10. Infectious Diseases

10.2 Antibiotics

Paper 2

Marking Scheme

Q1.

(b)	*allow murein for peptidoglycan* *must attempt similarities and differences to gain max* *any **three** from:* *similarities, both* **1** cause cell, lysis / bursting **;** **I** ref.to destroying / killing, bacteria (both) **2** detail **;** e.g. weaken / destroy / AW, cell wall act on peptidoglycan cell wall cell wall cannot withstand turgor pressure / AW *differences* *(lysozyme is, a protein / an enzyme / a catalyst, but)* **3** penicillin is, an antibiotic / an enzyme inhibitor / a beta-lactam **;** *(lysozyme hydrolyses, glycosidic bonds / peptidoglycan molecules, but)* **4** penicillin, inhibits transpeptidase(s) **;** **A** peptidase(s) **5** penicillin, prevents formation of / AW, peptide / cross, bridges / linkages **;** **R** penicillin breaks cross bridges **A** *ref. to* autolysins e.g. 'cannot repair holes made by autolysins' **6** penicillin only effective when cell is, growing / synthesising cell walls, but lysozyme effective, at all stages / AW**;** **7** AVP **;** e.g. lysozyme (much) larger molecule *ref. to* lysozyme denatured v penicillin less affected by heat *idea of* lysozyme more affected by factors affecting enzyme **A** examples lysozyme globular v penicillin contains (beta-lactam / 4-member) ring	**3**

Q2.

(c)	*any one from* antibiotic resistance, qualified **;** **A** drug for antibiotic e.g. increases risk of antibiotic resistance developing may cause / could lead to problems of, antibiotic resistance an antibiotic resistant bacterial strain may develop **R** if, immune / immunity, included **R** antibiotic resistance / mutation, in, TB / disease / people / virus mutation(s) occur in <u>bacteria</u> which, make antibiotics ineffective / prevent antibiotic action **;** **A** mutation occurs which may make bacteria resistant AVP **;** e.g. *ref. to* development of, DR-TB / MDR-TB / XDR-TB *(if latent bacteria become active)*	**1**

Q3.

(d)	*any **four** from:* (resistant) (*Vibrio cholerae*)is not killed by the antibiotic **;** **A** can still reproduce inability to treat people with cholera using antibiotics **;** prolonged periods of illness **;** (so) increased risk of spread / AW **;** increased death rate from cholera **;** transfer of antibiotic resistance (alleles) to, other species of bacteria / other strains of *V.cholerae* **;** development of multiple resistance in other species of bacteria **;** inability to treat other bacterial diseases **;** increased death rate from other bacterial diseases **;** need to research alternative antibiotics **;** AVP **;**	**4**

Q4.

(b)(i)	*idea of* using both antibiotics makes sure all bacteria are killed ; if, resistance against one antibiotic occurs then, the other antibiotic will be effective / bacteria still susceptible to the other antibiotic **or** if, some bacteria are less susceptible to one antibiotic, then, the other antibiotic will be effective / bacteria still susceptible to the other antibiotic ; *any **one** from:* antibiotics / gentamicin and penicillin G, have different sites of action / AW ; **A** suggestion of how the antibiotics have different ways of killing *ref. to* mutations, qualified ; e.g. need two mutations to occur to be resistant to both antibiotics probability / AW, of these two mutations occurring in the same bacterium is very small mutations must be in different genes	**2**
(b)(ii)	*any **three** from:* course of antibiotic is not completed ; less susceptible bacteria survive ; **A** not all bacteria destroyed replication / population growth, increases chance of mutation ; *ref. to* random mutation, ref to gene / allele, for resistance to gentamicin ; suggestion of outcome of different mutations ; e.g. changed ribosome structure so gentamicin cannot bind enzyme to breakdown gentamicin *ref. to* transmission of allele for resistance ; e.g. vertical transmission / described horizontal transmission / described (conjugation / transformation) e.g. frequency of allele for resistance increases in the population ; *when antibiotic next prescribed* antibiotic in the environment is the selection pressure / resistant bacteria selected for / susceptible bacteria selected against ;	**3**

Q5.

(a)	*any* ***four*** *from:* **1** (in combination treatment) antibiotics (in Table 2.1), act at different targets / have different modes of action / AW ; **A** comparison of any two antibiotics from Table 2.1 **A** suggestion of how two antibiotics have different ways of killing **2** *idea that* if resistance / mutation, occurs / exists, unlikely to be against all antibiotics / other antibiotics should still be effective ; **3** (in combination treatment) if resistance / mutation, occurs / exists, all bacteria will (still) be, killed / destroyed / AW ; **A** no bacteria remain to develop resistance / no reservoir of resistant bacteria **4** antibiotic resistance, not / less likely to be, spread to affect people because no bacteria surviving (with combination treatment) ; AW **5** long treatment time / 6 months, with, combination treatment / AW, increases chance of killing all bacteria **or** long treatment time with a single antibiotic not effective in killing all bacteria if, resistance develops / a mutation occurs ; **6** AVP ; e.g. combination treatment (is likely to) eliminate bacteria more quickly (so less chance of resistance occurring) resistance to different antibiotics involves more <u>genes</u> so less chance of resistance occurring <u>gene</u> for antibiotic resistance has more chance of being passed on if using single antibiotic (and not all killed) ora if using single antibiotic (and not all killed) more chance of being passed on (to other bacteria) by horizontal / vertical / AW, transmission ora	**4**

Q6.

b(ii)	*two from* (from 2009 to 2013) overall increase in number of cases (of RR-TB and MDR-TB) ; use of data to support overall trend ; *ref. to* large increase between 2011 and 2012 / 2013 **or** very little change between 2010 and 2011 ;	**2**

(b)(iii)	*four from* overuse of, antibiotics / rifampicin **or** example of over use ; e.g. taking for viral infection, over prescribing for bacterial infection people not completing course of antibiotics ; reservoir of bacteria remains ; *ref. to* mutation ; any detail of the mutation ; e.g. protein produced has a changed binding site bacteria with resistance, survive / selected for **or** only bacteria sensitive to antibiotic are, killed / selected against ; **A** antibiotic acts as a selection pressure bacteria reproduce and pass on, gene / allele, for resistance to offspring **or** vertical (gene) transmission ; (alleles for resistance to antibiotics transferred by) horizontal (gene) transmission / described ; frequency of resistance, gene / allele, increases in the bacterial population ;	**4**

Q7.

(a)	**1** prevents formation of, cross links / cross linkages (between, peptidoglycan / murein, chains) ; **A** peptide cross links **A** links between, murein / polymer, chains **I** peptide bonds **I** formation of peptidoglycan **R** if cellulose chains stated **2** (penicillin) inhibits, transpeptidase action / enzyme involved in forming cross links ; **A** alternative correct names for transpeptidase **3** weakens <u>cell wall</u> ; **A** cell wall unable to withstand (turgor) pressure **A** cell wall loses strength **R** idea that penicillin, punches / makes, holes, to weaken **4** (cell), lysis / bursts / ruptures / AW (so bacterium killed) ; **5** acts, on growing bacteria / when bacteria are increasing in size (when cell wall needs to be synthesised) ; **I** growing, wall / peptidoglycan chains	**3**

Q8.

(a)	**A** antibiotic for penicillin throughout *three from:* 1 (penicillin) weakens / AW, the cell wall ; **I** punches holes / holes made 2 (penicillin) acts, on growing cells / when cell wall being synthesised (during growth) ; 3 inhibits / binds to / AW, enzymes / transpeptidases (for cross linkage formation) ; **I** ref. to synthesis of peptidoglycan 4 prevents formation of cross, links / linkages (between, peptidoglycan / murein, molecules) / AW ; *suggestions why antibiotic is less effective on Gram negative* 5 outer membrane, prevents / interferes with / protects from / AW, entry (of penicillin) ; **A** idea of, more difficult / further, to reach peptidoglycan layer 6 proteins in outer membrane may pump out antibiotic ; **A** presence of efflux pumps 7 enzymes may be present (in periplasm) to degrade antibiotic / AW ; 8 suggestion that antibiotic cannot cross hydrophobic region of (outer) membrane ; 9 AVP ; e.g. proportionately, less / lower concentration of, penicillin reaches murein for, enzyme / transpeptidase, inhibition	**3**