysis ;	1. Accept protein, chains of amino acids 2. Ignore active site Accept a Y-shaped drawing 3. Accept references to {binding to specific antigen / antigen-specific / antigen receptors} 5. Accept present on B effector cells	(2)

Question Number	Answer	Additional guidance	Mark
*(b)(ii)	(QWC – answer must be organised in a clear, logical sequence) 1. reference to artificial (active) immunity ; 2. reference to {vaccine / vaccination} ; 3. containing {synthetic molecule / (synthetic) antigen / (synthetic) glycoprotein} ; 4. ref to stimulation of the {specific / humoral} immune response (to the synthetic antigen) ; 5. credit detail of process of producing effector B cells e.g. clonal expansion of B cells, involvement of cytokines, T helper cells activate B cells ; 6. reference to (production of B) memory cells ; 7. idea that (2G12) antibodies are produced {faster / in greater concentration} on {reinfection / eq} ;	Mps are awarded if the statements are clearly expressed 5. Ignore references to production of activated T killer cells 6. Ignore references to production of T memory cells 7. Accept ref to secondary immune response	(5)

Question Number	Answer	Additional guidance	Mark
(c)	1. idea that HIV infection does not always produce symptoms ; 2. reference to {provirus / latency} ; 3. reference to test needed to detect (symptomless) HIV ; 4. idea that only people who suspect they may have contracted HIV would have a test ; 5. idea that {some people would not want to be tested / impossible to test everyone} ; 6. idea that symptoms are common to other diseases ; 7. {new cases arising/ patients dying} all the time / eq ; 8. idea of new strains of virus arising ;	2. Accept virus is dormant	(2)

Q4.

Question Number	Answer	Additional Guidance	Mark
(a)	1. bacteria are cells, viruses are {not / particles} ; 2. idea of bacteria surrounded by {cell wall / slime / capsule } , viruses surrounded by {protein / capsids / envelope} ; 3. bacteria have { plasmids / ribosomes / other named structure} , viruses do not have {plasmids / ribosomes / other named structure } ; 4. bacteria (genome) are DNA, viruses can be DNA or RNA ; 5. bacterial DNA is double-stranded, viral genetic material is single (or double) stranded / eq ; 6. idea that bacteria have {circular / eq} genetic material, viruses have {linear / straight} genetic material ;	NB piece answers together throughout Accept only matched structures 2. Accept for envelope: membrane / phospholipid layer / eq 3. Accept bacteria have membranes, flagella cytoplasm, glycogen, lipid droplets 6. Not in context of plasmid	(3)

Question Number	Answer	Additional Guidance	Mark
(b)(i)	1. reference to humoral (immune) response ; 2. reference to {phagocytosis / eq} by {phagocytes / named phagocyte} ; 3. reference to macrophages as { antigen-presenting cells / APCs} (to T helper cells) ; 4. reference to B cells as { antigen-presenting cells / APCs} (to itself) ; 5. idea that T helper cells release cytokines for B cell {activation / stimulation} ; 6. idea of B cells {forming clones / dividing /eq} (to form B effector cells) ; 7. reference to {differentiation of B cells into plasma cells / formation of plasma cells from B cells} (subsequent to cloning) ;	2. Accept dendritic cells / Langerhans cells / B cells 3 Accept dendritic cells / Langerhans cells 4. Accept antigen binds to B cells 6. Not to form plasma cells	(4)

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	1. reference to {opsonisation / antibodies bind to bacteria / eq} ; 2. (as a result) enhancing phagocytosis / eq ; 3. reference to {immobilisation / agglutination / eq } (of bacteria) ; 4. idea of antibodies neutralising toxins / eq ;	1. Not reference to killing bacteria 2. Accept easier, better	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(iii)	1. idea that the immune response will be weaker ; 2. person may not recover from this infection / eq ; 3. idea of {other (opportunistic) infection / cancer} ; 4. reference to cytokines released from {T helper / CD4 } cells ; 5. idea that cytokines are involved in {activation / division } of {B cells / T killer cells} ; 6. credit consequence of impaired B cell function ; 7. credit consequence of impaired T killer cell function ;	1. Accept in context of either humoral or cell-mediated immune response 6. Accept e.g. no antibody produced by plasma cells 7. Accept e.g. infected cells not destroyed	(4)

Q5.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to one pair from the following: - mosquito coils / mosquito nets / insect repellent (1) - because {too expensive / not always available} (1) OR - anti-malarial tablets (1) - because {too expensive / not always available / side effects} (1) OR - avoiding stagnant water (1) - because impractical as people's {homes / work} are near stagnant water (1) OR - long clothing (1)	ACCEPT {removing / adding chemicals} to stagnant water ACCEPT affects organisms living in the water	(2)

	- because impractical for working (1) OR - insecticide (1) - expensive / can {poison / kill} other organisms / can affect the food chain (1) OR - sterile insect technique (1) - not fully tested / expensive (1) OR - biological control (1) - can affect the food chain (1)		
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Question Number	Answer	Additional Guidance	Mark
(ii)	- percentage of deaths in 2015 compared to 2010 (1) - number of deaths in 2010 (1)	<u>Example of calculation:</u> $100 - 29 = 71$ $429\,000 \times 100 \div 71 = 604\,225 / 604\,000$	(2)

Q6.

Question Number	Answer	Additional Guidance	Mark
(i)	Correct answer gains both marks $\{332 + 23 + 444 / 799\}$ and $\{338 + 450 / 788\}$; $(799 - 788) = 11$ (au) ;	CE applies	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	1. idea that rate of production of carbon dioxide is greater than rate of removal of carbon dioxide ; 2. idea of using of {fossil fuels / named fossil fuel / forests / eq} {releasing / producing} carbon dioxide ; 3. idea that this carbon (in fossil fuels / forests) was {locked up / removed from the air } years ago ; 4. idea of deforestation resulting in less {photosynthesis / carbon fixation / light independent reaction / eq} ;	1 ACCEPT carbon dioxide {production / release} is greater than used in photosynthesis 3 ACCEPT ref to carbon sink 4 ACCEPT less carbon dioxide used for photosynthesis	(3)

Q7.

Question Number	Answer	Additional Guidance	Mark
(a)(i)	1. {skin / epidermis} is a barrier / eq ; 2. reference to keratin ; 3. reference to lack of receptors (for the virus) ;	Accept prevents entry but not prevents infection NB keratin in skin forms a barrier = 2 marks Accept skin has different receptors	(2)

Question Number	Answer	Additional Guidance	Mark
(a)(ii)	1. idea that viruses only {infect / attach to / eq} {specific receptors / specific cells / host cells} ; 2. idea that receptors not present on {blood cells / endothelial cells / eq} ; 3. reference to {destruction / eq} of viruses by phagocytes ;	Accept white blood cells. neutrophils; PMN Ignore macrophages Not lymphocytes, T cells, plasma cells	(2)

Question Number	Answer	Additional Guidance	Mark
(b)	1. reverse transcriptase (required) in HIV, no reverse transcriptase in cold virus ; 2. DNA formed (using RNA) in HIV, {no DNA formed / RNA used to make protein / translation} in cold virus ; 3. reference to {provirus / latency / delay in virus formation / eq} in HIV infection, {no provirus / lytic cycle / (immediate) formation of virus particles / eq} in cold virus ;	NB answers can be pieced together but candidates still have to state both parts of mark point	(2)

Question Number	Answer	Additional Guidance	Mark
(c)(i)	1. to synthesise (common cold) RNA / eq ; 2. for amino acids to bind to tRNA / eq ; 3. to synthesise (common cold) protein (capsid) / eq ;	Accept translation	(2)

Question Number	Answer	Additional Guidance	Mark
(c)(ii)	1. idea of enzyme affecting {molecules in membrane / proteins / (phospho)lipids / cholesterol} ; 2. enzyme breaks {bonds / named bonds / eq} ; 3. reference to {(by) hydrolysis / hydrolytic enzymes} ; 4. credit detail of enzyme action ; 5. reference to enzyme U as {protease / lipase / cholesterase} ;	eg lowers activation energy, binding of active site to substrate (cannot credit reference to catalyst, as in stem of question) Ignore lysosyme	(3)