Model Answers: Easy

1a

(a) The Hardy Weinberg equation is used to...

- Calculate/work out allele frequency/frequencies **OR** genotype frequency/frequencies (in a population); [1 mark]

[Total: 1 mark]

1b

(b) Assumptions made by the Hardy Weinberg principle include...

Any **three** of the following:

- Mating is random; [1 mark]
- No natural selection is taking place; [1 mark]
- No gene flow with other populations / migration / immigration / new individuals entering the population / emigration / individuals leaving the population; [1 mark]
- No mutation is occurring; [1 mark]
- The population is large / no genetic drift is taking place; [1 mark]
- Organisms are diploid; [1 mark]
- Only sexual reproduction is taking place / no asexual reproduction is taking place; [1 mark]
- Generations do not overlap; [1 mark]
- Allele frequencies are the same between males and females; [1 mark]

[Total: 3 marks]

There are many marks up for grabs here so focus on the assumptions that you will find the easiest to remember.

1c

(c) In this equation **p** represents...

- The <u>frequency</u> of the <u>dominant</u> allele; [1 mark]

[Total: 1 mark]

The frequency of all of the alleles in a population is 1, or 100 %, so the frequencies of the dominant and recessive alleles must add up to this total, hence *p + q = 1*.

1d

(d) The frequency of the dominant allele is...

- p = 1 - q **OR** 1 - 0.21; [1 mark]
- 0.79; [1 mark]

Full marks awarded for the correct answer in the absence of other calculations

[Total: 2 marks]

$$p + q = 1$$

Rearrange the equation

$$p + q - q = 1 - q$$

$$p = 1 - q \quad [1 \text{ mark}]$$

substitute numbers into the equation

$$p = 1 - 0.21$$

$$= 0.79 \quad [1 \text{ mark}]$$

2a

(a) The type of selection represented by **A** and **B** are...
- A = disruptive (selection); [1 mark]
- B = directional (selection); [1 mark]

[Total: 2 marks]

2b

(b) A description of disruptive selection would include...

Any **two** of the following:
- Individuals with extreme phenotypes are selected for **OR** individuals with intermediate/average phenotypes are selected against; [1 mark]
- Alleles that code for extreme phenotypes increase in frequency (in the population) **OR** high frequencies of two/multiple different sets of alleles are maintained (in the population); [1 mark]
- Polymorphism/two/multiple different phenotypes are maintained; [1 mark]

[Total: 2 marks]

This type of selection may occur in an environment that shows variation. Many different environmental conditions could favour more than one set of alleles, leading to the occurrence of more than one prominent phenotype within that species.

2c

(c) The *fitness* of an organism can be defined as...
- The ability/capacity of the organism to survive (in its habitat); [1 mark]
- And pass on its <u>alleles</u> to its offspring / the next generation; [1 mark]

[Total: 2 marks]

Do not confuse this with physical fitness which refers to the ability to perform exercise. *Biological* fitness refers to the ability of an organism to **survive and reproduce**.

2d

(d) (i) The graph from Fig. 1 that would best represent the type of selection that would occur in the population in part (c) would be...
- **B**; [1 mark]

(d) (ii) The reason for this is that...
- There will be an increase in the <u>frequency</u> of the new <u>allele</u> over time (as the new allele will increase the fitness of the organism that carries it and therefore be selected for); [1 mark]

[Total: 2 marks]

Individuals with the new allele described in (c) are more likely to survive and pass on the allele due to their increased fitness, so the allele will increase in frequency in the population.

3a

(a) The event that led to the change in allele frequency in the northern elephant seal population is...
- The bottleneck effect / population bottleneck; [1 mark]

[Total: 1 mark]

The bottleneck effect occurs when there is a dramatic decrease in numbers within a population followed by a steady increase over time. All the members of the new population will descend from the few survivors.

3b

(b) The disadvantage of a population bottleneck for the northern elephant seal population would be...

Any **two** of the following:
- Alleles are lost (from the population) / there is a decrease in/reduced genetic diversity; [1 mark]
- The survivors breed/reproduce with close relatives / inbreeding occurs / harmful (recessive) alleles are more likely to be inherited together; [1 mark]
- There is a reduced ability to adapt to change in the environment; [1 mark]

[Total: 2 marks]

A population with a reduced gene pool will be less resilient to environmental changes so they therefore have an increased risk of going extinct when these changes occur.

3c

(c) Other processes that may change the allele frequency in a population over time include...

Any **two** of the following:
- Natural selection; [1 mark]
- Genetic drift; [1 mark]
- The founder effect; [1 mark]

[Total: 2 marks]

3d

(d) Genetic diversity is...

- The number of different <u>alleles</u> present in a population/species; [1 mark]

[Total: 1 mark]