

- M1.** (a) (i) Antibiotics kill other bacteria / *Clostridium* is resistant;  
 Less/no competition so (*Clostridium*)  
 reproduces/replicates/multiplies/increases in number;  
*Reference to bacteria being 'immune' negates first marking point.*  
*Reference to mitosis negates second marking point.* 2
- (ii) Immune system less effective / more likely to have other  
 infections/been in hospital;  
*Accept: 'Weak/lower' immune system'.* 1
- (b) Attaches to active site (of enzyme);  
 (Methicillin) is a competitive inhibitor / prevents monomers/substrate  
 attaching (to enzyme);  
*'Competes for active site' = 2 marks.*  
*Neutral: 'Prevents monomers joining/attaching to each other'.*  
*Allow one mark max for answers relating to non-competitive*  
*inhibitor changing active site / preventing substrate attaching.*  
*Do not penalise Methicillin forms an enzyme/substrate complex.* 2
- (c) (i) Have other illness/medical condition/'weak' immune system/disease/infection;  
*Reject: Due to 'other factors', 'are smokers', 'are obese' unless*  
*related to disease or illness.* 1
- (ii) Increase up to 2006/20 (per 100 000) then decreases; 1
- (iii) Correct answer in range of 52 – 59.1% = two marks;  
 Incorrect answer but shows change as between 4.8 – 5.2 / shows  
 correct subtraction giving this change e.g. 14 – 9 = one mark. 2

- (d) 1. (Antibiotic) resistant gene/allele;
2. Vertical (gene) transmission;
3. Resistant bacteria (survive and) reproduce / population of resistant bacteria increases;
4. Increase in frequency of (resistant) allele/gene (in future generations);
5. Horizontal (gene) transmission;
6. Plasmid;
7. Conjugation / pilus (tube);
8. (Horizontal transmission/ conjugation) can occur between bacteria of different species;
- Penalise reference to mitosis once when linked to either marking point 2 or 3.*
- Penalise reference to immunity once when linked to either marking point 1, 3 or 4.*
- Accept: Binary fission for reproduction in marking point 3.*
- Accept: 'Transfer' for transmission.*

6 max

[15]

**M2.** (a) stop cell walls forming / lysis;

1

- (b) (i) penicillinase produced / enzyme breaks down penicillin;  
or  
capsule/wall and membrane complex that does not allow penetration/ penicillin pumped out

1

- (ii) mutation;  
resistant individuals survive/susceptible ones killed by penicillin / mutants have selective advantage;  
survivors breed/proportion of resistant alleles in population increases; relevant reference to overuse of penicillin;

3 max

- (c) plasmids/DNA obtained from *E. faecalis*  
via conjugation/sexual reproduction/transformation/transduction;

2

[7]

**M3.** (a) To prevent contamination of apparatus with other microorganisms/bacteria;  
To prevent personal contact with bacteria;  
To prevent release of bacteria into air;

max 2

- (b) (i) Diffuses slowly; 1
- (ii) Disruption of cell wall;  
Interference with protein synthesis;  
Interference with DNA replication; max 2
- (iii) B;  
Produces inhibition zone greater than the minimum diameter; 2
- [7]
- M4.** (a) side effects / allergic reactions / low toxicity to cells;  
interaction with other drugs / effective in conditions of use /  
reasonably stable;  
should only act on the problem bacteria / narrow spectrum;  
how much resistance the bacteria have built up; 2 max
- (b) (i) tetracycline  
prevents tRNA binding to ribosomes/amino acid/mRNA; 1
- amino acids not available /brought/picked up; 1
- chloramphenicol  
prevents amino acids being joined / prevents primary  
structure forming; 1
- no enzymes / no structural proteins formed;  
*(accept cell wall formation if qualified) (prevents protein synthesis  
gains one mark in either section, once only)* 1
- (ii) only prevents tRNA binding to 70S/prokaryotic/bacterial  
ribosomes / human ribosomes are different sizes/shapes/structure; 1
- [7]

- M5.** (a) antibiotic has diffused/spread/moved into agar;  
killed/inhibited bacteria; 2
- (b) largest clear area/inhibition zone/killed the most bacteria; 1
- (c) disrupts cell wall/prevents cell wall synthesis;  
stops DNA replication; 2
- [5]

- M6.** (a) 1. Horizontal (gene) transmission;  
2. (Gene passed by) conjugation/through pilus;  
*Vertical negates horizontal* 2

(b) **Shape**

1. Different penicillin has different shape/structure/  
enzyme/active site has specific shape/structure;  
*Not different*

**Binding**

2. No longer fits/binds to active site/not complementary to  
active site/does not form E-S complex;

**Consequence**

3. (Different) penicillin not broken down; 3

- (c) (i) 1. Kills pathogenic/harmful bacteria/pathogens;  
2. Disease less likely/improves health/animals healthier/  
reduces spread of infection;  
3. Faster growth/more productive animals/more food  
converted to meat/greater survival/lower vet's bills/  
increased yield/less energy (for "fighting infection");  
*Principles:*  
*Action of antibiotic. Do not accept stops all disease*  
*Action on health*  
*Effect on production*

2 max

- (ii) 1. (Adding antibiotics) selects in favour of antibiotic resistance/resistant bacteria more likely to survive;
2. Increase in numbers/higher proportion of resistant bacteria;
3. May infect humans/may spread resistance to other species/horizontal transfer;
- Penalise immune only on the first occasion it occurs in this part of the question.*

2 max

[9]

**M7.** (a) (i) to ensure that no unwanted bacteria will be present;

1

- (ii) to check that bacteria cells do not die anyway / to show water/solvent has no effect on growth;

1

- (b) antibiotic damages/prevents formation of cell walls;  
antibiotic prevents DNA replication so cells die;  
antibiotic prevents protein synthesis/translation/transcription of mRNA;

max. 2

- (c) some bacteria are resistant / some areas of dish have no antibiotic / antibiotic not spread evenly;

1

[5]

**M8.** (a) Isolation/quarantine/'kept separate';

Screening/testing (of patients/doctors etc);

Sterilisation of wards/equipment/method to improve hygiene;

*Do not allow improve 'hygiene' or 'cleanliness' without named example such as 'washing hands' use of gloves etc.*

2 max

- (b) May not all be absorbed;

May be broken down/metabolised/excreted quickly;

To kill the microorganisms/bacteria;

Reference to antibiotic resistance;

*Reference to becoming 'immune' negates last marking point.*

2 max

- (c) (i) P; 1
- (ii) S; 1
- (d) (i) Prevents bias;  
 Vested interest (of scientists);  
 Prevents 'placebo'/positive/negative/psychological effects/  
 'demand characteristics' (in volunteers); 2 max
- (ii) Age;  
 Ethnicity;  
 Lifestyle;  
 Body mass;  
 Health;  
 Sex of person;  
*Ignore references to same or different* 2 max
- (e) (i) Gradual/slight increase followed by rapid/greater increase;  
*Allow more detailed descriptions which describe similar trend of  
 gradual increase followed by rapid increase.* 1
- (ii) 1. No/little resistance shown to drug X;  
 2. Mutation present (for antibiotic resistance);  
 3. Gene/allele for (antibiotic) resistance;  
 4. Bacteria with (antibiotic) resistance survive;  
 5. Vertical gene transmission;  
 6. Frequency of gene/allele (for resistance) increases;  
*Reference to horizontal gene transmission = neutral  
 Reject mark for mutation if context suggests presence of antibiotic  
 causes bacteria to mutate.  
 Resistance is passed on by vertical gene transmission = two  
 marks i.e. points 3 and 5.* 4 max

[15]

- M9.** (a) (Prokaryotic DNA) is circular/in a loop/not associated with proteins/not in chromosomes/does not contain introns/does not contain junk DNA/shorter;  
*It refers to prokaryote* 1
- (b) (i) Horizontal transmission;  
Plasmid /DNA / gene for resistance;  
(Plasmid / gene / DNA) passed on by conjugation;  
*Q To gain first marking point, reference must be made to horizontal* 3
- (ii) DNA / gene / plasmid is replicated / copied;  
Passed on to B and C when cell A divides / vertical gene transmission;  
*Q Reject second marking point if candidate refers to mitosis.*  
*Accept clones/multiplies* 2
- (c) Penicillin kills non-resistant bacteria/resistant bacteria survive/are not destroyed;  
Resistant bacteria reproduce and increase in proportion;  
*Ignore ref to mitosis.*  
*Penalise ref to immunity once only.* 2
- [8]
- M10.** (a) prevent DNA replication;  
prevent protein synthesis/transcription/translation/ribosome function;  
damage/inhibit formation of cell wall; 3
- (b) prevent further growth/multiplication of bacteria;  
allow time for immune response (to bacteria); 2
- [5]

