MULTIPLE-CHOICE QUESTIONS

1. All genes located on the same chromosome:
a. Form different groups depending upon their relative distance
b. Form one linkage group
c. Will not from any linkage groups
d. Form interactive groups that affect the phenotype
Solution:
Option (b) is the answer.

2. Conditions of a karyotype 2n +1, 2n –1 and 2n + 2, 2n – 2 are called:
a. Aneuploidy
b. Polyploidy
c. Allopolyploidy
d. Monosomy
Solution:
Option (a) is the answer.

3. Distance between the genes and the percentage of recombination shows:
a. a direct relationship
b. an inverse relationship
c. a parallel relationship
d. no relationship
Solution:
Option (a) is the answer.

4. If a genetic disease is transferred from a phenotypically normal but carrier female to only some of the male progeny, the disease is:
a. Autosomal dominant
b. Autosomal recessive
c. Sex-linked dominant
d. Sex-linked recessive
Solution:
Option (d) is the answer.

5. In sickle cell anaemia glutamic acid is replaced by valine. Which one of the following triplets codes for valine?
a. G G G
b. A A G
c. G A A
d. G U G
Solution:
Option (d) is the answer.

6. The person having genotype IA IB would show the blood group as AB. This is because of:

a. Pleiotropy
b. Co-dominance
c. Segregation
d. Incomplete dominance
Solution:
Option (b) is the answer.

7. Z Z / ZW type of sex determination is seen in:
a. Platypus
b. Snails
c. Cockroach
d. Peacock
Solution:
Option (d) is the answer.

8. A cross between two tall plants resulted in offspring having few dwarf plants. What would be the genotypes of both the parents?
a. TT and Tt
b. Tt and Tt
c. TT and TT
d. Tt and tt
Solution:
Option (b) is the answer.

9. In a dihybrid cross, if you get 9:3:3:1 ratio it denotes that:
a. The alleles of two genes are interacting with each other
b. It is a multigenic inheritance
c. It is a case of multiple allelism
d. The alleles of two genes are segregating independently
Solution:
Option (d) is the answer.

10. Which of the following will not result in variations among siblings?
a. Independent assortment of genes
b. Crossing over
c. Linkage
d. Mutation
Solution:
Option (c) is the answer.

11. Mendel's Law of independent assortment holds good for genes situated on the:
a. non-homologous chromosomes
b. homologous chromosomes
c. extranuclear genetic element
d. same chromosome

Solution:
Option (b) is the answer.

12. Occasionally, a single gene may express more than one effect. The the phenomenon is called:
a. multiple allelism
b. mosaicism
c. pleiotropy
d. polygeny
Solution:
Option (c) is the answer.

13. In a certain taxon of insects, some have 17 chromosomes and the others have 18 chromosomes. The 17 and 18 chromosome-bearing organisms are:
a. males and females, respectively
b. females and males, respectively
c. all males
d. all females
Solution:
Option (a) is the answer.

14. The inheritance pattern of a gene over generations among humans is studied by the pedigree analysis. Character studied in the pedigree analysis is equivalent to:
a. quantitative trait
b. Mendelian trait
c. polygenic trait
d. maternal trait
Solution:
Option (b) is the answer.

15. It is said that Mendel proposed that the factor controlling any character is discrete and independent. His proposition was based on the
a. results of the F3 generation of a cross.
b. observations that the offspring of a cross made between the plants having two contrasting characters shows only one character without any blending.
c. self-pollination of F1 offsprings
d. cross-pollination of F1 generation with recessive parent
Solution:
Option (b) is the answer.

16. Two genes 'A' and 'B' are linked. In a dihybrid cross involving these two genes, the F1 heterozygote is crossed with the homozygous recessive parental type (aa bb). What would be the ratio of offspring in the next generation?

a. 1: 1 : 1: 1
b. 9 : 3 : 3: 1
c. 3: 1
d. 1: 1
Solution:
Option (d) is the answer.

17. In the F2 generation of a Mendelian dihybrid cross the number of phenotypes and genotypes are:
a. phenotypes - 4; genotypes - 16
b. phenotypes - 9; genotypes - 4
c. phenotypes - 4; genotypes - 8
d. phenotypes - 4; genotypes - 9
Solution:
Option (d) is the answer.

18. Mother and father of a person with 'O' blood group have 'A' and 'B' blood group, respectively. What would be the genotype of both mother and father?
a. Mother is homozygous for 'A' blood group and father is heterozygous for 'B'
b. Mother is heterozygous for 'A' blood group and father is homozygous for 'B'
c. Both mother and father are heterozygous for 'A' and 'B' blood group, respectively
d. Both mother and father are homozygous for 'A' and 'B' blood group, respectively
Solution:
Option (c) is the answer.

VERY SHORT ANSWER TYPE QUESTIONS

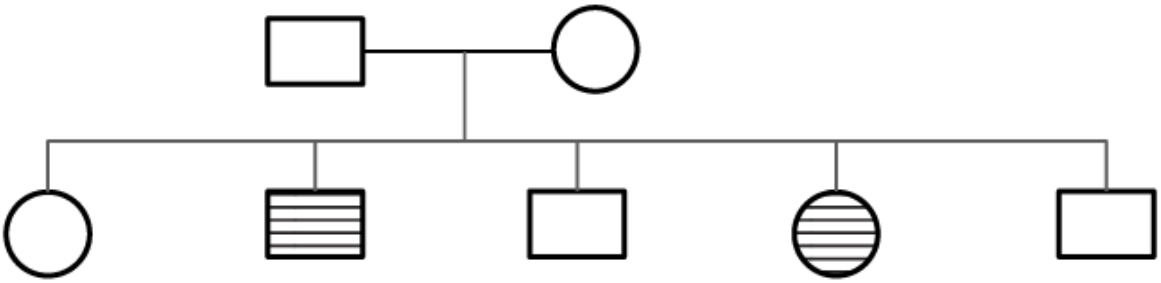
1. What is the cross between the progeny of F1 and the homozygous recessive parent called? How is it useful?
Solution:
The cross between the progeny of F1 (that is F2 generation) and the homozygous recessive parent is called Test cross and useful to identify the genotype (genetic makeup) of a plant whose phenotype (visible expression) is known.

2. Do you think Mendel's laws of inheritance would have been different if the characters that he chose were located on the same chromosome?
Solution:
Mendel's laws of inheritance would not have been different even if the characters were located on the same chromosome because Mendel's laws of inheritance would not have been different even if the characters were located on the same chromosome.

3. Enlist the steps of controlled cross-pollination. Would emasculation be needed in a cucurbit plant? Give reasons for your answer.
Solution:
1. Selection of parents with desired characters
2. Protection of stigma from the contamination (unwanted pollen grains) by emasculation and bagging techniques
Cucurbits are monoecious (bisexual); having both male and female flowers on the same plant. There is a possibility of being self-pollinated. Hence emasculation is needed.

4. A person has to perform crosses to study the inheritance of a few traits/characters. What should be the criteria for selecting the organisms?
Solution:
The criterion for selecting the organisms is true breeding.

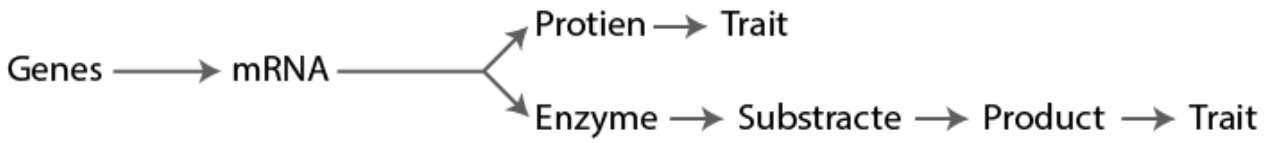
5. The pedigree chart given below shows a particular trait which is absent in parents but present in the next generation irrespective of sexes. Draw your conclusion based on the pedigree.



Solution:
Based on pedigree, both the parents are a carrier and among the offspring's a few shows the trait which is indifferent of sex. The other one may either normal or carrier

6. To obtain the F1 generation Mendel pollinated a pure-breeding tall plant with a pure breeding dwarf plant. But forgetting the F2 generation, he simply self-pollinated the tall F1 plants. Why?
Solution:
To obtain the F1 generation Mendel pollinated a pure-breeding tall plant with a pure breeding dwarf plant because of true breeding. Out of 100%, 50% of the offspring of genotype resembles their parent and rest the other parent. Self-pollination is allowed as the offspring of the cross are heterozygous.

7. Genes contain the information that is required to express a particular trait." Explain.
Solution:

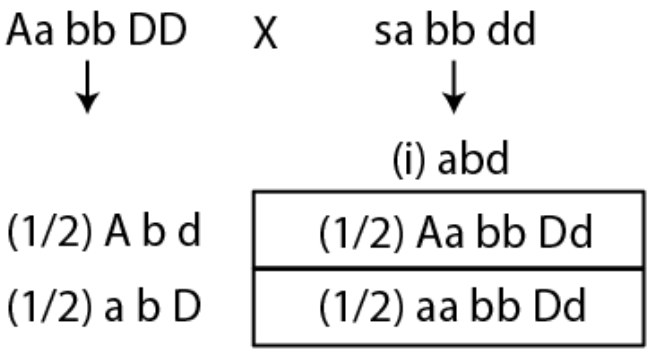


8. How are the alleles of a particular gene differ from each other? Explain its significance.
Solution:
When the allelic pairs of genes are identical then they are called homozygous and when the alleles of a gene are different it is heterozygous. A dominant factor is that a pair of dissimilar factors one dominates the other while the other called as recessive factor. The dominant one is denoted by upper case and recessive one with lower case. For example T is used for tall and t for dwarf of the same character-height.

9. In a monohybrid cross of plants with red and white-flowered plants, Mendel got only red-flowered plants. On self-pollinating these F1 plants got both red and white-flowered plants in 3:1 ratio. Explain the basis of using RR and rr symbols to represent the genotype of plants of the parental generation.
Solution:
On crossing red (RR) and white(rr) flowering plants, Mendel got only red-flowered plants with genotype Rr. This is the filial progeny (F1) or plants of the 1st hybrid generation. F1 always resembled either one of the parents and the trait of other parent was not seen in them.

10. For the expression of traits, genes provide only the potentiality and the environment provides the opportunity. Comment on the veracity of the statement.
Solution:
The phenotype of individuals is a result of the combined effect of environment and genotype.
Phenotype = Genotype + Environment

11. A, B, D are three independently assorting genes with their recessive alleles a, b, d, respectively. A cross was made between individuals of Aa bb DD genotype with aa bb dd. Find out the type of genotypes of the offspring produced.
Solution:
The given cross is Aa bb DD X aa bb dd. Hence the offspring's would be:



12. In our society, a woman is often blamed for not bearing a male child. Do you think it is right? Justify.
Solution:
Sex of the baby is determined by the father, not by the mother. 50% of sperms carry X chromosome and 50% carry the Y. After the fusion zygote carries XX or YY chromosomes depending on the sperm carrying X or Y.

13. Discuss the genetic basis of wrinkled phenotype of pea seed.
Solution:
The genetic basis of wrinkled phenotype of pea seed is due to the small grain size produced by a double recessive allele.

14. Even if a character shows multiple allelism, an individual will only have two alleles for that character. Why?
Solution:
A diploid organism has more than two alleles and shows two alleles of a character. When population studies are made multiple alleles can be found.

15. How does a mutagen induce mutation? Explain with example.
Solution:
A mutagen can change the alignment and composition of nitrogen bases of DNA that results in a changed product of gene thus bring about mutation.

SHORT ANSWER TYPE QUESTIONS

1. In a Mendelian monohybrid cross, the F2 generation shows identical genotypic and phenotypic ratios. What does it tell us about the nature of alleles involved? Justify your answer.
Solution:
In a monohybrid cross, starting with parents which are homozygous dominant and homozygous recessive, F1, at the same time with incomplete dominance can show identical genotypic and phenotypic ratios.

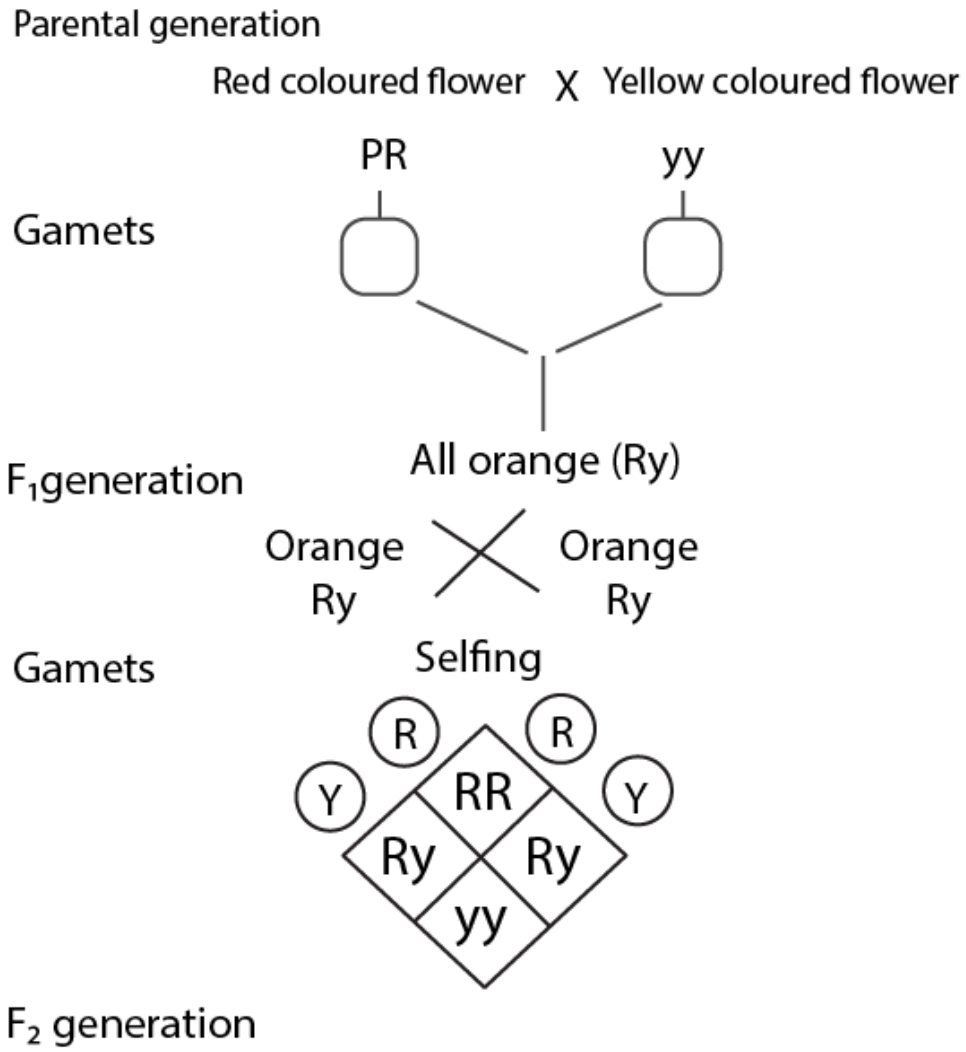
2. Can a child have blood group O if his parents have blood group 'A' and 'B'? Explain.
Solution:
Yes, it is possible for a child to have blood group O if his parents have blood groups A and B. ABO blood grouping in humans is controlled by the gene I. The gene (I) has three alleles IA, IB and i. The genotype of blood group A is IAIA or IAi; blood group B is IBIB or IBi and that of blood group O is ii.

3. What is Down's syndrome? Give its symptoms and cause. Why is it that the chance of having a child with Down's syndrome increases if the age of the mother exceeds forty years?
Solution:
Down syndrome is caused due to the presence of an additional copy of chromosome number 21 9trisomy of 21). Karyotype with 23 pairs of autosomes and 1 pair of sex chromosomes. (total of 24 pairs i.e. 47 chromosomes). The chances of having a child with Down's syndrome increases if the age of the mother exceeds forty years because ova are present in females since their birth and therefore older cells

are more prone to chromosomal non-disjunction

4. How was it concluded that genes are located on chromosomes?
Solution:
Morgan confirmed the Mendelian laws of inheritance and the fact that genes are located on the same chromosomes. He discovered that eye colour in Drosophila expressed a sex-linked trait. The X chromosome is transferred to both male and female offspring because Dorsophilia exhibits an XY type of sex determination.

5. A plant with red flowers was crossed with another plant with yellow flowers. If F1 showed all flowers orange in colour, explain the inheritance.
Solution:
The inheritance is of incomplete dominance. F1 had a phenotype that did not resemble either of the parent plants and was in between the two.



6. What are the characteristic features of a true-breeding line?
Solution:
It increases homozygosity of the organism. This also helps to eliminate the harmful recessive genes through deletion. Thus it promotes accumulation of superior genes.

7. In peas, tallness is dominant over dwarfness, and red colour of flowers is dominant over the white colour. When a tall plant bearing red flowers was pollinated with a dwarf plant bearing white flowers, the different phenotypic groups were obtained in the progeny in numbers mentioned against them:

Tall, Red = 138
Tall, White = 132
Dwarf, Red = 136
Dwarf, White = 128
Mention the genotypes of the two parents and the four offspring types.
Solution:

F_2 GENERATION

GAMETES	TR	Tr	tR	tr
TR	TTRR TALL RED	TTRr TALL RED	TtRR TALL RED	TtRr TALL RED
Tr	TTRr TALL RED	TTrr TALL WHITE	TtRr TALL RED	Ttrr TALL WHITE
tR	TtRR TALL RED	TtRr TALL RED	ttRR DWARF RED	ttRr DWARF RED
tr	TtRr TALL RED	Ttrr TALL WHITE	ttRr DWARF RED	ttrr DWARF WHITE

9. If a father and son are both defective in red-green colour vision, is it likely that the son inherited the trait from his father? Comment.
Solution:
Colour blindness is a common hereditary condition which means it is passed down from parents. When the father is colour blind, he can only pass an X chromosome to his daughter. Hence a colour blind boy

can't receive a colour blind gene from his father, even if his father is colour blind. A father can only pass the Y gene to his son.

10. Discuss why Drosophila has been used extensively for genetical studies.
Solution:
Drosophila has been used extensively for genetical studies because it is a simple synthetic medium that could be grown in the laboratory. A single mating can produce a large number of progeny files and their life cycle is about 2 weeks.

11. How do genes and chromosomes share similarity from genetical studies?
Solution:
1. It both occurs in pair
2. At the time of the formation of gamete, genes and chromosome separate and one of each pair is transmitted to a gamete.
3. The pairs will independently separate each other.

12. What is recombination? Discuss the applications of recombination from genetic engineering.
Solution:
Recombination is the generation of non-parental gene combinations by either crossing over or independent assortment. Alfred Sturtevant used the frequency of recombination between gene pairs on the same chromosome as a measure of the distance between the genes and mapped their positions on the chromosome

13. What is artificial selection? Do you think it affects the process of natural selection? How?
Solution:
It is a selection in which humans select desired traits or a combination of traits for exploiting the variations among species. The process of natural selection gets arrested and promoted the growth of desired traits only in plants. It can lead to decreased yield and growth.

14. With the help of an example differentiate between incomplete dominance and co-dominance.
Solution:
In the incomplete dominance, it produces a mixture of the expression of two alleles and the F1 does not resemble either of the parents. An example is flower colour in a dog flower. In co-dominance, there is no mixing of the two alleles and F1 resembles both the parent. For example ABO blood group in humans.

15. It is said, that the harmful alleles get eliminated from the population over some time, yet sickle cell anaemia is persisting in the human population. Why?
Solution:
Sickle cell anaemia is persisting in the human population. It is affected individuals carrying mutations in both the parental and maternal inherited haemoglobin gene. There is an advantage that the patients are better protected against malaria. And this can be the reason for the harmful alleles of sickle cell anaemia to persist in the human population despite the elimination of harmful genes over time.

LONG ANSWER QUESTIONS

1. In a plant, tallness is dominant over dwarfness and red flower is dominant over white. Starting with the parents work out a dihybrid cross. What is the standard dihybrid ratio? Do you think the values would deviate if the two genes in question are interacting with each other?
Solution:

PARENTS TTRR TALL RED x DWARF WHITE

F_1 GENERATION TtRr TALL RED x TtRr (SELFING) TALL RED

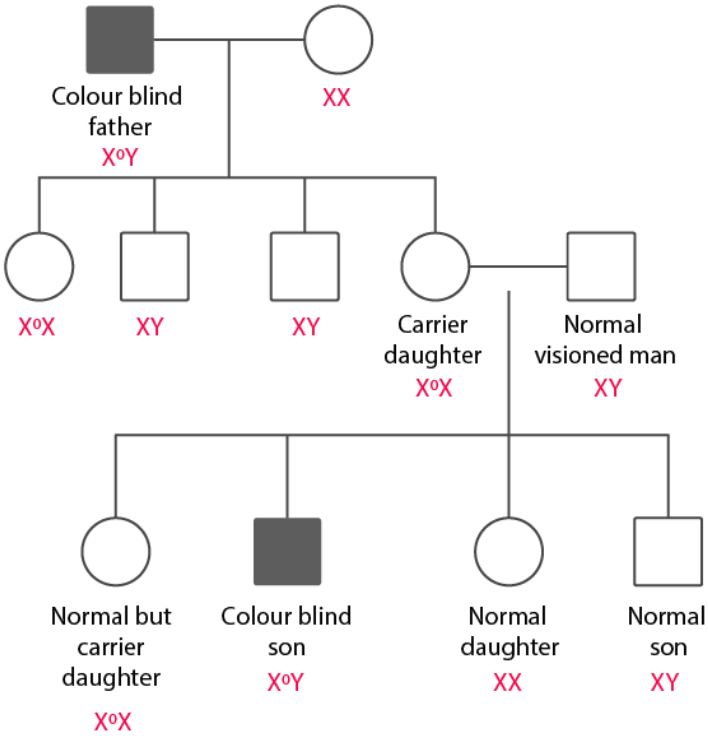
F_2 GENERATION

GAMETES	TR	Tr	tR	tr
TR	TTRR TALL RED	TTRr TALL RED	TtRR TALL RED	TtRr TALL RED
Tr	TTRr TALL RED	TTrr TALL WHITE	TtRr TALL RED	Ttrr TALL WHITE
tR	TtRR TALL RED	TtRr TALL RED	ttRR DWARF RED	ttRr DWARF RED
tr	TtRr TALL RED	Ttrr TALL WHITE	ttRr DWARF RED	ttrr DWARF WHITE

examples where males are homogametic and females heterogametic?
b. Also describe as to, who determines the sex of an unborn child? Mention whether the temperature has a role in sex determination.
Solution:

In human beings, it has XY chromosomes which determine the sex. Both male and female have the same number of chromosomes. Males an X chromosome and Y chromosome is present. However, females have a pair of the X chromosome. They have autosomes also. Males have autosomes plus XY that is heterogametic and females have autosomes plus XX which is female homogametic. Birds are examples where males are homogametic and females heterogametic as birds have a different sex-determining mechanism where two different types of gametes in terms of sex chromosomes are produced by females: female heterogamety.
b. The sex of an unborn baby is determined by his father. In some reptiles, they use incubation temperature to determine sex. In some species the pattern is; the eggs in extreme low or high temperature become male and eggs in medium temperature become female. Thus temperature has a role in sex determination.

3. A normal visioned woman, whose father is colour blind, marries a normal visioned man. What would be the probability of her sons and daughters to be colour blind? Explain with the help of a pedigree chart.
Solution:
The colour blindness is a disease which can be passed from parents.



4. Discuss in detail the contributions of Morgan and Sturvant in the area of genetics.
Solution:
Thomas Hunt Morgan and his colleagues experimentally verified the theory of inheritance and carried several dihybrid crosses of drosophila to study the sex-linked genes. Example: Morgan hybridized yellow bodied, white-eyed females to brown bodied, red-eyed males and intercrossed their F1 progeny. He observed that the two genes did not segregate independently of each other and the F2 ratio deviated

vary significantly from 9:3:3:1 ratio. Morgan and his colleagues saw the two genes located in the same chromosome. Morgan concluded this due to the physical association of two genes or linkage. Even though they are in the same chromosome some are tightly and some are loosely linked showed only 1.3% recombination while white and miniature wing showed 37.2% recombination.

5. Define aneuploidy. How is it different from polyploidy? Describe the individuals having following chromosomal abnormalities.

a. Trisomy of 21st Chromosome
b. XXY
c. XO
Solution:
Failure of segregation of chromatids during cell division cycle results in the gain or loss of a chromosome(s), called aneuploidy.
Failure of cytokinesis after telophase stage of cell division results in an increase in a whole set of chromosomes in an organism and this phenomenon is known as polyploidy.
a. Trisomy of 21st Chromosome
The genetic disorder of the presence of an additional copy of chromosome number 21 is called Down's syndrome.
b. XXY
The genetic disorder of the presence of an additional copy of X chromosome resulting in a karyotype of 47, XXY is called Klinefelter's syndrome.
c. XO
The disorder caused due to the absence of one of the X chromosomes, that is 45 with XO is called Turner's syndrome.