UNIT – VII : GENETICS AND EVOLUTION

Term-I

PRINCIPLES OF INHERITANCE AND VARIATION

Syllabus

➢ ***Heredity and variation :*** *Mendelian inheritance; deviations from Mendelism - incomplete dominance, co-dominance, multiple alleles and inheritance of blood groups, pleiotropy; elementary idea of polygenic inheritance; chromosomal theory of inheritance; chromosomes and genes; Sex determination - in human being, birds, grasshopper and honey bee; linkage and crossing over; Mutation, Pedigree analysis, sex linked inheritance - haemophilia, colour blindness; Mendelian disorders in humans - sickle cell anaemia, Phenylketonuria, thalassaemia; chromosomal disorders in humans; Down's syndrome, Turner's and Klinefelter's syndromes.*

STAND ALONE MCQs (1 Mark each)

Q. 1. The genotype of a plant showing the dominant phenotype can be determined by : U

(A) test cross **(B)** dihybird cross

(C) pedigree analysis **(D)** back cross.

Ans. Option (A) is correct

> ***Explanation :*** In a test cross an organism showing a dominant phenotype whose phenotype is to be determined (Whether it homozygous or heterzygous for that trait) is crossed with a recessive parent.

Q. 2. F_2 generation in a Mendelian cross showed that both genotypic and phenotypic ratios are same as 1 : 2 : 1. It represent a case of : U

(A) Co-dominance

(B) Dihybrid cross

(C) Monohybrid cross with incomplete dominance

(D) Monohybrid cross with complete dominance

Ans. Option (C) is correct

> ***Explanation :*** Monohybrid cross with incomplete dominance shows both genotypic and phenotypic ratio as same (1 : 2 : 1).

Q. 3. Which of the following pairs is wrongly matched. U

(A) Starch synthesis in pea : Multiple alleles

(B) ABO blood grouping : Co-dominance

(C) Flower colour in Snapdragon : Incomplete dominance

(D) T.H. Morgan : Linkage

Ans. Option (A) is correct

> ***Explanation :*** Starch synthesis in pea seed is controlled by one gene which has two alleles (B and b). Pleiotropy is shown by B gene.

Q. 4. A cross between two tall plants resulted in offspring having few dwarf plants. What would be the genotypes of both the parents? C

(A) TT and Tt

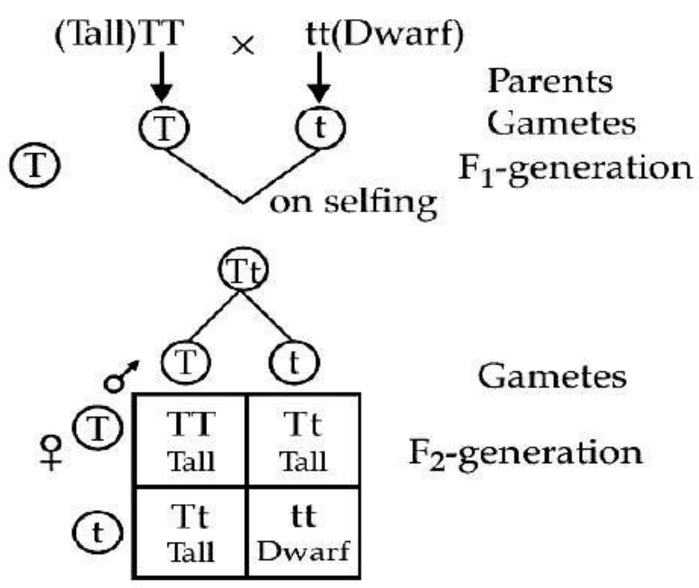
(B) Tt and Tt

(C) TT and TT

(D) Tt and tt

Ans. Option (B) is correct

> ***Explanation :*** The genotypes of both the parents are Tt and Tt. Refer the given cross between true breeding tall plants and true breeding dwarf plants.



Phenotypic Ratio Tall plants: Dwarf plants
Genotypic Ratio
3 : 1
TT Tt tt
1:2:1

When true breeding plants were crossed to each other, this is called a parental cross and offspring comprise the first filial or F_1 - generation. When the members of the F_1 - generation were crossed, this produced the F_2-generation or second filial generation. A cross between true breeding tall and dwarf plants of the parent generation yield phenotypically tall plants. The cross between TT and Tt is called back cross, which results into two homozygous and two heterozygous dominant gametes. The cross between Tt and tt is called test cross which results into 1 : 1 ratio of gametes.

Q. 5. Person having genotype $I^A I^B$ would show the blood group as AB. This is because of

(A) pleiotropy.

(B) co-dominance.

(C) segregation.

(D) incomplete dominance. U

Ans. Option (B) is correct

Explanation : ABO blood grouping in humans is an example of co-dominance. ABO blood groups are controlled by gene I. Gene I has three alleles I^A, I^B, and I^i. When I^A, and I^B are present together, both express equally and produce the surface antigens A and B, whereas I is the recessive allele and does not produce any antigen. Pleiotropy referred the genetic effect of a single gene on multiple phenotypic traits. Incomplete dominance does not completely dominate another allele. Segregation is the separation of allele during the process of gametogenesis. This is the basis of reappearance of recessive character in F_2 generation.

Q. 6. Mendel's Law of independent assortment holds good for genes situated on the

(A) non-homologous chromosomes.

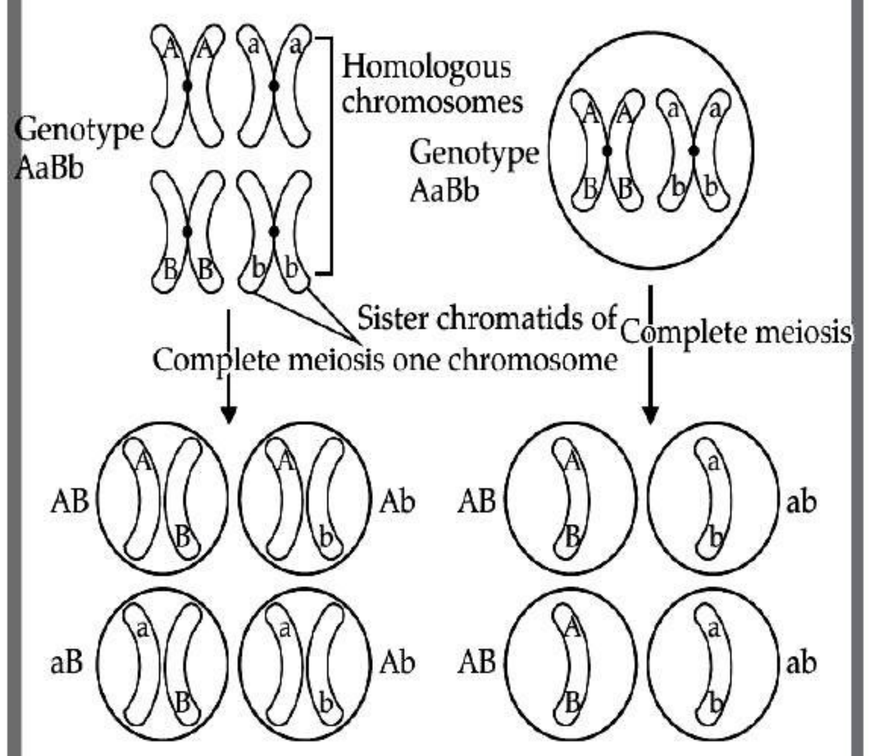
(B) homologous chromosomes.

(C) extra nuclear genetic element.

(D) same chromosome. U

Ans. Option (B) is correct

Explanation : Mendel's Law of independent assortment holds good for genes situated on the non-homologous chromosome. According to law of independent assortment when two or more characteristics are inherited, individual hereditary factors assort independently of one another during gamete production, giving different characters an equal opportunity of occurring together. It can be illustrated by the dihybrid cross (a cross between two true-breeding parents) that express different traits for two characteristics. When the genes are on separate chromosome, the two alleles of one gene (A and a) will segregate into gametes independently of the two alleles of the other gene (B and b). Equal numbers of four different gametes will form AB, aB, Ab, ab. But if the two genes are on the same chromosome, then they will be linked and will segregate together during meiosis, producing only two kinds of gametes. Homologous chromosomes are essentially similar in size but not identical. Each carries the same genetic information in same order but the alleles for each trait may not be the same. Extra nuclear genetic elements (also called as plasmids) shows the pattern of maternal inheritance.



Homologous chromosomes are essentially similar in size but not identical. Each carries the same genetic information in same order but the alleles for each trait may not be the same. Extra nuclear genetic elements (also called as plasmids) shows the pattern of maternal inheritance.

Q. 7. Occasionally, a single gene may express more than one effect. The phenomenon is called

(A) multiple allelism. **(B)** mosaicism.

(C) pleiotropy. **(D)** polygeny. U

Ans. Option (C) is correct.

Explanation : Pleiotropy is a phenomenon in which a single gene affects multiple effects. Sometimes, one trait will be very evident and others will be less evident, e.g., a gene for white eye in *Drosophila* also affect the shape of organs in male responsible for sperm storage as well as other structures. Similarly, sickle-cell anaemic individuals suffer from a number of problems, all of which are pleiotropic effects of the sickle-cell alleles. Multiple allelism is the state of having more than two alternative contrasting characters controlled by multiple alleles at a single genetic locus, e.g. ABO blood group. Mosaicism describes the occurrence of cells that differ in their genetic component from other cells of the body. Polygeny refers to a single characteristic that is controlled by more than two genes. (it is also known as multifactorial inheritance).

Q. 8. 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. U

Ans. Option (B) is correct

Explanation : All the genes, present on a particular chromosome form a linkage group. The number of linkage group of a species correspond to the total number of different chromosomes of that species. It is not simply the number of chromosomes in haploid set. For example, in human male there are 22 pairs of autosomes and X and Y sex chromosomes, that is, 24 linkage groups and in female = 22 pairs autosomes + 2X-chromosomes, that is, 23 linkage groups.

Q. 9. Distance between the genes and percentage of recombination shows

(A) a direct relationship.

(B) an inverse relationship.

(C) a parallel relationship.

(D) no relationship. U

Ans. Option(A)is correct.

Explanation : Crossing over separates genes away from each other. So, the physical distance between the two genes and percentage of recombination shows a direct relationship. More the distance between two genes, more is the frequency of crossing over between them and hence more is the percentage of recombination.

Q. 10. Which of the following will not result in variations among siblings?

(A) Independent assortment of genes

(B) Crossing over

(C) Linkage **(D)** Mutation U

Ans. Option (C) is correct.

Explanation : Linkage may be defined as the relationship between genes on the same chromosome that causes them to be inherited together, therefore it will not result in variations among siblings. In linkage there is a tendency to maintain the parental gene recombination except for occasional crossovers. Independent assortment of genes means that allele pair separate during the formation of gametes independently; it means that traits are transmitted to offspring independently of one another. Crossing over is the exchange of genetic material between homologous chromosomes. It is one of the final phases of genetic recombination. Mutation is the sudden inheritable change in genetic material of an organism which transfers to next generation.

Q. 11. Females with 'Turner's syndrome have

(A) less developed breasts

(B) rudimentary ovaries

(C) small sized uterus

(D) all of these. U

Ans. Option (D) is correct.

Explanation : Features of female with Turner's syndrome; Ovaries are rudimentary, lack of other secondary sexual characters, dwarf, mentally retarded.

Q. 12. ZZ / ZW type of sex determination is seen in

(A) Platypus **(B)** snails.

(C) cockroach **(D)** peacock R

Ans. Option (D) is correct)

Explanation : Z Z / ZW type of sex determination is seen in birds, reptiles and fish. Thus, peacock shows ZZ/ZW sex determination type. In this type, female has heteromorphic (ZW) sex chromosomes and the male has homomorphic (ZZ) sex chromosomes. In Platypus the sex determination is of XX-XY type in which both male and females has ten sex chromosome each. The male has XY, XY, XY, XY, XY and female has XX, XX, XX, XX, XX. In snails, the sex determination is environmentally induced, while in cockroaches it is of XX-XO types. In this type Y-chromosome is absent. In this the presence puffs unpaired X-chromosomes determines the masculine sex.

Q. 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. U

Ans. Option (A) is correct.

Explanation : In certain taxon of insects, 17 and 18 chromosome bearing organisms are males and females respectively. Because, insects have X0 type of sex determination method. In certain insects, such as cockroach, and some roundworms lacks Y-chromosome, so that the male has only one sex chromosome, that is, 'X' besides autosomes. This condition in the male is designated as XO (where O means absence of one sex chromosome) and in the female it is XX.

Q. 14. What is the genetic disorder in which an individual has an overall masculine development, Gynaecomastia, and is sterile ? R

(A) Turner's syndrome

(B) Klinefelter's syndrome

(C) Down's syndrome

(D) Edward syndrome

Ans. Option (B) is correct.

Explanation : Klinefelter's syndrome is the genetic disorder which is caused due to the presence of an additional copy of X-chromosome resulting in karyotype of 47, XXY chromosome but only the son will be affected by the disease.

Q. 15. A woman has an X-linked condition on one of her X-chromosomes. This chromosome can be inherited by

(A) only daughters

(B) both sons and daughters

(C) only grandchildren

(D) only sons

Ans. Option (B) is correct.

Explanation : Here is this case, the women is a carrier. Both the son and daughter will inherit the X-chromosome but only the son will be diseased.

Q. 16. A human female with Turner's syndrome. R

(A) has 45 chromosome with XO.

(B) has one additional X chromosome

(C) exhibits male characters.

(D) is able to produce children with normal husband

Ans. Option (A) is correct.

Explanation : It is a disorder caused due to the absence of one of the X-chromosomes, i.e., 45 with XO.

Q. 17. In XO type of sex determination R

(A) males produce two different types of gametes

(B) females produce two different types of gametes

(C) males produce gametes with Y chromosome.

(D) females produce gametes with Y chromosome

Ans. Option (A) is correct.

Explanation : XO mechanism shows male heterogamety. Males produce two different types of gametes.

Q. 18. 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 R

Ans. Option (D) is correct.

Explanation : Sickle-cell anaemia is a recessive autosomal gene disorder. This disease is controlled by a single pair of allele HbA and HbS. It is caused due to inheritance of a defective allele coding for beta globulin. It results in the transformation of HbA into HbS in which glutamic acid (Glu) is replaced by valine (Val) at sixth position in each of two beta chains of haemoglobin. This substitution occurs due to the single base substitution of the beta globin gene from GAG (Glu) to GUG (Val). Whereas, the other codes GGG, AAG. GAA do not codes for valine.

Q. 19. 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.

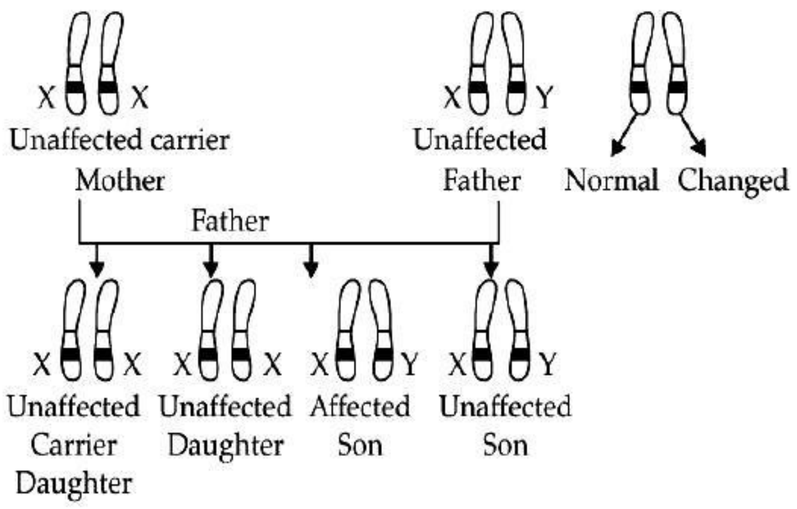
(B) autosomal recessive.

(C) sex-linked dominant.

(D) sex-linked recessive. R

Ans. Option (D) is correct.

Explanation : If a genetic disease is transferred from a phenotypically normal but carrier female to only some of the male progeny, the disease is sex linked recessive disease. Most sex-linked (X-linked) conditions are recessive. Because, in this condition a person with two X-chromosomes (females) must have a change or mutation whereas in a person with one X-chromosomes (males), only one copy of a gene must have a mutation. A female with a mutation in one copy of a gene on the X-chromosome is said to be a 'carrier' for an X-linked condition. For X-linked recessive disorders, an unaffected carrier mother who has a mutation in a gene on the X-chromosome can transmit either the X-chromosome with this mutation or a normal X-chromosome to her children (as shown below in cross).



Autosomal dominant inheritance refers to the pattern of inheritance of a condition directly or indirectly due to a dominant faulty gene located on autosome. Autosomal recessive inheritance is caused directly or indirectly due to presence of recessive faulty gene copy on autosome. Sex-linked dominant is a rare trait, caused by a single abnormal gene on the X-chromosome.

Q. 20. Conditions of a karyotype $2n \pm 1$ and $2n \pm 2$ are called

(A) aneuploidy.

(B) polyploidy.

(C) allopolyploidy.

(D) monosomy. R

Ans. Option (A) is correct.

Explanation : Aneuploidy is a condition in which a person has one or a few more number of chromosomes above or below the normal chromosomes number. In this case organism either gains or loses one or more chromosomes but not a complete set. Polyploidy is defined as the addition of entire set of chromosomes. It can be triploidy (3n), tetraploidy (4n), pentaploidy (5n), etc. Allopolyploidy is the polyploidy in which chromosome sets are nonhomologous. In other words, we can say that the allopolyploids are derived from a stock which is heterozygous. Monosomy is the process in which one chromosome is removed from diploid set of chromosomes (2n-1).

ASSERTION AND REASON BASED MCQs (1 Mark each)

Directions : In the following questions a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as :

(A) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

(B) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

(C) Assertion (A) is true but reason (R) is false.

(D) Assertion (A) is false but reason (R) is true.

Q. 1. Assertion (A) : Haemophilia is an autosomal disorder.

Reason (R) : A haemophilic father can never pass the gene for haemophilia to his son.

Ans. Option (D) is correct.

Explanation : Haemophilia is a sex-linked recessive disorder in which X-chromosome has the haemophilic gene. A haemophilic father can never pass the gene for haemophilia to his son.

AI **Q. 2. Assertion (A) :** Sickle cell anaemia is an example of point mutation.

Reason (R) : It is caused by addition or deletion of nitrogenous bases in the DNA or mRNA.

Ans. Option (C) is correct.

Explanation : Sickle-cell anaemia is caused by a single point mutation in the beta haemoglobin gene which converts a GAG, codon into GUG, which code for valine amino acid rather than glutamic acid.

Q. 3. Assertion (A) : Grasshopper shows male heterogamety.

Reason (R) : In grasshopper, males have one X only (XO type).

Ans. Option (A) is correct.

Explanation : Male grasshopper shows XO gametes while female grasshopper shows XX.

Q. 4. Assertion (A) : The offspring of a cross made between the plants having two contrasting characters shows only one character without any blending.

Reason (R): The factor controlling any character is discrete and independent.

Ans. Option (A) is correct.

Explanation : According to law of segregation or law of purity of gametes, factors or alleles of a pair segregate from each other during gamete formation, such that a gamete receives only one of the two factors and do not show any blending.

Q. 5. Assertion (A) : Cross of F_1 individual with recessive homozygous parent is test cross.

Reason (R) : No recessive individual are obtained in the monohybrid test cross progeny.

Ans. Option (C) is correct.

Explanation : In the monohybrid test cross progeny both heterozygous and recessive individuals are obtained in 1 : 1 ratio.

AI **Q. 6. Assertion (A) :** ABO blood group in human being is an example of multiple allelism.

Reason (R) : It has three alleles for the gene 1 *i.e.* I_A, I_B, *i.*

Ans. Option (A) is correct.

Explanation : Due to three different types of allele I_A, I_B, i in blood group, it shows multiple allelism.

Q. 7. Assertion (A) : A cross between a red flower-bearing plant and a white flower-bearing plant of *Antirrhinum* is a case of incomplete dominance.

Reason (R) : This type of cross produces all plants having pink flowers.

Ans. Option (A) is correct.

Explanation : The cross between white and red flower of *Antirrhinum* shows pink colour in the offspring plant *i.e.,* neither white or red is completely dominant.

Q. 8. Assertion (A) : Crossing of F_1 hybrid with the recessive parent is known as test cross.

Reason (R) : Test cross helps to determine the unknown genotype by crossing it with the recessive parent.

Ans. Option (A) is correct.

Explanation : Crossing F_1 with recessive parent will. may inherit recessive genotypic characters as dominant characters in their offspring.

Q. 9. Assertion (A) : The frequency of red-green colour blindness is many times higher in females than that in males.

Reason (R) : In females if only one X-chromosome of female possess allele for colour blind character she becomes the colour blind.

Ans. Option (D) is correct.

Explanation : Colour blindness is X-linked sex inheritance. The frequency of red-green colour blindness is many times higher in males than that in the females because males have only one X chromosomes therefore they develop colour blindness when their sole X-chromosome has the allele for it. Thus, males are more prone to colour blindness while females are carriers. For becoming colour blind, the female must have the allele for it in both her X-chromosomes and if only one X-chromosome of female possess allele for colour blind character she becomes the carrier for this characteristic.

Q. 10. Assertion (A) : The chances of having a child with Down's syndrome increases if the age of the mother is between 20 to 25.

Reason (R) : The chances of having a child with Downs syndrome increases with the age of the mother because age adversely affects meiotic chromosome behaviour.

Ans. Option (D) is correct.

Explanation : Down's syndrome increases if the age of the mother exceeds forty years because age adversely affects meiotic chromosome behaviour. Meiosis in the egg cells is not completed, until after fertilization. During this long gap (till meiosis is not completed) egg cells are arrested in prophase I and chromosomes are unpaired. The greater the time they remain unpaired greater the chance for unpairing and chromosome non-disjunction.

CASE-BASED MCQs

Attempt any four sub-parts from each question. Each question carries 1 mark.

I. Read the following text and answer the following questions on the basis of the same :

Down syndrome (sometimes called Down's syndrome) is a condition in which a child is born with an extra copy of their 21st chromosome hence its other name, trisomy 21. The affected individual mental retarded, short statured with small round, head, furrowed tongue and partially open mouth, Physical, psychomotor and mental development is retarded.

Q. 1. The number of chromosomes a child with Down syndrome has is

(A) 45 **(B)** 46

(C) 47 **(D)** 48

Ans. Option (C) is correct.

Explanation : The affected person inherited with one extra copy of 21st chromosome that forms trisomy condition.

Q. 2. Down syndrome is

(A) Sex-linked **(B)** Chromosomal

(C) dominant **(D)** recessive

Ans. Option (B) is correct.

Explanation : Down syndrome is an autosomal recessive disorder which can be inherited through normal parents in the child.

Q. 3. One of this trait is seen in a person with Down syndrome

(A) Upward slant eye **(B)** Baldness

(C) Short stature **(D)** Long neck

Ans. Option (C) is correct.

Explanation : The person affected with Down syndrome has symptoms like mental retarded, short statured with small round, head, furrowed tongue etc.

Q. 4. Down Syndrome is an extra copy which chromosome

(A) 22^{nd} chromosome

(B) 21^{st} chromosome

(C) 45^{th} chromosome

(D) 47^{th} chromosome

Ans. Option (B) is correct.

Explanation : Down Syndrome is due to extra copy of 21st chromosome forming trisomy condition.

Q. 5. Down syndrome is caused due to

(A) bacterial infection

(B) a chromosomal abnormality lack of oxygen supply to the brain during birth
(C) Viral infection
(D) a chromosomal abnormality

Ans. Option (D) is correct.

Explanation : Down syndrome is due to autosomal chromosome abnormality.

II. Read the following text and answer the following questions on the basis of the same :

Sickle cell anaemia is a genetic disorder where the body produces an abnormal haemoglobin called haemoglobins. Red blood cells are normally flexible and round, but when the haemoglobin is defective, blood cells take on a "sickle" or crescent shape. Sickle cell anaemia is caused by mutations in a gene called HB^B.

It is an inherited blood disorder that occurs if both the maternal and paternal copies of the HBB gene are defective. In other words, if an individual receives just one copy of the defective HBB gene, either from mother or father, then the individual has no sickle cell anaemia but has what is called "sickle cell trait". People with sickle cell trait usually do not have any symptoms or problems but they can pass the mutated gene onto their children. Three inheritance scenarios can lead to a child having sickle cell anaemia :

— Both parents have sickle cell trait
— One parent has sickle cell anaemia and the other has sickle cell trait
— Both parents have sickle cell anaemia

Q. 1. Sickle cell anaemia is a/an _____ disease.

(A) X linked (B) autosomal dominant
(C) autosomal recessive (D) Y linked

Ans. Option (C) is correct.

Explanation : Sickle cell anaemia is an autosomal recessive disease, meaning that it only occurs if both the material and paternal copies of the the HBB gene are defective.

Q. 2. If both parents have sickle cell trait, then there is _____of the child having sickle cell anaemia.

(A) 25 % risk (B) 50 % risk
(C) 75% risk (D) No risk

Ans. Option (A) is correct.

Explanation : If both parents have sickle cell trait, there is a 25% chance with each pregnancy that the baby will have sickle cell anemia. A child with sickle cell anemia appears normal at birth.

Q. 3. If both parents have sickle cell trait, then there is _____of the child having sickle cell trait.

(A) 25 % risk (B) 50 % risk
(C) 75% risk (D) No risk

Ans. Option (B) is correct.

Explanation : If both parents have sickle cell trait, there is a 50% chance with each pregnancy that the baby will have sickle cell trait. A child with sickle cell anemia appears normal at birth.

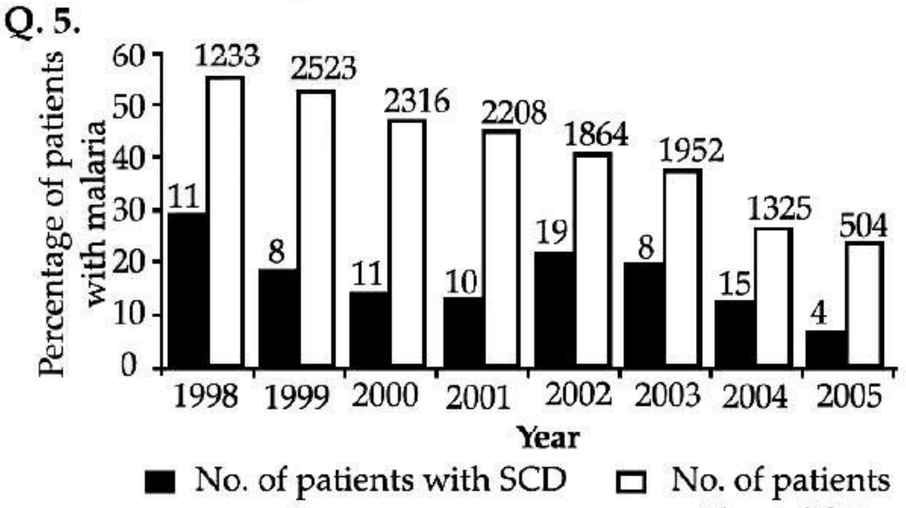
Q. 4. If one parent has sickle cell anaemia and the other has sickle cell trait, there is _____that their children will have sickle cell anaemia and _____will have sickle cell trait.

(A) 25 % risk, 75% risk (B) 50 % risk, 50% risk
(C) 75% risk, 25% risk (D) No risk

Ans. Option (B) is correct.

Explanation : If one parent has sickle cell disease and one parent has sickle cell trait, there is a 50% chance that their children will be born with sickle cell disease. It is equally likely that any given child will get two HbA genes and be completely unaffected.

Q. 5.



The following statements are drawn as conclusions from the above data (Kenya).

I. Patients with SCD (Sickle Cell Disease) are less likely to be infected with malaria.
II. Patients with SCD (Sickle Cell Disease) are more likely to be infected with malaria.
III. Over the years the percentage of people infected with malaria has been decreasing.
IV. Year 2000 saw the largest percentage difference between malaria patients with and without SCD.

Choose from below the correct alternative.

(a) only I is true (b) I and IV are true
(c) III and II are true (d) I and III are true

[SQP, 2020]

Ans. Option (D) is correct.

Explanation : Patients with SCD (Sickle Cell Disease) are less likely to be infected with malaria. Several studies suggested that, in one way or another, sickle hemoglobin might get in the way of the Plasmodium parasite infecting red blood cells, reducing the number of parasites that actually infect the host and thus conferring some protection against the disease year 2000 saw the largest percentage difference between malaria patients with and without SCD.

III. Read the following text and answer the following questions on the basis of the same :

Mutation is sudden, discontinuous variation in genotype of an organism due to a change in its

chromosomes and genes. Variation in DNA is a result of mutation. It is of three types : Gene mutation, chromosomal aberrations and gametic mutation. Gametic mutation is a change in chromosome number that brings effect on the phenotype, it is of two type - aneuploidy and euploidy. Mutation can be artificially produced by certain agents called mutagen. There are two major types of mutagens : physical and chemical mutagen.

Q. 1. Aneuploidy which occurs due to loss of a complete homologous pair of chromosomes is :

(A) Trisomy **(B)** Nullisomy

(C) Tetrasomy **(D)** Euploidy

Ans. Option (B) is correct.

> ***Explanation :*** Nullisomy - the loss of both pairs of homologous chromosomes; individuals are called nullisomic and their chromosomal composition is 2N-2.

Q. 2. Substitution of a purine with another purine is known as ..... :

(A) Transversion **(B)** Inversion

(C) Transition **(D)** Translocation

Ans. Option (C) is correct.

> ***Explanation :*** When a purine base is replaced by another purine and pyrimidine by another pyrimidine, it is transition.

Q. 3. Which is the main category of mutation ?

(A) Genetic mutation **(B)** Somatic mutation

(C) Heterosis **(D)** None of these.

Ans. Option (A) is correct.

> ***Explanation :*** Mutation is a change of the nucleotide sequence of the genome of an organism. It is a sudden inheritable change. A genetic mutation is a permanent change in the DNA sequence that makes up a gene. It can occur in all type of cells even in virus and extrachromosomal plasmid.

Q. 4. Change in sequence of nucleotide in DNA is known as ..... .

(A) Translation **(B)** Recombination

(C) Mutation **(D)** Transcription.

Ans. Option (C) is correct.

> ***Explanation :*** Change in sequence of nucleotide in DNA is known as mutation. A mutation involves a change in the sequence of nucleotides in a nucleic acid molecule.

Q. 5. Give one word for the following :

Type of mutation that arise due to change in a single base pair of DNA.

(A) Point mutation

(B) Somatic mutation

(C) Deletion

(D) Insertion

Ans. Option (A) is correct.

> ***Explanation :***Point mutations refer to changes in the sequence of DNA bases, and include substitutions, insertions, and deletions of one or more bases.