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Daffodil International University

Department of Genetic Engineering and Biotechnology
Faculty of Health and Life Sciences
B. Sc. (Hons.) in Genetic Engineering and Biotechnology
Midterm Examination Fall 2026

Course Code: 0521-2105
Level and Term: L-2, T-1
Time: 1 Hour 30 Minutes

Section: 253 (A+B)

Course Title: Animal Breeding
Course Teacher Initials: MAR
Total Marks: 25

Answer the following questions:

Marks

1. A livestock development officer in a rural district of Bangladesh surveys local cattle kept by smallholders across several villages. These animals interbreed freely, differ widely in coat colour and body size, and have no pedigree records. A nearby private farm keeps a Holstein Friesian herd with a registered pedigree, a uniform appearance, and a known history of selection for milk yield. [CLO1, PLO1]

(a) Decide whether each group is better described as an animal population or a breed, and justify each decision with evidence from the scenario. 2.5

(b) The officer decides to start an Animal Breeding Program (ABP) for the local cattle. List the first four steps of the ABP in the correct order and name one trait that could be set as the breeding goal. 2.5

2. A breeder owns a polled (hornless) bull and plans to use it widely in a herd of horned cows. The polled allele (P) is dominant over the horned allele (p). Before using the bull, the breeder wants to know whether it is homozygous (PP) or heterozygous (Pp). [CLO2, PLO12]

(a) Apply a test cross to this bull. Show, with Punnett squares, the offspring genotypes and phenotypes expected from mating it with horned cows if the bull is (i) PP and (ii) Pp. 2.5

(b) The bull is mated with several horned cows and produces eight calves, all polled. Analyze whether the breeder can be certain that the bull is PP, supporting your answer with the probability of this result if the bull were Pp. 2.5

3. A cat breeder notices that tortoiseshell cats in her cattery are almost always female. The coat colour gene is X-linked: the allele X^O produces orange fur and the allele X^B produces black fur, and heterozygous females show both colours. She plans to mate a tortoiseshell female with an orange male. [CLO2, PLO12]

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(a) Predict the genotypes and phenotypes, including the sex, of the kittens expected from this cross by constructing a Punnett square. 3

(b) Explain why tortoiseshell cats are almost always female and why their fur shows patches of orange and black, with reference to X-chromosome inactivation. 2

4 In a flock of 500 sheep, 20 animals show a recessive coat-colour trait (aa). Assume that the flock is in Hardy–Weinberg equilibrium for this gene, where A is the dominant allele and a is the recessive allele. [CLO3, PLO4]

(a) Calculate the frequencies of alleles A and a, and the expected number of heterozygous (Aa) carrier sheep in the flock. 3

(b) Explain what it means for the flock to be in Hardy–Weinberg equilibrium, and state two conditions that must be met. 2

5 A cyclone kills most of an indigenous cattle population in a coastal village, and only 12 animals survive, including two bulls. The farmers plan to mate the survivors among themselves, while a local project proposes introducing a few exotic high-yielding bulls to boost milk production. [CLO4, PLO11]

(a) Analyze how the cyclone and the plan to mate only the survivors can change allele and genotype frequencies in the coming generations, naming the evolutionary forces involved. 2.5

(b) Evaluate the proposal to introduce exotic bulls by giving one benefit and one risk for the local population, and recommend, with justification, whether the project should proceed. 2.5

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