INTERNATIONAL UNIVERSITY OF EAST AFRICA
'Learning to Succeed'

FACULTY OF SCIENCE AND TECHNOLOGY

END OF SEMESTER EXAMINATIONS - DECEMBER 2025

PROGRAMME: BSEM
YEAR/SEM: YEAR 3/SEMESTER 1
COURSE CODE: BSE3106
NAME: BASIC CONSERVATION GENETICS

DATE:
TIME:

INSTRUCTIONS TO CANDIDATES:

SECTION A

Attempt all questions in section A by circling the correct answer

Question 1:

1. A key distinction between the negative genetic consequences of inbreeding depression and outbreeding depression is that outbreeding depression: (2marks)

A. Results from the expression of deleterious recessive alleles in a small gene pool.

B. Occurs when gene flow is introduced between two genetically distinct populations, potentially disrupting co-adapted gene complexes.

C. Is caused by a rapid loss of heterozygosity due to the founder effect.

D. Is primarily a concern in ex situ conservation, unlike inbreeding depression, which is a wild population problem.

Question 2:

2. The Allee effect exacerbates the problems of population fragmentation by: (2marks)

A. Increasing the rate of mutation in small, isolated groups.

B. Causing a direct loss of heterozygosity through the breakdown of social structures.

C. Further reducing fitness in small populations through mechanisms like difficulty finding mates.

D. Creating physical barriers that prevent the use of habitat corridors.

Question 3:

3. When using landscape genetics to inform conservation policy for a fragmented large mammal, identifying a "gene flow corridor" would most directly lead to a recommendation to: (2marks)

A. Establish a captive breeding program in that specific area.

B. Prioritize the legal protection and ecological restoration of that landscape segment.

C. Translocate individuals from a source population to a sink population.

D. Collect and bank genetic samples from all individuals passing through the area.

Question 4:

4. Which type of evolution occurs when two species reciprocally influence each other's adaptations? (2marks)

A. Divergent evolution
B. Coevolution
C. Genetic drift
D. Parallel evolution

Question 5:

5. Which statement accurately distinguishes Allopatric speciation from Peripatric speciation? (2marks)

A. Allopatric speciation is controversial, whereas Peripatric speciation is widely accepted.

B. Allopatric speciation results from differences in habitat without a physical barrier, while Peripatric speciation involves a physical barrier.

C. In Allopatric speciation, the separated groups are of roughly equal size, but in Peripatric speciation, one diverging group is much smaller.

D. Peripatric speciation leads to reproductive isolation, while Allopatric speciation does not.

Question 6:

6. Which of the following scenarios best exemplifies how gene flow can counteract the effects of local natural selection? (2marks)

A. Migrating mainland snakes continuously introduce a disadvantageous banded pattern allele into an island snake population, preventing its disappearance.

B. A small population of isolated plants develops a unique, non-adaptive flower color due to random events.

C. An insect population evolves resistance to a newly introduced pesticide.

D. A forest fire reduces a large population of deer, leading to a loss of genetic variation in the survivors.

Question 7:

7. The acquisition of insecticide resistance in the *Anopheles coluzzii* mosquito, initially arising as a mutation in *A. gambiae* and then spreading, is an example of: (2marks)

A. Stabilizing selection.

B. Intraspecific gene flow followed by a founder effect.

C. Interspecific gene flow followed by intraspecific gene flow.

D. A genetic bottleneck event.

Question 8:

8. In the fruit fly example, speciation was considered not to have occurred immediately after the island population was geographically isolated. What event must occur after isolation for speciation to be complete upon reunion? (2marks)

A. The island population had to become much smaller than the mainland population.

B. The two populations had to diverge genetically, leading to reproductive isolation, such as the production of inviable eggs.

C. The island flies had to adopt entirely new food preferences distinct from the mainland flies.

D. A new storm had to reintroduce the island flies back to the mainland physically.

Question 9:

9. Which process does not result in a change in allele frequencies? (2marks)

A. Gene flow
B. Mutation
C. Natural selection
D. Somatic mutations

Question 10:

10. In the context of the bottleneck effect, the surviving individuals are: (2marks)

A. Always better suited to the new environment, leading to adaptive evolution.

B. Selected for their enhanced fitness traits in the new, adverse

conditions.

C. Genetically uniform, as only the most common alleles pass through the bottleneck.

D. Those who survived by chance, often unrelated to their traits, leading to non-adaptive changes in allele frequency.

Question 11:

11. If a small, isolated founder population diverges genetically from the originating population and experiences an increase in the frequency of a previously rare, harmful recessive allele that eventually leads to complete homozygosis, the primary cause is: (2marks)

A. The magnifying effects of inbreeding, a consequence of extreme genetic drift.

B. Predator-prey selection.

C. Strong directional selection.

D. Disruptive selection on an intermediate phenotype.

Question 12:

12. Which type of evolution best explains the independent development of flight in insects, bats, and birds? (2marks)

A. Adaptive radiation
B. Convergent evolution
C. Parallel evolution
D. Divergent evolution

Question 13:

13. What is the fundamental difference between directional selection and stabilizing selection? (2marks)

A. Directional selection favors two or more extreme phenotypes, while stabilizing selection favors the average.

B. Directional selection causes the allele frequency to shift toward one extreme, while stabilizing selection selects against both extremes to favor the average.

C. Directional selection reduces genetic variance, while stabilizing

selection increases it.

D. Directional selection occurs in a changing environment, while stabilizing selection only occurs in a static one.

Question 14:

14. The observation that most snakes on the Lake Erie mainland are strongly banded (beneficial for camouflage in marshes), while most on the islands are uniformly coloured (beneficial on rocky shores), illustrates the outcome of: (2marks)

A. Stabilizing selection.

B. Sexual selection.

C. Local natural selection favoring different traits in different environments.

D. A founder effect followed by a genetic bottleneck.

Question 15:

15. A large population is least likely to lose a significant percentage of its beneficial alleles through the effects of: (2marks)

A. Genetic drift.

B. Disruptive selection.

C. Gene flow.

D. Natural selection.

Question 16:

16. Which of the following is not a key takeaway regarding the effects of genetic drift? (2marks)

A. It can reduce genetic variation within a population.

B. The changes it produces are generally non-adaptive.

C. It tends to homogenize the genetic makeup of different populations.

D. Its effects are stronger in small populations.

Question 17:

17. In diversifying (disruptive selection), the medium-sized individuals are often less fit than the extreme phenotypes because: (2marks)

A. They are susceptible to both sexual and predator-prey selection pressures.

B. They lack the specific advantages of either extreme phenotype in that environment.

C. Their intermediate traits are randomly lost due to genetic drift.

D. They are favored in stabilizing selection, which conflicts with disruptive selection.

Question 18:

18. A small isolated cheetah population shows extremely low genetic diversity. Which evolutionary force is most responsible for this pattern? (2marks)

A. Genetic drift
B. Gene flow
C. Mutation
D. Artificial selection

Question 19:

19. For gene flow to occur, an organism migrating to a receiving population must not only arrive but also: (2marks)

A. Possess advantageous traits in the new environment.

B. Be from a highly mobile species, such as birds or bats.

C. Be protected from natural selection in the new environment.

D. Reproduce and pass on its genes to that population's gene pool.

Question 20:

20. Which mechanism of evolution can introduce entirely new genetic variation into a population? (2marks)

A. Natural selection
B. Genetic drift

C. Mutation
D. Non-random mating

SECTION B

Choose 3 questions from section B

Question 1:

1. Explain the concept of directional selection and illustrate it using the classic example of the Peppered Moth during the Industrial Revolution. Describe how the shift in the environment caused a change in the favored phenotype. (20marks)

Question 2:

2. Distinguish between the bottleneck effect and the founder effect as extreme cases of genetic drift, and detail the causes and consequences of each. Explain how both events can lead to similar outcomes in the new population. (20marks)

Question 3:

3. Discuss the four main mechanisms of evolution and explain how each contributes differently to changes in allele frequencies within populations. (20marks)

Question 4:

4. Compare and contrast convergent, divergent, parallel, and coevolution. Use examples to illustrate how different environments and interactions shape species evolution. (20marks)

Question 5:

5. Describe the founding, growth, and reinforcement phases of a captive breeding program, and critically evaluate how each phase influences long-term species recovery and genetic diversity. (20marks)

Question 6:

6. Describe how gene flow and migration contribute to genetic variation within populations. Evaluate situations in which gene flow is beneficial versus those in which it may hinder local adaptation. (20marks)

Question 7:

7. a) Critically analyze the importance of maintaining genetic diversity in captive populations. (10marks)

b)

Discuss the mechanisms by which diversity is lost and management strategies that can be implemented to prevent inbreeding depression. (10marks)

Question 8:

8. a) Discuss the mechanisms by which inbreeding significantly contributes to the risk of extinction in small populations. (10marks)

b) Explain the advantages and disadvantages of inbreeding (10marks)

Question 9:

9. Focusing on postzygotic isolation mechanisms, describe Hybrid Inviability, Hybrid Sterility, and Hybrid Breakdown. Provide a distinct real-world example for each mechanism that illustrates how it prevents successful gene flow between species. (20marks)

Question 10:

10. Explain the heterosis and risks of outbreeding (20marks)

Question 11:

11. a) Explain the overall significance of reproductive isolation in conservation (10marks)

b) Explain the key steps involved in the crossbreeding process. (10marks)

Question 12:

12. Discuss the five types of speciation (20marks)