



BIOLOGY 2016

Unit 4

Key Topic Test 5 – Population Genetics

Recommended writing time*: 45 minutes

Total number of marks available: 45 marks

SOLUTIONS

SECTION A: Multiple-choice questions (1 mark each)

Question 1

Answer: C

Explanation:

Artificial selection is a non-natural process whereby the gametes from one organism are inserted into another organism.

Question 2

Answer: B

Explanation:

Every individual has their own unique genetic code, with the exception of identical twins. The presence of mutations demonstrate possible lineages between different populations that are evident within the group as a whole.

Question 3

Answer: C

Explanation:

As there is the least amount of migration patterns in the third population, there would be less chance of genetic diversity among the group in comparison to populations 1 and 2.

Question 4

Answer: A

Explanation:

Speciation is the actual splitting of the two populations over a period of time until they can no longer reproduce. The question specifically asks how they originally arose. This is the founder effect due to the small population making a new population. Speciation would come after the founder population occurred.

Question 5

Answer: C

Explanation:

Adaptations are traits that are acquired by individuals to best allow them to living within their environment based on selective agents. The toxins are a selective agent that the animals have adapted to over many generations in this case.

Question 6

Answer: B

Explanation:

As some individuals would die as a result of eating the toxins, they are acting as a selective agent. If others are more careful about not eating the plants due to higher cognitive function then they are more likely to reproduce.

Question 7

Answer: D

Explanation:

Whilst individuals within this population are selected based on their mating rituals, it may not necessarily lead to a genetic drift as they may be heterozygotes. The interspecies selection is the best possible answer.

Question 8

Answer: D

Explanation:

Selection always acts directly on the individual's phenotype and not their genotype.

Question 9

Answer: A

Explanation:

Selective breeding is the deliberate choosing of mates based on particular traits that lead to changes in the overall gene pool. Whilst having a heterozygote advantage within the population is positive for gene flow it does not usually effect the overall population gene pool.

SECTION B – Short-answer solutions

Question 1

- a. A gene pool 1 mark
- b.
- i. Population B has a greater frequency of the dominant A allele and far less of the recessive a allele in comparison to population A. 1 mark
 - ii. Differences in selection pressures within the habitat may exist and the dominant A allele in population B may be a more favourable trait. 1 mark
 - iii. Population A's allele frequency would most likely remain stable as it has a better spread of alleles across the gene pool 1 mark
 - iv. Population B's recessive a allele would be likely to decline as there is a reduction in chance of producing a homozygous recessive individual from the population. 1 mark
 - v. It prevents regular gene flow between the populations 1 mark
- c.
- i. Using heterozygotes increases the spread of AA, Aa and aa across the offspring in the population 1 mark
 - ii. It is not representative of real populations, the change in gene pool still might not be maintained when the kangaroos are placed back into the wild as they may not have a favourable trait that lead to the changes in the first place. 1 mark
- d. Population B 1 mark
- AND
- As it has a low levels of heterozygosity due to its smaller gene pool and lower allele frequency of recessive individuals. 1 mark
- e. Speciation 1 mark
- f. Variation of traits exists within a population of red kangaroos 1 mark
- AND
- Geographical isolation of individuals results in specific traits selected for or against depending on the environmental conditions 1 mark
- AND
- Over a period of time the two populations have developed differences that no long allow them to reproduce to produce viable offspring. 1 mark

Total 14 marks

Question 2

Number of different genes present in organism	Number of different alleles found in a single member of the population	Number of different genotypes found in the gene pool
5	10	15
10	20	30

1 mark per correct box

Total 4 marks

Question 3

- a.** Organisms that reproduce sexually produce gametes that contain half of the genetic material through meiosis. These can form recombinant offspring to increase the variation within the gene pool.

1 mark

AND

Organisms that reproduce by mitosis are only able to give an exact copy of their own DNA into the gene pool.

1 mark

- b.** A mutation

1 mark

AND

A mutation can give rise to a new genotype and phenotype, which if favoured may become incorporated into the gene pool.

1 mark

- c.** The frequency of births would increase and generation span decrease

1 mark

AND

This would increase the population available for reproduction to occur with and thus increase the chance of spread of alleles among the population.

1 mark

Total 6 marks

Question 4

- a.** Similar environments favoured similar traits and thus alleles were maintained from the original population.

1 mark

- b.** They would be unable to produce viable offspring if crossed

1 mark

c.

- i.** Emmigration caused by the seeds of a single tree, or small population relocating, before the continents separated and become geographically isolated.

1 mark

AND

Over a period of time inbreeding has occurred between these individuals and low genetic diversity is present.

- ii. The founder group 1 mark
- iii. The species is undergoing population bottle neck 1 mark
- iv. If a chance event like disease or a natural disaster occurs that increases selection pressures, the baobab may not have adaptations to survive and this could lead to extinction. 1 mark

Total 7 marks

Question 5

- a. Change in allele frequency due to a chance event and not selective agents 1 mark
- b. Founder effect and population bottleneck 1 mark
- c. Founder effect occurs when a small portion of a population is removed from the original population and becomes its own founder population.
OR
Population bottleneck occurs when a population has a severe reduction in size and the gene pool is adversely affected.

1 mark

- d. Migration occurs between populations of members of the same species.

1 mark

AND

Mating between individuals is random and non-selective.

1 mark

Total 5 marks