

- M1.(a)**
1. Change / mutation in base / nucleotide sequence (of DNA / gene);  
*Q.*  
*Ignore: references to changing base-pairing*  
*Accept: affect for change, if in correct context*  
*Accept: changes triplets / codons*
  2. Change in amino acid sequence / primary structure (of enzyme);  
*Accept: different amino acid(s) coded for*  
*Q Reject: different amino acids produced / formed / made*
  3. Change in hydrogen / ionic / disulfide bonds;  
*Accept: references to sulfur bonds*
  4. Change in the tertiary structure / shape;  
*Neutral: alters 3D structure / 3D shape*
  5. Change in active site;
  6. Substrate not complementary / cannot bind (to enzyme / active site) / no enzyme-substrate complexes form.  
*Accept: no E S complexes form*

6

- (b)
1. Non-SR strain falls more / SR strain falls less / up to  $10(\mu\text{g} / \text{cm}^{-3})$ ;  
*Must include 10 but only required once in either MP1 or MP2*  
*Ignore: units or absence of*  
*This must be a comparative statement*
  2. Above  $10(\mu\text{g} / \text{cm}^{-3})$ , SR strain levels out / off and non-SR strain continues to decrease;
  3. Greater difference between strains with increasing concentration of antibiotic.  
*This must be a comparative statement*

2 max

- (c)
1. Division stopped (of both strains by scientist);  
*Reject: references to mitosis stopping*
  2. SR strain still more resistant / fewer die / none die (at higher concentrations of antibiotic).  
*Accept: SR strain and non-SR strain would be similar if*

*resistance is due to only stopping division*  
*Need some comparison with non-SR*

2

- (d) 1. Make a competitive / non-competitive inhibitor;  
*Mark in pairs*  
*either MP1 and MP2 OR MP3 and MP4*
2. Competitive competes with / blocks active site / non-competitive inhibitor affects / changes active site;  
*Do not mix and match*
- OR
3. (Make a drug) that inhibits / denatures / destroys enzyme / stringent response;  
*Accept: drug that 'knocks out' / destroys enzyme*
4. Give at the same time as / before an antibiotic.

2 max

- (e) (SR strain)
1. Fewer free radicals (than non-SR);  
*Note: has to be comparative statement*
2. Produces more catalase (than non-SR);  
*Accept converse statements for non-SR.*
3. Catalase (might be) linked to production of fewer free radicals / breaking down / removing free radicals.  
*Accept: hydrolysis of radicals by catalase.*

3

[15]

**M2.(a)** (No – no mark)  
Graph / bar chart only shows number of species, not the name of the species.

1

- (b) (No – no mark)
1. Mutations are spontaneous / random;
2. Only the rate of mutation is affected by environment;
3. Different species do not interbreed / do not produce fertile offspring;

4. So mutation / gene / allele cannot be passed from one species to another.

*Ignore references to correlation does not prove causation*

4

- (c) 1. Initially one / few insects with favourable mutation / allele;  
2. Individuals with (favourable) mutation / allele will have more offspring;  
3. Takes many generations for (favourable) mutation / allele to become the most common allele (of this gene).

3

[8]

**M3.(a)** PKNJ.

1

- (b) *Lutra lutra*.

1

- (c) Bone / skin / preserved remains / museums.

1

- (d) 1. (Hunting) reduced population size(s), so (much) only few alleles left;  
*Accept bottleneck*

2. Otters today from one / few surviving population(s);  
*Accept founder effect*

3. Inbreeding.  
*Allow any two*

2 max

- (e) 1. Population might have been very small / genetic bottleneck;  
2. Population might have started with small number of individuals / by one pregnant female / founder effect;  
3. Inbreeding.

*Allow any two*

2 max

**M4.(a)** 0.32.

*Correct answer = 2 marks*

*Accept 32% for 1 mark max*

*Incorrect answer but identifying 2pq as heterozygous = 1 mark*

2

- (b)
1. Mutation produced *KDR minus* / resistance allele;
  2. DDT use provides selection pressure;
  3. Mosquitoes with *KDR minus* allele more likely (to survive) to reproduce;
  4. Leading to increase in *KDR minus* allele in population.

4

- (c)
1. Neurones remain depolarised;
  2. So no action potentials / no impulse transmission.

2

- (d)
1. (Mutation) changes shape of sodium ion channel (protein) / of receptor (protein);
  2. DDT no longer complementary / no longer able to bind.

2

[10]

- M5.(a)**
1. Kingdom, Phylum, Class, Order, Family;
  2. *Luscinia svecica*.

*1 mark for each correct column*

*Allow Genus and Species if both placed in box for species but not if both placed in genus box*

2

- (b) Number of different alleles of each gene.

*Accept number of different base sequences (found) in each gene*

- (c)
1. Has greater proportion of genes / percentage of genes showing diversity;
  2. Percentage is 35% compared with 28% / proportion is 0.35 compared with 0.28.

*Allow correct figures that are not rounded up, i.e., 34.9% / 0.349 and 27.8% / 0.278*