10.3 Gene Pools & Speciation

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Course	DP IB Biology
Section	10. Genetics & Evolution (HL Only)
Topic	10.3 Gene Pools & Speciation
Difficulty	Medium

To be used by all students preparing for DP IB Biology HL
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1

The correct answer is **C**.

- Answer **A** is incorrect as it is derived from subtracting the remaining allele frequency (0.28) from 0.72 instead of 1
- Answer **B** is incorrect as it refers to the frequency of both I^A and I^B alleles
- Answer **D** is incorrect as it was calculated by dividing the allele frequency of I^B by 2

Remember that the allele frequency in a population must add up to 1.

① Allele frequency for the I° allele is 0.72
The allele frequency for the remaining two alleles can be calculated as follows:

$$1 - 0.72 = 0.28$$

Since they have an equal abundance in this population, it means that the frequency for the I^B allele will be:

② $0.28 \div 2 = 0.14$ [1 mark]

2

The correct answer is **B**.

In order for a gene pool to be considered stable there should not be any selective pressure on individuals based on their phenotype. In this particular population the trophy hunters exert a selective pressure against Kudu bulls with large, spiralled horns. Over time, one would expect to see a decrease in the allele frequency for these horns.

3

The correct answer is **D**.

The process of evolution by natural selection requires the allele frequencies within a population to change over time. This can happen in a variety of ways including selection for advantageous alleles that increase the fitness of the individual. Those with unfavourable alleles in their genetic makeup will not survive long enough to pass these on to the next generation. Changes in allele frequencies will lead to changes in the dominant phenotype of organisms in a population over time.

4

The correct answer is **B**.

Directional selection is when one extreme in the range of variation is selected for, in this case the giraffes with the longer necks.

Disruptive selection means that the average individuals within the range of variation is selected against, in this case it would be the turtles with an average body size, while those at the two extremes will be selected for.

Stabilising selection is where the average individual is selected for, in this case the cacti with medium spine density.

5

The correct answer is **C** because in order for speciation to occur a population must be split up by a range of different barriers (seasonal, behavioural or geographical). Over time each group will experience different selection pressures and ultimately become reproductively isolated from each other.

- **A** is incorrect because for speciation to occur the barrier must be between individuals of the same species. Different species would already be reproductively isolated from each other
- **B** is incorrect since slight changes to the phenotype would probably not be enough to prevent these individuals from reproducing with members of the same species. Greater changes would be needed to isolate them reproductively
- **D** is incorrect as the ability to mate with one another means that those organisms belong to the same species

6

The correct answer is **A** because the diagram represents geographical (allopatric) speciation. A geographical barrier separates two populations of the same species, with each population adapting to different environments. Over time the genetic differences between the populations accumulate to the point where they become reproductively isolated from each other.

- **B** and **D** are incorrect as the initial barrier that separates the two populations is geographical and not temporal
- **C** is incorrect because the two populations are initially composed of individuals of the same species, not different species

7

The correct answer is **D** because the organisms found in the newer rock layers show gradual changes that took place over many millions of years compared to those found in the older rock layers. The main differences are the size of the lower body and wings that changed over time.

- **A** is incorrect because the changes would have occurred from 500 million years ago until 180 million years ago, not the other way around
- **B** and **C** are incorrect because none of these changes can be considered dramatic, the organisms still resemble each other, besides the increase in abdomen- and wing size

8

The correct answer is **B** because this scenario would not lead to mice that are dramatically different from the original population. This would lead to a more gradual process of speciation, with many small differences accumulating over time.

In each example mentioned at **A**, **C** and **D** there is either some dramatic event wiping out most of the population (such as the species of island rodent or the bacteria killed off by antibiotics) or a new niche that is discovered that favours individuals with a very different genetic makeup to the rest of the population (such as the locusts with very robust mouth parts for eating wheat). These events would drive an abrupt speciation event, which is what the theory of punctuated equilibrium suggests.

9

The correct answer is **B**. Polyploidy increases allele diversity and having multiple copies of the same gene will reduce the chance of recessive mutations being expressed in the phenotype.

- **A** is incorrect because polyploidy will not have an impact on the rate of meiosis or gamete formation
- **C** is incorrect since polyploid individuals will be unable to reproduce with diploid plants, thus it can lead to sympatric speciation
- **D** is incorrect because polyploidy will lead to more crossbred individuals in a population, not a higher occurrence of purebreds

10

The correct answer is **C**.

Statement III is not correct as the effect of environmental factors on the phenotype of individuals will not necessarily require comparing the allele frequencies between those populations. It can therefore not be considered an application of comparing allele frequencies between populations.