INDIAN SCHOOL AL WADI AL KABIR		
CLASS: XII	**DEPARTMENT: SCIENCE 2026 – 2027** **SUBJECT: BIOLOGY**	**DATE: 02/05/2026**
WORKSHEET NO. 4	**UNIT- VII- GENETICS** **CHAPTER:04 PRINCIPLES OF INHERITANCE AND VARIATION**	**NOTE:** **A4 FILE FORMAT**
NAME OF THE STUDENT:	**CLASS & SEC:**	**ROLL NO.**

I. OBJECTIVE-TYPE QUESTIONS

1. A plant having the genotype AABbCC will produce how many kinds of gametes?
   A. 5
   B. 4
   C. 3
   D. 2
2. Which of the following is an example of polygenic inheritance?
   A. Human skin color
   B. Flower color in *Mirabilis jalapa*
   C. Pod shape in garden pea
   D. Production of male honey bees
3. A person with genotype I^AI^B shows the AB blood group due to:
   A. Pleiotropy
   B. Co-dominance
   C. Incomplete dominance
   D. Segregation
4. Down syndrome is caused by the:
   A. Monosomy of the 21st chromosome
   B. Trisomy of the 21st chromosome
   C. Extra X chromosome in males
   D. Absence of an X chromosome in females
5. Distance between genes and the percentage of recombination shows:
   A. An inverse relationship
   B. A parallel relationship
   C. A direct relationship
   D. No relationship
6. In sickle cell anemia, glutamic acid is replaced by valine. Which triplet codes for valine?
   A. GGG
   B. AAG
   C. GAA
   D. GUG

7. Haemophilia is a genetic disorder that is:
   A. Autosomal dominant
   B. X-linked recessive
   C. X-linked dominant
   D. Autosomal recessive
8. A Turner's syndrome female has how many chromosomes?
   A. 45 (XO)
   B. 47 (XXY)
   C. 47 (XYY)
   D. 44 (Autosomes only)

For the following questions, two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (i), (ii), (iii), and (iv) as given below:

A. Both A and R are true, and R is the correct explanation of the assertion.
B. Both A and R are true, but R is not the correct explanation of the assertion
C. A is true, but R is false.
D. A is false, but R is true

9. **Assertion (A):** Deletions and insertions of base pairs of DNA cause a frame shift mutations.
   Reason (R): Such mutations result in a change in the reading frame from the point of insertion or deletion.
10. **Assertion (A):** In a monohybrid cross, the F1 generation always resembles both parents.
    Reason (R): According to the Law of Dominance, only one parental character is expressed in the F_1 generation.
11. **Assertion (A):** A person with 'O' blood group has neither A nor B antigens on their Red Blood Cells.
    Reason (R): The allele "***i***" does not produce any sugar polymer (antigen).

II. VERY SHORT QUESTIONS (2M):

12. What is a point mutation? Give one example.
13. Explain how the sex of a child is determined in humans.
14. Define "Pleiotropy" and provide a suitable example from the human body.
15. What is Turner's Syndrome?

III. SHORT ANSWER TYPE QUESTIONS: (3M)

16. Why is *Drosophila melanogaster* (fruit fly) suitable for genetic studies?
17. Define and design a test cross.
18. What is Colour Blindness? Explain its inheritance pattern.
19. Differentiate between the following.
    (a) Dominance and Recessive
    (b) Homozygous and Heterozygous
    (c) Monohybrid and Dihybrid

IV. SOURCE-BASED/ CASE STUDY-BASED QUESTIONS

20. Haemophilia is a sex-linked recessive disorder that shows its transmission from an unaffected carrier female to some of the male progeny. It involves a protein that is a part

of the cascade of proteins involved in the clotting of blood. In an affected individual, a simple cut will result in non-stop bleeding. The heterozygous female (carrier) for haemophilia may transmit the disease to her sons. The possibility of a female becoming a haemophiliac is extremely rare because the mother of such a female has to be at least a carrier, and the father should be haemophilic.

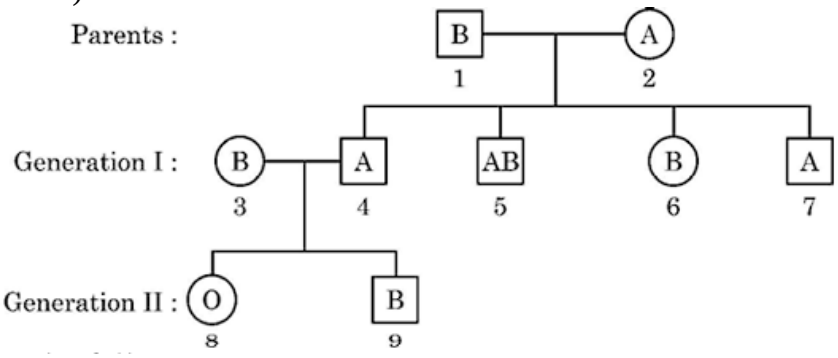
A. Why is haemophilia more common in males than in females?
B. What is the genotype of a "carrier" female?
C. If a normal man marries a carrier woman, what percentage of their sons are likely to be haemophilic?
D. Why is this disorder referred to as a "sex-linked recessive" trait?

V.LONG ANSWER TYPE QUESTIONS. (5M)

21. (a)Mention any two autosomal genetic disorders with their symptoms.
    (b) Explain the cause and symptoms of Phenylketonuria (PKU).
22. (a) A diploid organism is heterozygous for 4 loci; how many types of gametes can be produced?
    (b) Define Linkage and Recombination. How does the tight linkage between two loci affect the number of gamete types produced compared to independent assortment?

VI BOARD QUESTIONS

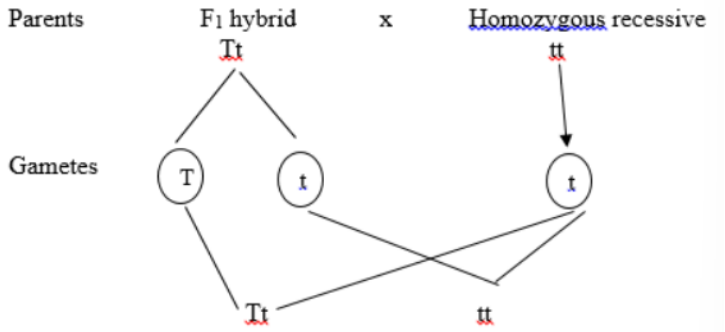
23. **Assertion(A):** When two genes in a dihybrid cross are situated on the same chromosome, the proportion of parental gene combinations is much higher than non-parental types.
    Reason(R): Higher parental gene combinations can be attributed to crossing over between two genes. (CBSE 2025)
24. Study the pedigree chart given below, showing the inheritance pattern of blood group in a family: (CBSE 2025)

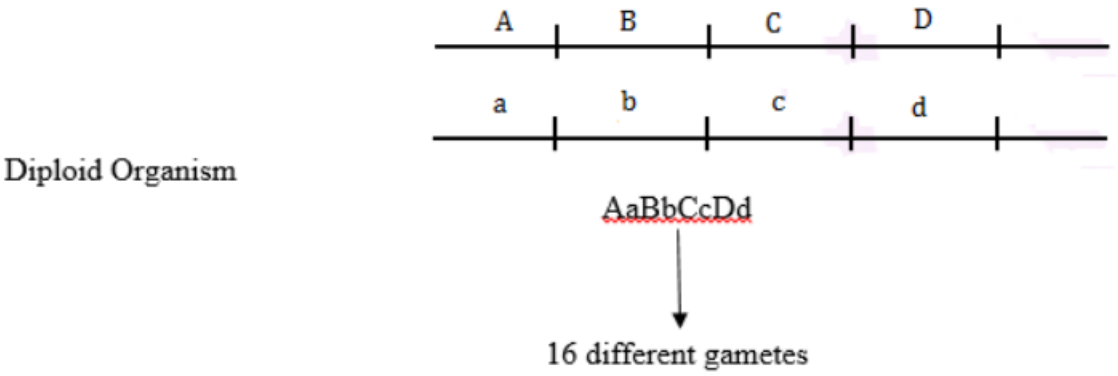


Answer the following questions:
(a) Give the possible genotypes of individuals 1 and 2.
(b) Which antigen or antigens will be present on the plasma membranes of the RBCs of individuals ‘5’ and ‘8’?

25. (a) How does a chromosomal disorder differ from a Mendelian disorder? Write one example for each.
    (b) Name the phenomenon that leads to conditions such as the ‘XO’ abnormality in humans. Also, name this genetic disorder. How are individuals with an XO chromosomal abnormality affected? Write its symptoms as well as karyotype. (CBSE 2026)

ANSWER KEY	
I. OBJECTIVE-TYPE QUESTIONS	
1.	D. 2
2.	A. Human skin color
3.	B. Co-dominance
4.	B. Trisomy of the 21st chromosome
5.	C. A direct relationship
6.	D. GUG
7.	B. X-linked recessive
8.	A. 45 (XO)
II	**VERY SHORT QUESTIONS (2M):**
9.	A. Both A and R are true, and R is the correct explanation of the assertion.
10.	D. A is false, but R is true
11.	A. Both A and R are true, and R is the correct explanation of the assertion.
II. VERY SHORT ANSWER TYPE QUESTIONS: (2M)	
12.	A point mutation is a gene mutation that arises due to a change in a single base pair of DNA. **Example:** Sickle-cell anemia is the most common example. It occurs due to a substitution of a single base pair in the gene coding for the β-globin chain of hemoglobin. This change results in the substitution of Glutamic acid (Glu) by Valine (Val) at the sixth position of the β-globin chain.
13.	In humans, sex is determined by the sex chromosomes present in the sperm that fertilizes the ovum. Since females are homogametic (XX), all eggs carry an X chromosome. In contrast, males are heterogametic (XY) and produce two types of sperm: 50% carrying an X and 50% carrying a Y. If a sperm carrying an X chromosome fertilizes the egg, the child will be female (XX), and if a sperm carrying a Y chromosome fertilizes the egg, the child will be male (XY).
14.	Pleiotropy is a genetic phenomenon where a single gene mutation affects multiple, seemingly unrelated phenotypic traits. A classic example in humans is **Phenylketonuria (PKU)**, where a single gene mutation results in the lack of an enzyme; this leads to a variety of symptoms, including mental retardation, reduction in hair growth, and skin depigmentation.
15.	Turner's Syndrome is a chromosomal disorder caused by the absence of one of the X chromosomes, resulting in a genetic constitution of 45XO. This is an example of **a**neuploidy (specifically monosomy). **Key Features/Symptoms:** • **Sex:** Such individuals are sterile females. • **Physical Traits:** They have rudimentary ovaries (underdeveloped). • **Other Characteristics:** They lack other secondary sexual characteristics and typically exhibit short stature.
III	**SHORT ANSWER TYPE QUESTIONS (3M)**
16.	They can be grown on a simple synthetic medium in the laboratory, requiring minimal space and maintenance. **Rapid Life Cycle:** They complete their entire life cycle in about two weeks, allowing scientists to study many generations in a short period.

	Prodigious Progeny: A single mating produces a very large number of offspring, which provides a significant statistical sample for analyzing inheritance patterns. **Sexual Dimorphism:** There is a clear and visible differentiation of the sexes. The female is generally larger, while the male is smaller with a darker posterior, making them easy to separate for controlled breeding. **Genetic Variation:** They possess many types of hereditary variations (such as eye color, wing shape, and body color) that are easily observable under a low-power microscope.
17.	A test cross can be defined as a cross of an F_1 individual that has a dominant phenotype with its homozygous recessive parent. This test cross can be used to determine if an individual displaying a dominant character is homozygous or heterozygous. For eg, • Take a tall plant (TT) and cross it with a dwarf plant(tt). • The F_1 generation shows a tall plant (Tt). • This tall plant (Tt) is then test-crossed with a homozygous recessive plant(tt). 
18.	It is a **sex-linked recessive** disorder where the individual fails to distinguish between red and green colours due to a defect in the cone cells of the retina. **Chromosomal Location:** The genes responsible for color vision are located on the X-chromosome**.** **Gender Disparity:** **Males:** Since males have only one X chromosome (XY), a single recessive allele on the X chromosome is enough to cause the disorder. This is why ~8% of males are colour blind. **Females:** Females have two X chromosomes (XX). They only become colour blind if both X chromosomes carry the recessive allele. If only one is present, they are "carriers" but have normal vision. **Criss-Cross Inheritance:** A colour-blind father passes the gene to his daughters (who become carriers), who then pass it to their sons. A son cannot inherit colour blindness from his father; he always gets it from his mother.
19.	(a) **Dominance and Recessive:** • **Dominance:** A dominant allele expresses itself in the presence of a recessive allele. • **Recessive:** A recessive allele only expresses itself in the absence of a dominant allele. (b) **Homozygous and Heterozygous:** • **Homozygous:** An individual has two identical alleles for a trait (e.g., TT or tt). • **Heterozygous:** An individual has two different alleles for a trait (e.g., Tt). (c) **Monohybrid and Dihybrid:** • **Monohybrid:** A cross between two organisms differing in a single trait (e.g., seed color). • **Dihybrid:** A cross between two organisms differing in two traits (e.g., seed color and seed shape).

IV. SOURCE-BASED/ CASE STUDY-BASED QUESTIONS	
20.	A. Males have only one X chromosome. Since the disorder is X-linked recessive, a single faulty gene on their X chromosome is enough to cause the disease. Females need two faulty genes (one on each X) to be affected.
	B. The genotype is X^HX^h (where X^h represents the haemophilic allele).
	C**.** 50% of the sons. (The mother passes either X^H or X^h to her sons; the father provides the Y chromosome).
	D. It is sex-linked because the gene is located on the X chromosome, and recessive because the trait only expresses itself in females when both alleles are defective (homozygous state).
V. LONG ANSWER TYPE QUESTIONS. (5M)	
21.	**(a)Autosomal Genetic Disorders and Their Symptoms** **Down's Syndrome Symptoms:** • Flat hands and short neck • Broad forehead • Partially open mouth with a furrowed tongue • Mongolian-type eyelid fold and stubby fingers • Stunted psychomotor, physical, and mental development • Heart deformities and deformities in other organs • Underdeveloped genitalia and gonads **Sickle Cell Anaemia Symptoms**: • The shape of red blood cells (RBCs) changes from round, biconcave discs to sickle-shaped (curved) under low oxygen tension. • Sickle-shaped RBCs are rigid and less flexible, causing them to get stuck in small blood vessels, which can lead to pain episodes, anemia, and organ damage. • Individuals may experience episodes of severe pain, known as "sickle cell crises." • Increased risk of infections, fatigue, and delayed growth. (b) PKU is an autosomal recessive metabolic disorder caused by the lack of an enzyme called **phenylalanine hydroxylase**, which converts the amino acid phenylalanine into tyrosine. Symptoms include intellectual disability and behavioral problems due to the accumulation of phenylalanine in the brain.
22.	(a)A diploid organism heterozygous at four loci (e.g., Mm, Nn, Oo, Pp) can produce 16 different types of gametes, as each pair of alleles can produce two types of gametes (e.g., M or m for the first locus, N or n for the second, etc.). 

	(b) **Linkage:** The physical association of two or more genes on the same chromosome. **Recombination:** The process of crossing over during meiosis that produces new combinations of alleles in offspring. **Effect of Tight Linkage:** If two loci are "tightly linked" (very close together on the same chromosome), they tend to be inherited together as a single unit rather than segregating independently. **Impact on Gametes:** This reduces gamete diversity. For example, in a dihybrid (AaBb), independent assortment produces **4** types of gametes, but tight linkage might result in only **2** types (the parental combinations) because crossing over between them is rare.
VI	**BOARD QUESTIONS**
23.	(C) Assertion (A) is true, but Reason (R) is false.
24.	(a) Individual 1 = I^Bi, Individual 2 = I^Ai. (b) Individual 5 - Antigens A and B are both present on RBCs. Individual 8 - Neither antigen A nor Antigen B is present on the RBCs
25.	(a) **Chromosomal vs. Mendelian Disorders** **Mendelian Disorders:** These are caused by an alteration or mutation in a single gene. They follow Mendelian inheritance patterns (e.g., dominant or recessive). *Example:* Haemophilia or Sickle-cell anaemia. **Chromosomal Disorders:** These are caused by the absence, excess, or abnormal arrangement of one or more entire chromosomes. *Example:* Down's syndrome or Turner's syndrome. **(b)** The condition is caused by non-disjunction, which is the failure of chromatids to segregate during cell division, leading to the loss of a chromosome (aneuploidy). **Genetic Disorder: Turner's Syndrome**. **Affected Individuals:** These individuals are **sterile females**. **Karyotype:** 45 chromosomes with XO (44 + XO). **Symptoms:** Rudimentary ovaries (lack of secondary sexual characters). Short stature. Webbed neck. Lack of menstruation.

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