

Principles of Inheritance and Variation — Assignment 2

Class 12 Biology · Higher-difficulty challenge set + integrated problems · Answer key included · Narayan Gurukul Academy

Instructions: (1) Attempt all questions; start with the topic-wise challenge set, then attempt the integrated (multi-topic) problems.
(2) Give all answers with correct SI units. $g = 10 \text{ m/s}^2$ unless stated.
(3) A final answer key is provided at the end — try the full set before checking it.

Part A — Topic-wise challenge questions

Mendel's Experiments and Laws of Inheritance

1. Why did Mendel choose pea plant?
2. State the law of dominance.
3. State and explain Mendel's three laws of inheritance.

Extensions of Mendelism

1. What is incomplete dominance?
2. What is co-dominance?
3. Describe the extensions of Mendelism with examples.

Linkage, Recombination and Sex Determination

1. What is linkage?
2. Describe sex determination in humans.
3. Explain linkage and recombination.

Sex-Linked Disorders

1. What is a sex-linked disorder?
2. Why is colour blindness more common in males?
3. Explain the inheritance of haemophilia.

Pedigree Analysis

1. What is pedigree analysis?
2. What does a square represent in a pedigree?
3. How is pedigree analysis used to trace a trait?

Chromosomal and Mendelian Disorders

1. Give two examples of Mendelian disorders.
2. What causes Down's syndrome?
3. Explain sickle-cell anaemia and its inheritance.

Part B — Integrated problems (multi-topic)

1. State and explain Mendel's three laws of inheritance.
2. Describe the various extensions of Mendelism with examples.
3. Explain the chromosomal theory of inheritance and sex-linked inheritance.
4. Describe sex determination in humans.
5. Explain Down's, Turner's and Klinefelter's syndromes.
6. Explain sickle-cell anaemia and describe its inheritance.

Answer Key

Mendel's Experiments and Laws of Inheritance

Mendel worked on garden pea. Laws: (1) dominance, (2) segregation (purity of gametes), (3) independent assortment. Monohybrid F₂ = 3:1, dihybrid F₂ = 9:3:3:1.

Extensions of Mendelism

Incomplete dominance (pink snapdragon, 1:2:1), co-dominance (AB blood group), multiple alleles (ABO), pleiotropy and polygenic inheritance.

Linkage, Recombination and Sex Determination

Linked genes on the same chromosome are inherited together; crossing over produces recombinants (Morgan). In humans, females are XX and males XY; the male gamete determines sex.

Sex-Linked Disorders

X-linked recessive disorders such as haemophilia and colour blindness affect males more because males have one X chromosome.

Pedigree Analysis

A family tree using standard symbols to trace the inheritance of a trait across generations and deduce its mode of inheritance.

Chromosomal and Mendelian Disorders

Chromosomal: Down's (trisomy 21), Turner's (XO), Klinefelter's (XXY). Mendelian: haemophilia, sickle-cell anaemia, thalassaemia, phenylketonuria.

Integrated problems

- 1: Dominance, segregation and independent assortment. 2: Incomplete dominance, co-dominance and multiple alleles.
- 3: Genes on chromosomes; X-linked recessive disorders affect males. 4: XX female, XY male; male gamete determines sex. 5: Trisomy 21; XO female; XXY male. 6: Autosomal recessive; glutamic acid replaced by valine in beta-globin.