

- 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)** 1. Chromosome is formed of two chromatids;  
2. (Because) DNA replication (has occurred);  
3. (Sister) chromatids held together by centromere.

3

- (b) 1. Chromosomes in homologous pair;  
2. One of each into daughter cells / haploid number.

2

(c) Separation of (sister) chromatids / division of centromere. 1

(d) 1. Independent segregation (of homologous chromosomes);  
*Accept random assortment*  
2. Crossing over / formation of chiasmata. 2

[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)** Translation. 1
- (b) Transfer RNA / tRNA. 1
- (c) TAC;  
UAC. 2
- (d) Have different R group.  
*Accept in diagram* 1
- (e) 1. Substitution would result in CCA / CCC / CCU;  
2. (All) code for same amino acid / proline;  
3. Deletion would cause frame shift / change in all following codons /  
change next codon from UAC to ACC. 3

[8]

- M5.(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*

- (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]**