PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



MARK SCHEME

TOPIC 6: MICROBIOLOGY AND PATHOGENS

BACTERIA AS PATHOGENS

SCORE	PERCENTAGE
/62	%

STEMUP

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Mark Scheme

Q1.

Question Number	Acceptable Answer	Additional guidance	Mark
	An explanation that makes reference to the following: • *Salmonella* food poisoning can spread easily (1) • therefore early identification means quicker treatment and containment of infection (1) • so that the correct antibiotic can be used to help prevent spread of infection and prevent antibiotic resistance if wrong antibiotic used (1)		**(3)**

Q2.

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)	1. reference to {phagocytosis /endocytosis / engulfing} ; 2. credit details of phagocytosis ; 3. reference to bacterium inside a {vacuole / vesicle / phagolysosome} ;	eg formation of {pseudopodia / membrane extensions around bacteria} / cytoplasmic streaming / binding to bacteria **Not** phagolysozyme	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	1. idea that bacteria need to be accessible to antibiotics ; 2. idea of bacteria inside macrophages ; 3. reference to waxy layer of (these) bacteria ; 4. idea that (bacteriostatic) antibiotics affect dividing bacteria; 5. reference to antibiotic resistance (of these bacteria) ;	**Not** bacteriocidal antibiotics	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(iii)	1. idea of {dead / attenuated / eq} {organisms / pathogen / bacterium / eq} put into person; 2. reference to (stimulation of) {specific / primary} (immune) response ; 3. credit details of T helper cell activation ; 4. credit details of B cell activation ; 5. credit details of T killer cell activation ; 6. 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)	1. reference to {<u>further</u> lung damage / severe breathing problems / eq} ; 2. idea that the *Mycobacterium* get into the {blood / lymph}; 3. idea that organ failure (leads to death) ; 4. idea of {reduced / weakened} immune response (due to a loss of T cells) ; 5. credit detail of role of T (helper) cells ; 6. credit detail of effect of no T killer cells ; 7. credit detail of effect of no B cells ; 8. 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)

Q3.

Question Number	Answer	Additional guidance	Mark
	A (lipopolysaccharide in the cell wall membrane)		**(1)**

Q4.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that makes reference to three of the following: **Similarity** • both have peptidoglycan (1) **Two differences from:** • positive has {more / thicker layer of} peptidoglycan than negative / positive has a thicker cell wall than negative (1) • positive has teichoic acid, negative does not (1) • negative has outer membrane, positive does not (1) • negative (most) has periplasmic space, positive does not (1) • negative has {more lipid / lipopolysaccharide / porin proteins}, positive does not (1)	Accept periplasm	**(3)**

Question Number	Answer	Additional Guidance	Mark
(ii)	• subtraction using values from graph (1) • calculation of percentage change (1)	$10^8 - 10^2 = 99\ 999\ 900$ $\div 10^8 \times 100 =$ **99.9999** Correct answer gains full marks, with no working shown.	**(2)**

Question Number	Answer	Additional Guidance	Mark
(iii)	An answer that makes reference to the following: • it is effective if irradiation longer than 3 hours (1) • it is effective against E. coli which infect the intestine (1) • not all species of {pathogenic bacteria / bacteria causing food poisoning} investigated / only three types of bacteria investigated (1) • toxins may remain in food (1)	Accept effectiveness depends on how long it is irradiated for	(4)

Q5.

Question Number	Answer	Additional Guidance	Mark
(i)	• *Salmonella* (species) (1)	Candidates may name other types of bacteria, each of which will need looking up **ACCEPT** phonetic spellings **ACCEPT** *Shigella, Neisseria, Escherichia, Pseudomonas, Klebsiella, Proteus, Providencia, Escherichia, Morganella, Aeromonas, Citrobacter* **ACCEPT** specific examples e.g. *E.coli* **IGNORE** pathogens **DO NOT ACCEPT** gram positive bacteria e.g. *Actinomyces, Clostridium, Mycobacterium, Streptococci, Staphylococci, Nocardia*	(1) EXP

Question Number	Answer	Additional Guidance	Mark
(ii)	• gram negative bacteria have {a thinner peptidoglycan cell wall / an (outer) lipopolysaccharide (layer) / an outer membrane } (1)	**ACCEPT converse for gram positive bacteria** **ACCEPT** less peptidoglycan murein for peptidoglycan larger periplasm (space) no teichoic acid (in cell wall)	(1) GRAD

Q6.

Question Number	Answer	Additional Guidance	Mark
(i)	• 0.308 / 0.31 / 0.3 (1)		(1) GRAD

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to two of the following: • endotoxins released from Gram negative bacteria (only) but exotoxins released from both Gram negative and Gram positive bacteria (1) • endotoxins are lipopolysaccharides but exotoxins are proteins (1) • endotoxins released from {dead / broken down} bacteria but exotoxins are released from living bacteria (1) • effect of endotoxins is later (1)	**DO NOT PIECE TOGETHER**	(2) EXP

Q7.

Question Number	Correct Answer	Additional guidance	Mark
(a)	*Staphylococcus* spp.		**(1)**

Question Number	Correct Answer	Additional guidance	Mark
(b)	An explanation that makes reference to the following: • the number of living bacteria does not increase (1) • because cell division is prevented (1)	Accept more sophisticated answers that give details of how cell division is prevented	**(2)**

Question Number	Indicative content
***(c)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Candidates are expected to reach a decision/conclusion on whether the development of bacterial resistance is so serious and rapid that antibiotics will become ineffective in the treatment of the majority of bacterial infections. • Prior use of antibiotics increases the percentage of resistant bacteria, supported by quantitative data • Prior use of the named antibiotic has the greatest effect, supported by quantitative data • Increasing use of antibiotics increases selection pressures so more resistant strains • Shows understanding that resistance mechanisms are inherited by sexual means and lateral gene transfer, e.g. via plasmids and this means they can spread rapidly and in some cases across species • Bacteria have high reproduction rates and mutations more likely within a short time • Understands current methods used to limit increase in resistant strains such as strict controls on antibiotic prescribing, problems of ensuring patients complete course of treatment when symptoms disappear, limit use of antibiotics in animal husbandry etc. • Comments on difficulties of developing new drugs • Methods of preventing spread of resistant strains especially hospital infection • Movement of humans means that transfer of resistant strains will spread to

Level	Mark	Descriptor
	0	No rewardable material
Level 1	1-3	Provides little or no reference to a range of scientific ideas, processes, techniques and procedures. Scientific argument may be attempted, but fails to link biological concepts and/or ideas in order to support decision/conclusion. Limited attempt to address the question.
Level 2	4-6	Scientific reasoning occasionally supported through the linkage of a range of scientific ideas, processes, techniques and procedures. Scientific argument is partially developed. Attempts to synthesise and integrate relevant knowledge with linkages to biological concepts and/or ideas, leading to a notional scientific argument or decision/conclusion based on evidence.
Level 3	7-9	Scientific reasoning supported throughout by sustained linkage of a range of scientific ideas, processes, techniques or procedures. Scientific argument is well developed and logical. Demonstrating throughout the skills of synthesising and integrating relevant knowledge with consistent linkages to biological concepts and/or ideas, leading to nuanced and balanced scientific argument or decision/conclusion based on evidence.

Q8.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to three of the following: • because the food poisoning was happening {after one hour /within a few hours} of the meal **(1)** • indicating that exotoxins caused the food poisoning **(1)** • because endotoxins are only present after {about 12 hours / several hours / when the bacterial cells are estroyed} **(1)** • *Staphylococcus* releases exotoxins / endotoxins come from *Salmonella* **(1)**	**Accept** soon after meal / quickly / by {12 / 1} o clock **Do not accept** *Staphylococcus* is an exotoxin / *Salmonella* is an endotoxin	**(3)**

Question Number	Answer	Additional Guidance	Mark
(ii)	A description that makes reference to any four of the following: • isolate the bacteria from the {food / patient / faeces / vomit} **(1)** • look at the colonies to see if they have a {characteristic / named characteristic} (of *Staphylococcus*) **(1)** • use Gram stain to show presence of Gram positive bacteria **(1)** • grow on selective media that identify {*Staphylococcus* / eliminates other bacteria} **(1)** • use antibodies against *Staphylococcus* **(1)**	**Accept** a description of how this is done e.g. streak plating from a faecal sample **Accept** *Staphylococci* will appear purple with Gram stain **Accept** differential media / selective agar / named example e.g. mannitol salt agar / with antibiotics	**(4)**

Q9.

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)	1. reference to glycoprotein ; 2. credit detail of structure e.g. specific (3D) shape, L and H regions, Y-shape, 4 (peptide) chains, disulphide bridges between peptides, hinge region ; 3. reference to {antigen-binding site / variable region / Fab (region) / eq }; 4. idea of antibodies have a {similar / constant / Fc / eq } region; 5. produced by plasma cells / present on B cells ; 6. 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)**

Q10.

Question Number	Answer	Mark
	The only correct answer is C ***A*** *is not correct because Salmonella are gram negative bacteria so will have a thin peptidoglycan cell wall* ***B*** *is not correct because Salmonella are gram negative bacteria so will have a thin peptidoglycan cell wall and they produces endotoxins* ***D*** *is not correct because Salmonella produces endotoxins*	**(1)**