BINDURA UNIVERSITY OF SCIENCE EDUCATION
DEPARTMENT OF SCIENCE AND MATHEMATICS EDUCATION
BZH107 GENETICS

EXAMINATION
2 HOURS (100 MARKS)

≑ AUG 202 4

## INSTRUCTIONS TO CANDIDATES

Answer **FOUR** questions. You **MUST** answer **QUESTION 1 (Section A)** and any **THREE** questions from **Section B**. Each question carries **25 MARKS**. Where a question contains subdivisions, the mark value of each subdivision is given in brackets. Illustrate your answers where appropriate with large, clearly labelled diagrams. You should not spend more than thirty minutes on each question.

## SECTION A (COMPULSORY)

1. A geneticist crosses tall pea plants with short pea plants. All the F 1 plants are tall. The F1 plants are then allowed to self-fertilize, and the F2 plants are classified by height: 62 tall and 26 short. From these results, the geneticist concludes that shortness in peas is due to a recessive allele (t) and that tallness is due to a dominant allele (T).

On this hypothesis, 2/3 of the tall F2 plants should be heterozygous **Tt**. To test this prediction, the geneticist uses pollen from each of the 62 tall plants to fertilize the ovules of emasculated flowers on short pea plants. The next year, three seeds from each of the 62 crosses are sown in the garden and the resulting plants are grown to maturity. If none of the three plants from a cross is short, the male parent is classified as having been homozygous **TT**; if at least one of the three plants from a cross is short, the male parent is classified as having been heterozygous **Tt**. Using this system of progeny testing, the geneticist concludes that 29 of the 62 tall F 2 plants were homozygous **TT** and that 33 of these plants were heterozygous **Tt**.

(a) (i) Using the chi-square procedure, evaluate these results for goodness of fit to the prediction that 2/3 of the tall F2 plants should be heterozygous.          (5 marks)

(ii) Informed by Genetics: Mendel's, explain why the geneticist's procedure for classifying tall F2 plants by genotype is not definitive.          (3 marks)

(iii) Adjust for the uncertainty in the geneticist's classification procedure and calculate the expected frequencies of homozygotes and heterozygotes among the tall F 2 plants.          (4 marks)

(iv) Evaluate the predictions obtained in (c) using the chi square procedure.
          (3 marks)

(b) (i) State the five conditions that must be met in order for a population to be in genetic equilibrium according to the Hardy Weinberg law.              (5 marks)

(ii) Explain the significance of the Hardy Weinberg law in understanding genetic variations within populations.              (2 marks)

(iii) Explain how the deviations from the Hardy Weinberg equilibrium can provide insight into evolutionary processes within a population.              (3 marks)

## SECTION B

2. (a) Differentiate between mitosis and meiosis.              (10 marks)

(b) Describe the following:

(i) Central dogma in genetics.              (5 marks)

(ii) Structure of nucleotide.              (5 marks)

(iii) Genetic code.              (5 marks)

3. (a) Describe the three main types of natural selection.              (10 marks)

(b) Describe the four techniques used in gene mapping.              (10 marks)

(c) Give an example of a genetic disorder and explain how it occurs.              (5 marks)

4. (a) Distinguish between DNA and RNA:
(i) Chemically              (3 marks)

(ii) Functionally              (5 marks)

(iii) Location in the cell.              (2 marks)

(b) Explain the following on translation:

(i) Initiation.              (3 marks)

(ii) Termination.              (2 marks)

(c) (i) State the difference between a nonsense mutation and a missense mutation.              (1 mark)

(ii) Are nonsense or missense mutations more frequent in living organisms?

(1 mark)

(iii) Give reason for your answer on 4 (c) (ii). (3 marks)

(d) Identify the following point mutations represented in DNA and in RNA as:

(1) transitions, (2) transversions, or (3) reading frameshifts.

(i) A to G (1 mark)

(ii) C to G (1 mark)

(iii) T to A (1 mark)

(iv) UAU ACC UAU to UAU AAC CUA; (1 mark)

(v) UUG CUA AUA to UUG CUG AUA (1 mark)

5. Explain in detail the differences between continuous and discontinuous variation.

6. Natural selection leads to evolution. Explain.

**END OF EXAMINATION QUESTION PAPER**