

Student Name: _____



BIOLOGY 2016

Unit 4

Key Topic Test 5 – Population Genetics

Recommended writing time*: 45 minutes

Total number of marks available: 45 marks

QUESTION BOOK

* The recommended writing time is a guide to the time students should take to complete this test. Teachers may wish to alter this time and can do so at their own discretion.

Conditions and restrictions

- Students are permitted to bring into the room for this test: pens, pencils, highlighters, erasers, sharpeners and rulers.
- Students are NOT permitted to bring into the room for this test: blank sheets of paper and/or white out liquid/tape.
- No calculator is permitted in this test.

Materials supplied

- Question and answer book of 12 pages.

Instructions

- Print your name in the space provided on the top of the front page.
- All written responses must be in English.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic communication devices into the room for this test.

SECTION A – Multiple-choice questions

Instructions for Section A

Select the response that is **most correct** for the question. A correct answer scores 1, an incorrect answer scores 0. Marks are not deducted for incorrect answers. If more than 1 answer is completed for any question, no mark will be given.

Question 1

Which one of the following accurately identifies artificial selection

- A. Introducing a new gene into an existing gene pool
- B. Inoculating a broth of bacterial culture with many strains of bacteria
- C. The insemination of prize bull sperm into a dairy cow
- D. Survival of the fittest lion in a pride

Human population studies are an integral part of determining ancestry and human evolution. The first studies involving mitochondrial DNA (mtDNA) suggested that there are four main ethnic groups, Caucasian, African, Asian and Amerindian.

Question 2

Scientists concluded that differences between the ethnic groups occurred due to:

- A. Them all having different DNA codes
- B. Mutations in the mtDNA being present in some ethnic groups and not others
- C. Molecular markers being found in the same locations of all of the groups
- D. Polymorphic traits within the populations

The following information relates to questions 3 and 4

A parent population of horses undergoes regular immigration and emigration by another horse population (second population). A third population, which started from two individuals leaving the group, have been separated from the parent population for many years.

Question 3

Which of the horse populations would have the least amount of genetic diversity?

- A. Parent population
- B. Second population
- C. Third population
- D. Parent and second populations

Question 4

If the third population of horses became their own species, they would have originally arisen due to:

- A. The founder effect
- B. Polyploidy of the species
- C. Speciation
- D. A population bottleneck

The following information relates to questions 5 and 6

Many plants are able to secrete toxins from their leaves and fruits that can be deadly to animals. Some animals have been able to develop traits that allow them to digest these toxins. The ability to taste bitter tastes more strongly has been a highly selective trait among humans. Humans that were able to taste the toxins were able to find nutritious foods without the risk of death; this has impacted the human population in regards to the inheritance of food tasting preferences.

Question 5

What is the name given to the term that identifies a developed trait, like the ability of some animals to digest the toxins?

- A. Natural selection
- B. Population advantage
- C. Adaptation
- D. Environmental mutation

Question 6

The plants that secrete toxins that result in the death of individuals that consume them would be known as:

- A. The founding population
- B. The selective agent
- C. The mutagenic agent
- D. A niche

Question 7

The black grouse is a large game bird that exhibits unusual mating patterns. In the spring males strut around living areas and exhibit a large and distinctive mating call. Males with a better strut and call are favoured over those who have a diminished call. This is an example of:

- A. A genetic drift where males with a larger strut are selected for and those without are selected against, for mating partners.
- B. Artificial breeding practices where more males with larger struts and mating calls are selected for.
- C. A mechanism of gene flow to improve the genetic variation in offspring
- D. Interspecies sexual selection where males with a larger strut are selected for

Question 8

Malaria is a mosquito borne infection that is common in tropical regions and contributes to many deaths worldwide. Individuals with sickle cell anaemia, however, cannot contract the disease due to a genetic mutation that changed the shape of their red blood cells. This type of selection acts directly on which of the following?

- A. The individuals allele
- B. The individuals genome
- C. The individuals genotype
- D. The individuals phenotype

Question 9

Which of the following would have the greatest impact on the change in allele frequency within a population?

- A. The selective breeding of individuals
- B. The immigration and emigration of individuals
- C. A large number of heterozygotes in the population
- D. Having a large population size

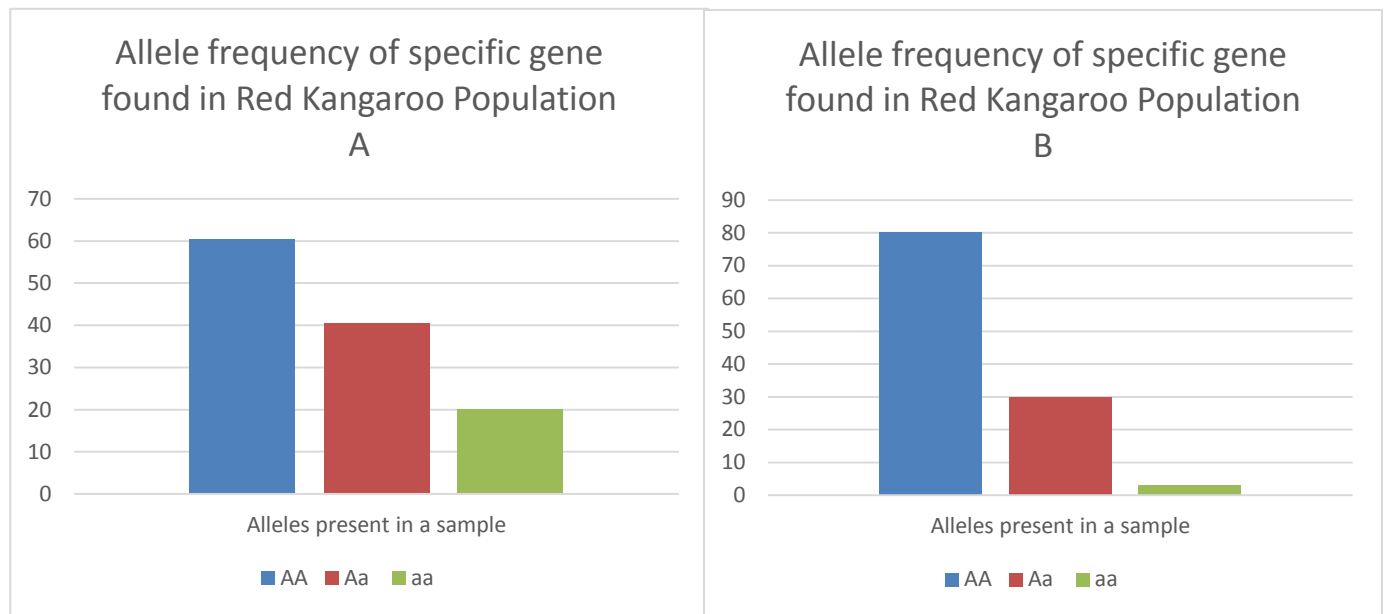
SECTION B- Short-answer questions

Instructions for Section B

Answer all questions in the spaces provided.

Question 1 (14 marks)

The following graphs demonstrate the frequency of a particular allele for a specific gene found in two populations of Red Kangaroo's.



a. What would the sum of the alleles in Population A be known as?

1 mark

b. It was known that population A's habitat is 2000kms away from population B's and the groups were not known to have contact with each other.

i. Identify any differences between the alleles present in each population.

1 mark

ii. Explain a possible reason as to why the populations do not have the same allele frequency despite both being a Red Kangaroo

1 mark

iii. Over a larger period of separation time, what could be expected to occur in population A if environmental conditions remain stable?

1 mark

iv. Over a larger period of separation time, what could be expected to occur in population B if environmental conditions remain stable?

1 mark

v. How do geographical barriers such as distance, impact the gene pool of red kangaroos?

1 mark

c. Captive breeding programs of the Red Kangaroo promote the use of heterozygotes as breeding mates.

i. Outline one benefit of this type of breeding practice.

1 mark

ii. Outline one detriment that this type of breeding practice might have.

1 mark

d. Determine and explain which population would most likely undergo changes that result in it becoming its own distinct species?

2 marks

e. What is the name given to the process outlined in part D?

1 mark

f. Explain how the process outlined in part E occurs.

3 marks

Question 2 (4 marks)

Using your knowledge of population genetics and autosomal dominant/recessive inherited traits involving a single gene, complete the following table.

| 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 | | |

4 marks

Question 3 (6 marks)

- a. Outline how organisms that undergo sexual reproduction to produce offspring assist in increasing the spread of alleles within a population in comparison to those that undergo asexual reproduction.

2 marks

- b. Explain the source of new variation within a population and give an example.

2 marks

- c. Overtime individuals within a sexually reproducing population were able to develop a successful reproductive trait that increased the rate of gestation period. How might this impact the population's gene pool?

2 marks

Question 4 (7 marks)

The Baobab tree, *Adansonia digitata*, is a large African native tree that can live up to 3000 years. Found predominantly in Madagasca, it reproduces via small native animals allowing pollination and produces seeds that have a hard outer covering that are around 20cms in length. A tree from the same genus, *Andansonia gregorii*, is also found in Western Australia, in the Kimerleys. A genetic analysis of the two trees revealed that they are actually the same genus, but different species of the Andansonia genus and it has been suggested that this tree was present before the separation of Australia from Africa in the Gondwana supercontinent.

- a. Explain why the trees found in Africa and Australia still have similar structure despite being different species.

1 mark

- b. Outline a key indicator that would be present to determine that the two species are fully separated and not a subspecies?

1 mark

c. The population found in Australia has been found to have low genetic diversity in comparison to the African species.

i. What does this suggest about migration being an agent of change that resulted in the new species of baobab arising in Australia?

2 marks

ii. What is the name given to the new population of baobab in Australia?

1 mark

iv. Considering the genetic diversity is reduced within the species, what could be occurring to the Australian species?

1 mark

v. Outline how it may adversely affect the population in the long term?

1 mark

Question 5 (5 marks)

a. Define genetic drift

1 mark

b. Name the two processes that can lead to genetic drift

1 mark

c. Outline a cause that could lead to one of the processes outlined in part b.

1 mark

e. Allele frequency in gene pools generally remain stable over time. Outline two conditions that support this statement.

2 marks

END OF KEY TOPIC TEST