27

Principles of Inheritance and Variation

TOPIC 1
Mendelism

01 The production of gametes by the parents, formation of zygote, the F_1 and F_2 plants, can be understood from a diagram called **[NEET 2021]**

(a) Bullet square (b) Punch square
(c) Punnett square (d) Net squ are

Ans. *(c)*

Punnett square is a tool that helps to show all possible allelic combinations of gametes in a cross of parents with known genotypes in order to predict the probability of their offspring possessing certain sets of alleles. For a cross involving two genes, a Punnett square is still a good strategy.

02 The number of contrasting characters studied by Mendel for his experiments was **[NEET (Oct.) 2020]**

(a) 14 (b) 4 (c) 2 (d) 7

Ans. *(d)*

Mendel conducted breeding experiments on garden pea by selecting seven pairs of contrasting characters. Luckily all these characters were related as dominant and recessive and none of them showed linakge. The seven pairs of contrasting characters in pea plant were

Characters of pea plant

Character	Contrasting Trait	
	Dominant	Recessive
Stem height	Tall	Dwarf
Flower colour	Violet	White
Flower position	Axial	Terminal
Pod shape	Full	Constricted
Pod colour	Green	Yellow
Seed shape	Round	Wrinkled
Seed colour	Yellow	Green

03 How many true breeding pea plant varieties did Mendel select as pairs, which were similar except in one character with contrasting traits? **[NEET (Sep.) 2020]**

(a) 2 (b) 14 (c) 8 (d) 4

Ans. *(b)*

Mendel (father of genetics) selected 14 true-breeding pea plant varieties, in pairs, which were similar except for one character with contrasting traits. A true breeding line refers to the plant that has undergone continuous self-pollination and showed stable trait inheritance and expression for several generations.

04 Identify the wrong statement with reference to the gene 'I' that controls ABO blood groups. **[NEET (Sep.) 2020]**

(a) A person will have only two of the three alleles
(b) When I^A and I^B are present together, they express same type of sugar
(c) Allele 'i' does not produce any sugar
(d) The gene (I) has three alleles

Ans. *(b)*

When I^A and I^B are present together, they express same type of sugar is wrong statement with reference to the gene 'I' that controls ABO blood group because I^A and I^B are completely dominant over I^O, but when I^A and I^B are present together, they both express their own types of sugar and thus behaving as codominant alleles.

05 The production of gametes by the parents, the formation of zygotes, the F_1 and F_2 plants, can be understood using **[NEET (Odisha) 2019]**

(a) pie diagram (b) a pyramid diagram
(c) Punnett square (d) Venn diagram

Ans. *(c)*

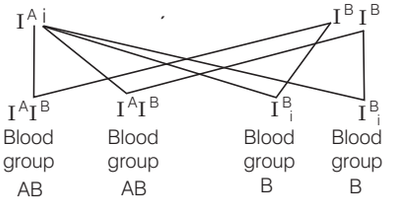
The production of gametes by the parents, the formation of zygotes, the F_1 and F_2 plants can be understood from a diagram called Punnett square. It was developed by a British geneticist, Reginald C. Punnett. It is a graphical representation to calculate the probability of all possible genotypes of offspring in a genetic cross.

06 In a marriage between male with blood group A and female with blood group B, the progeny had either blood group AB or B. What could be the possible genotype of parents? **[NEET (Odisha) 2019]**

(a) I^Ai (Male) : I^BI^B (Female)
(b) I^AI^A (Male) : I^BI^B (Female)
(c) I^AI^A (Male) : I^Bi (Female)
(d) I^Ai (Male) : I^Bi (Female)

Ans. *(a)*

The possible genotype of parents having progeny with either blood group AB or B is I^Ai (male): I^BI^B (female)



07 In *Antirrhinum* (Snapdragon), a red flower was crossed with a white flower and in F_1-generation, pink flowers were obtained.
When pink flowers were selfed, the F_2-generation showed white, red and pink flowers.Choose the

incorrect statement from the following **[NEET (National) 2019]**

(a) Pink colour in F_1 is due to incomplete dominance

(b) Ratio of F_2 is $\frac{1}{4}$(Red) : $\frac{2}{4}$(Pink) : $\frac{1}{4}$(White)

(c) Law of segregation does not apply in this experiment

(d) This experiment does not follow the principle of dominance

Ans. *(c)*

The statement that 'law of segregation does not apply in this experiment' is incorrect because the law of segregation applies universally. The reappearence of parental (red and white) flowers in the F_2-generation also confirms, that law of segregation applies in this experiment. Rest statements are correct.

08 A gene locus has two alleles A, a. If the frequency of dominant allele A is 0.4, then what will be the frequency of homozygous dominant, heterozygous and homozygous recessive individuals in the population? **[NEET (National) 2019]**

(a) 0.16(AA); 0.24(Aa); 0.36 (aa)

(b) 0.16(AA); 0.48(Aa); 0.36 (aa)

(c) 0.16(AA); 0.36(Aa); 0.48 (aa)

(d) 0.36(AA); 0.48(Aa); 0.16 (aa)

Ans. *(b)*

The frequency of homozygous dominant, heterozygous and homozygous recessive individuals would be 0.16 (AA); 0.48 (Aa); 0.36 (aa). The frequencies are calculated as follows:

Frequency of dominant allele (p)= 0.4 (given)

Frequency of recessive allele (q) = 1–0.4 = 0.6

Frequency of homozygous dominant individuals (AA)= p^2=(0.4)= 0.16

Frequency of heterozygous individual (Aa) = 2pq

= 2 (0.4) (0.6) = 0.48

Frequency of homozygous recessive individual (aa)

= q^2 = $(0.6)^2$ = 0.36

09 Select the correct statement. **[NEET 2018]**

(a) Spliceosomes take part in translation

(b) Punnett square was developed by a British scientist

(c) Franklin Stahl coined the term 'linkage'

(d) Transduction was discovered by S. Altman.

Ans. *(b)*

Punnett Square is a checker-board used to show the result of a cross between two organisms. The checker board was devised by a British geneticist, Regnald Punnett (1927). It depicts both genotypes and phenotypes of the progeny.

Franklin Stahl with Matthew Meselson proved the semi-conservative replication of DNA. **Spliceosome** is formed during post-transcriptional changes in eukaryotes. It is a complex, formed between 5′ end (GU) and 3′ end (AG) of intron to remove it.

Transduction is a method of sexual reproduction in bacteria. It involves the transfer of foreign genes by means of viruses. It was discovered by Zinder and his teacher Lederberg (1952) in *Salmonella typhimurium.*

10 Which of the following characteristics represents 'Inheritance of blood groups' in humans? **[NEET 2018]**

1. Dominance
2. Codominance
3. Multiple allele
4. Incomplete dominance
5. Polygenic inheritance

(a) 2, 4 and 5 (b) 1, 2 and 3

(c) 2, 3 and 5 (d) 1, 3 and 5

Ans. *(b)*

Dominance, codominance and multiple alleles are the characteristics that represent 'inheritance of blood groups' in humans. ABO blood groups are determined by the gene I. There are **multi ple** (three) **alleles;** I^A, I^B and I^0 of this gene. Allele I^A and I^B are **dominant** over I^0. However, when I^A and I^B alleles are present together, they show **codominance.**

Therefore, option (b) is correct.

11 Which one from those given below is the period of Mendel's hybridisation experiments? **[NEET 2017]**

(a) 1856 - 1863

(b) 1840 - 1850

(c) 1857 - 1869

(d) 1870 - 1877

Ans. *(a)*

Mendel was a great Mathematician and was Austrian Monk. He became interested in genetics and conducted experiments in pea plant (*Pisum sativum*). He hybridised the contrasting characters of the plant and conducted his experiments for more than 10 years between 1856-1863; this experimental data was published in 1865.

12 Among the following characters, which one was not considered by Mendel in his experiments on pea? **[NEET 2017]**

(a) Stem – Tall or Dwarf

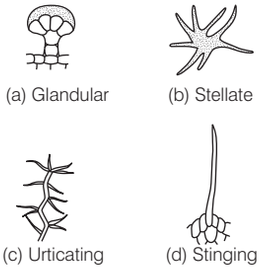
(b) Trichomes – Glandular or Non-glandular

(c) Seed – Green or Yellow

(d) Pod – Inflated or Constricted

Ans. *(b)*

Trichomes are the epidermal tissues structure. When epidermal cells become glandular hair, it is called trichome. This character was not amongst the seven characters of pea, which mendel selected for his hybridisation experiments.



(a) Glandular (b) Stellate

(c) Urticating (d) Stinging

Different types of trichomes

13 The genotypes of a husband and wife are I^AI^B and I^Ai. Among the blood types of their children, how many different genotypes and phenotypes are possible? **[NEET 2017]**

(a) 3 genotypes ; 3 phenotypes

(b) 3 genotypes ; 4 phenotypes

(c) 4 genotypes ; 3 phenotypes

(d) 4 genotypes ; 4 phenotypes

Ans. *(c)*

A cross between two individuals, one with AB blood group and other with A blood group will produce four genotypes and three phenotypes.

Parents	Male	Female
Phenotype	AB	A
Genotype	I^AI^B	I^Ai
Gametes	I^A, I^B	I^A, i

X

	I^A	I^B
I^A	I^AI^A (A)	I^AI^B (AB)
i	I^A i (A)	I^B i (B)

Offsprings Genotypes 4(I^AI^A, I^AI^B, I^A i, I^B i)
Phenotypes 3 (A, B, AB)

14 A true breeding plant is **[NEET 2016, Phase II]**

(a) one that is able to breed on its own
(b) produced due to cross-pollination among unrelated plants
(c) near homozygous and produces offspring of its own kind
(d) always homozygous recessive in its genetic constitution

Ans. *(c)*

A true breeding plant (pureline) has homozygous genes for a character (e.g. TT for tall or tt for dwarf). It always produces offsprings which are true (pure) for its characters.

15 Match the terms in column I with their description in column II and choose the correct option. **[NEET 2016, Phase I]**

Column I	Column II
A. Dominance	1. Many genes govern a single character
B. Codominance	2. In a heterozygous organism only one allele expresses itself
C. Pleiotropy	3. In a heterozygous organism both alleles express themselves fully
D. Polygenic inheritance	4. A single gene influences many characters

Code

	A	B	C	D
(a)	2	3	4	1
(b)	4	1	2	3
(c)	4	3	1	2
(d)	2	1	4	3

Ans. *(a)*

Dominance—Expression of only one allele in a heterozygous organism.

Codominance—Side by side full expression of both alleles. F_1 resembles both parents.

Pleiotropy - Single gene can exhibit multiple phenotypic expression, e.g. Phenylketonuria.

Polygenic inheritance—Many genes govern a single character, e.g. Human skin colour.

16 A tall true breeding garden pea plant is crossed with a dwarf true breeding garden pea plant. When the F_1 plants were selfed the resulting genotypes were in the ratio of **[NEET 2016, Phase I]**

(a) 1 : 2 : 1 :: Tall heterozygous : Tall homozygous : Dwarf
(b) 3 : 1 :: Tall : Dwarf
(c) 3 : 1 :: Dwarf : Tall
(d) 1 : 2 : 1 :: Tall homozygous : Tall heterozygous : Dwarf

Ans. (d)

Parents - TT (Tall) × tt (Dwarf)

F_1-generation Tt (Heterozygous tall)

K-Pollen → On selfing

Egg \	T	t
T	TT (Tall)	Tt (Tall)
t	Tt (Tall)	tt (Dwarf)

F_2-generation

Phenotypic ratio = 3 : 1 [Tall : Dwarf]
Genotypic ratio ⇒ 1 : 2 : 1
[Homozygous tall : Heterozygous tall : Dwarf]

17 A gene showing codominance has **[CBSE AIPMT 2015]**

(a) one allele dominant on the other
(b) alleles tightly linked on the same chromosome
(c) alleles that are recessive to each other
(d) Both alleles independently expressed in the heterozygote

Ans. *(d)*

A gene shows codominance when both alleles in heterozygous condition, express their traits independently instead of showing dominant-recessive relationship and such alleles are called codominant alleles.

18 In his classic experiments on pea plants, Mendel did not use **[CBSE AIPMT 2015]**

(a) seed colour (b) pod length
(c) seed shape (d) flower position

Ans. *(b)*

Pod length was not considered by Mendel in his experiments. For his experiments, Mendel choose seven characters of pea plants which are

1. Seed colour
2. Seed shape
3. Flower colour
4. Pod colour
5. Pod shape
6. Flower position and
7. Plant height

19 A pleiotropic gene **[CBSE AIPMT 2015]**

(a) is expressed only in primitive plants
(b) is a gene evolved during Pliocene
(c) controls a trait only in combination with another gene
(d) controls multiple traits in an individual

Ans. *(d)*

Pleiotropic gene is a gene that controls multiple traits is an individual. It is also called polyphenic gene, e.g. phenylketonuria causing multiple adverse effects due to the mutation in a single gene coding for enzyme phenylalanine hydroxylase.

20 Fruit colour in squash is an example of **[CBSE AIPMT 2014]**

(a) recessive epistasis
(b) dominant epistasis
(c) complementary genes
(d) inhibitory genes

Ans. *(b)*

Fruit colour in squash is an example of dominant epistasis in which the dominant gene (epistatic gene) masks the effect of other gene (recessive hypostatic gene).

Squash fruit appear white due to the epistatic effect of 'W' allele (white colour) over 'G' allele (green colour).

21 If two persons with 'AB' blood group marry and have sufficiently large number of children, these children could be classified as 'A' blood group : 'AB' blood group : 'B' blood group in 1 : 2 : 1 ratio. Modern technique of protein electrophoresis reveals presence of both 'A' and 'B' type proteins in 'AB' blood group individuals. This is an example of **[NEET 2013]**

(a) codominance
(b) incomplete dominance
(c) partial dominance
(d) complete dominance

Ans. *(a)*

In codominance both alleles of a pair express themselves fully in F_1 hybrid. It is contrary to the situation seen in incomplete dominance, where traits express themselves only partially. This is not the example of partial dominance or complete dominance

$AB \longrightarrow I^AI^B \longrightarrow$ Antigen A + Antigen B $\xrightarrow{\text{Genotype}}$ Codominance

22 Which Mendelian idea is depicted by a cross in which the F_1-generation resembles both the parents? **[NEET 2013]**

(a) Incomplete dominance
(b) Law of dominance
(c) Inheritance of one gene
(d) Codominance

Ans. *(d)*

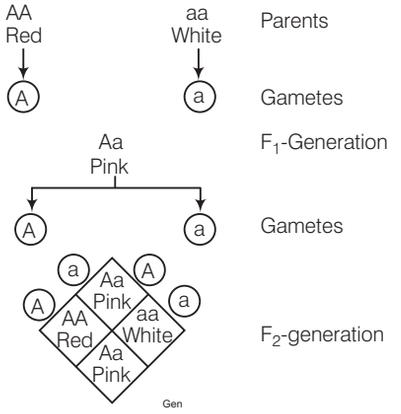
In codominance, both alleles of a pair express themselves fully in F_1 hybrid, so, it resembles both the parents. In incomplete dominance, the two genes of allelomorphic pair are not related as dominant or recessive, but each of them express itself partially. Law of dominance states that when a cross is made between two homozygous individuals considering contrasting trait of simple character then the trait that appear in F_1 hybrids is called dominant. Inheritance of one gene is based on crossing between single traits.

23 F_2-generation in a Mendelian cross showed that both genotypic and phenotypic ratios are same as 1 : 2 : 1. It represents a case of **[CBSE AIPMT 2012]**

(a) codominance
(b) dihybrid cross
(c) monohybrid cross with complete dominance
(d) monohybrid cross with incomplete dominance

Ans. *(d)*

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



Genotypic ratio – 1 (AA) : 2 (Aa) : 1 (aa)
Phenotypic ratio – 1 (Red) : 2 (Pink) : 1 (white)

23 ABO blood groups in humans are controlled by the gene I. It has three alleles – I^A, I^B and i. Since there are three different alleles, six different genotypes are possible. How many phenotypes can occur? **[CBSE AIPMT 2010]**

(a) Three (b) One
(c) Four (d) Two

Ans. *(c)*

The ABO blood group system has at least 6 genotypes. On the basis of presence or absence of antigens and antibodies, four blood groups (phenotypes) have been differentiated—A, B, AB and O blood groups. In ABO blood group system, inheritance of grouping is controlled by a single autosomal gene on chromosome 9 with three major alleles A, B and O (I^A, I^B and I^O).

24 Which one of the following cannot be explained on the basis of Mendel's Law of Dominance? **[CBSE AIPMT 2010]**

(a) The discrete unit controlling a particular character is called a factor
(b) Out of one pair of factors one is dominant, and the other recessive
(c) Alleles do not show any blending and both the characters recover as such in F_2-generation
(d) Factors occur in pairs

Ans. *(c)*

Out of the following statement (c) is incorrect because the law of dominance does not occur universally. After Mendel several cases were recorded by scientists, where a clear deviation from law of dominance was seen.

Such a deviation may be seen in the form of incomplete dominance or blending inheritance and co-dominance.

Where, F_1 hybrids exhibited a mixture or blending of character of two parents, the case is considered as that of incomplete dominance or blending inheritance. It simply means that two genes of allelomorphic pair are not related as dominant or recessive, but each of them expresses itself partially. In the case of 4 O'clock plant, when plants with red flowers are crossed with plants having white flower, the F_1 hybrids bear pink flower. When these pink flowers are self pollinated, they develop red, pink and white flowers in the ratio of 1 : 2 : 1 respectively.

25 The genotype of a plant showing the dominant phenotype can be determined by **[CBSE AIPMT 2010]**

(a) test cross
(b) dihybrid cross
(c) pedigree analysis
(d) back cross

Ans. *(a)*

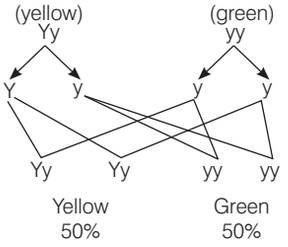
In genetics, a test cross, first introduced by Gregor J Mendel, is used to determine if an individual exhibiting a dominant trait is homozygous or heterozygous for that trait. More simply, test cross determines the genotype of an individual with a dominant phenotype. In some sources, the test cross is defined as being a type of back cross between the recessive homozygote and F_1-generation.

26 In pea plants, yellow seeds are dominant to green. If a heterozygous yellow seeded plant is crossed with a green seeded plant, what ratio of yellow and green seeded plants would you expect in F_1-generation? **[CBSE AIPMT 2007]**

(a) 50 : 50 (b) 9 : 1 (c) 1 : 3 (d) 3 : 1

Ans. *(a)*

In the given cross the ratio is 50 : 50 of yellow and green seeded plants in F_1-generation.



27 A common test to find the genotype of a hybrid is by **[CBSE AIPMT 2007]**

(a) crossing of one F_2 progeny with male parent
(b) crossing of one F_2 progeny with female parent
(c) studying the sexual behaviour of F_1-progenies
(d) crossing of one F_1 progeny with male parent

Ans. *(d)*

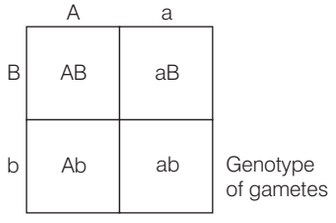
Test cross, i.e. crossing of F_1-progeny to the recessive parent is used to find the genotype of the progeny.

28 A human male produces sperms with the genotypes AB, Ab, aB and ab pertaining to two diallelic characters in equal proportions. What is the corresponding genotype of this person? **[CBSE AIPMT 2007]**

(a) AaBb (b) AaBB
(c) AABb (d) AABB

Ans. *(a)*

The corresponding genotype of person will be AaBb.



29 Test cross involves **[CBSE AIPMT 2006]**

(a) crossing between two genotypes with recessive trait
(b) crossing between two F_1 hybrids
(c) crossing the F_1 hybrid with a double recessive genotype
(d) crossing between two genotypes with dominant trait

Ans. *(c)*

The test cross involves the crossing of F_1 hybrid with a double recessive genotypic parent. By test cross, the heterozygosity and homozygosity of the organism can be tested.

Thus, the offspring will be 100% dominant, if the individual which crossed with recessive parent, i.e. (tt) was homozygous dominant and ratio will be 50% dominant and 50% recessive if the individual was heterozygous dominant. In dihybrid test cross, ratio will be 1:1:1:1.

30 How many different kinds of gametes will be produced by a plant having the genotype AABbCC ? **[CBSE AIPMT 2006]**

(a) Three (b) Four
(c) Nine (d) Two

Ans. *(d)*

The types of gametes produced by a plant depend upon the number of heterozygous pair.

Number of types of gametes = 2^n

n = number of heterozygous pair $2^1 = 2$

The gametes are – ABC and AbC.

31 In Mendel's experiments with garden pea, round seed shape (RR) was dominant over wrinkled seeds (rr), yellow cotyledon (YY) was dominant over green cotyledon (yy). What are the expected phenotypes in the F_2-generation of the cross RRYY × rryy ? **[CBSE AIPMT 2006]**

(a) Only round seeds with green cotyledons
(b) Only wrinkled seeds with yellow cotyledons
(c) Only wrinkled seeds with green cotyledons
(d) Round seeds with yellow cotyledons and wrinkled seeds with yellow cotyledons

Ans. *(d)*

When a cross (dihybrid) is made between plants bearing round yellow (RRYY) and wrinkled green (rryy) seeds, all the plants in F_1-generation are with yellow round seeds (showing the genotype RrYy). The phenotype in F_2 will be as follows

32 Phenotype of an organism is the result of **[CBSE AIPMT 2006]**

(a) mutations and linkages
(b) cytoplasmic effects and nutrition
(c) environmental changes and sexual dimorphism
(d) genotype and environmental interactions

Ans. *(d)*

Phenotype is the observable characteristics or the total appearance of an organism. It is determined by its genes, the relationships between the alleles and by the interaction during development between its genetic constitution (genotype) and the environment.

33 In order to find out the different types of gametes produced by a pea plant having the genotype AaBb, it should be crossed to a plant with the genotype **[CBSE AIPMT 2005]**

(a) aaBB
(b) AaBb
(c) AABB
(d) aabb

Ans. *(d)*

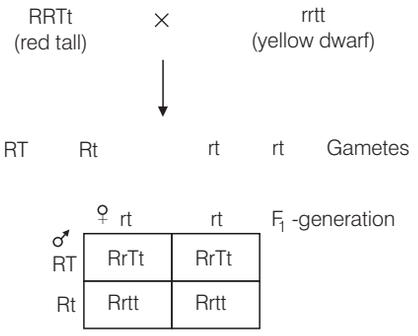
In the given question AaBb should be crossed with aabb. Scientists perform test cross to find out the different types of gametes or the genotype of an unknown individual. Test cross is performed always between the F_1 heterozygous plants and pure recessive (homozygous) parent plant. So, in the given case AaBb should be crossed with aabb.

34 In a plant, red fruit (R) is dominant over yellow fruit (r) and tallness (T) is dominant over shortness (t). If a plant with RRTt genotype is crossed with a plant that is rrtt **[CBSE AIPMT 2004]**

(a) 25% will be tall with red fruit
(b) 50% will be tall with red fruit
(c) 75% will be tall with red fruit
(d) all of the offspring will tall with red fruit

Ans. *(a)*

In the given experimnet 50% will be tall with red fruits. It can be explanied as



Conclusion :

1. All plants are red.
2. 50% are red tall.
3. 50% are red dwarf.

35 A male human is heterozygous for autosomal genes A and B and is also hemizygous for haemophilic gene h. What proportion of his sperms will be abh?

[CBSE AIPMT 2004]

(a) $\frac{1}{8}$ (b) $\frac{1}{32}$

(c) $\frac{1}{16}$ (d) $\frac{1}{4}$

Ans. *(a)*

The genotype of human male in question must be Aa Bb X^hY.

Hence $2 \times 2 \times 2 = 8$ types of gametes would be formed. AB X^h, ABY, aB X^h. aBY, Ab X^h, AbY, ab X^h, abY.

Hence, 1/8 proportion of his sperms would be abh.

36 Two crosses between the same pair of genotypes or phenotypes in which the sources of the gametes are reversed in one cross, is known as **[CBSE AIPMT 2003]**

(a) dihybrid cross (b) reverse cross

(c) test cross (d) reciprocal cross

Ans. *(d)*

Since genotypes/phenotypes of both parents are same—only sources of gametes are reversed, these crosses are called reciprocal crosses.

37 The genes controlling the seven pea characters studied by Mendel are now known to be located on how many different chromosomes? **[CBSE AIPMT 2003]**

(a) Five (b) Four

(c) Seven (d) Six

Ans. *(b)*

As a result of studies by S Blixt, it is now known that Mendel's seven selected characters are located on four chromosomes. Of these, two characters are located on chromosome number 1, three of chromosome number 4 and one each on chromosome number 5 and 7.

38 Which one of the following traits of garden pea studied by Mendel was a recessive feature? **[CBSE AIPMT 2003]**

(a) Green pod colour

(b) Round seed shape

(c) Axial flower position

(d) Green seed colour

Ans. *(d)*

Green seed colour was a recessive character in Mendel's experiment. When a pair of contrasting characters are crossed together then F_1-generation has only one type of character. This expressed character is known as dominant character while the character which could not express in F_1-generation is known as recessive character. In pea plants, tallness, round seed, yellow seed, purple flower, green pod, inflated pod and axial flower are dominant over dwarfness, wrinkled seed, green seed, white flower, yellow pod, constricted pod and terminal flower respectively.

39 A plant of F_1-generation has genotype 'AABbCC'. On selfing of this plant, the phenotypic ratio in F_2-generation will be **[CBSE AIPMT 2002]**

(a) 3 : 1

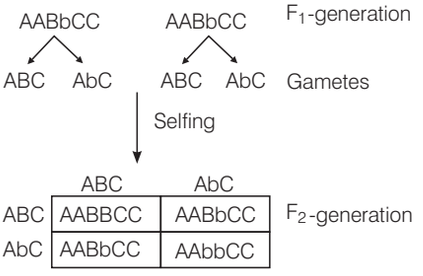
(b) 1 : 1

(c) 9 : 3 : 3 : 1

(d) 27 : 9 : 9 : 9 : 3 : 3 : 3 : 1

Ans. *(a)*

Since, AABbCC contains only one heterozygous allelic pair 'Bb', the cross would behave as monohybrid cross leading to 3 : 1 phenotypic ratio in F_2.



Phenotypic ratio is 3 : 1.

40 In his experiment, Mendel obtained wrinkled pea. The wrinkling was due to deposition of sugar instead of starch. This happened due to the enzyme **[CBSE AIPMT 2001]**

(a) amylase

(b) invertase

(c) diastase

(d) absence of starch-branching enzyme

Ans. *(d)*

In round seeds (RR/Rr) Starch-Branching Enzyme-1 (SBE-1) is found but is absent from wrinkled seeds. In rr seeds, a small DNA segment interferes with SBE-1 activity so that starch is not formed and free sugar gets accumulated. Resulting high osmotic pressure in rr seeds leads to shrinkage and wrinkling.

41 Which of these do not follow independent assortment? **[CBSE AIPMT 2001]**

(a) Genes on non-homologous chromosomes and absence of linkage

(b) Genes on homologous chromosomes

(c) Linked genes on same chromosome

(d) Unlinked genes on same chromosome

Ans. *(c)*

Genes which are 'linked' and are situated on same chromosome, cannot 'separate' during gametes formation and hence, cannot assort independently.

42 Two non-allelic genes produce the new phenotype when present together but fail to do so independently, it is called

(a) epistasis **[CBSE AIPMT 2001]**

(b) polygene

(c) non-complementary gene

(d) complementary gene

Ans. *(d)*

In complementary genes, two separate pair of genes interact to produce the phenotype in such a way that neither of the dominant genes is expressive unless the other one is absent.

43 Ratio of complementary genes is **[CBSE AIPMT 2001]**

(a) 9 : 3 : 4

(b) 12 : 3 : 1

(c) 9 : 3 : 3 : 4

(d) 9 : 7

Ans. *(d)*

In case of complementary genes, the ratio of 9 : 7 is obtained in

F_2-generation. This was first discovered by **Bateson** and **Punnett**.

Complementary genes are those genes which express themself when present together. None of these two get expressed yourself when present alone.

44 Which one of the following characters studied by Mendel in garden pea was found to be dominant? **[CBSE AIPMT 2000]**

(a) Green seed colour
(b) Terminal flower position
(c) Green pod colour
(d) Wrinkled seed

Ans. *(c)*

Green pod colour was a dominant character in Mendel's garden pea experiment.

45 Hybridisation between $\mathrm{Tt} \times \mathrm{tt}$ gives rise to the progeny of ratio **[CBSE AIPMT 1999]**

(a) 1 : 1 (b) 1 : 2 : 1
(c) 1 : 2 (d) 4 : 1

Ans. *(a)*

Offsprings with genotypes Tt (heterozygous tall) and tt (homozygous dwarf) are produced in the ratio of 1 : 1.

46 How many types of genetically different gametes will be produced by a heterozygous plant having genotype AABbCc? **[CBSE AIPMT 1998]**

(a) Two (b) Four
(c) Six (d) Nine

Ans. *(b)*

First pair AA is homozygous hence, it will contribute only one type of gene to gametes, Bb will yield two types of gametes—B and b similarly, Cc will yield two types of gametes—C and c. Hence, $1 \times 2 \times 2 = 4$ types of gametes would be produced having the genotypes ABC, ABc, AbC and Abc.

47 If Mendel had studied the seven traits using a plant with 12 chromosomes instead of 14, in what way would his interpretation have been different? **[CBSE AIPMT 1998]**

(a) He would have mapped the chromosome
(b) He would have discovered blending or incomplete dominance
(c) He would not have discovered the law of independent assortment
(d) He would have discovered sex-linkage

Ans. *(c)*

If Mendel would have studied seven traits in 12 chromosomes instead of 14 he would not have discovered independent assortment.

48 When a single gene influences more than one traits it is called **[CBSE AIPMT 1998]**

(a) pleiotropy (b) epistasis
(c) pseudodominance
(d) None of these

Ans. *(a)*

Pleiotropy is the condition in which a single gene influences more than one traits, e.g. gene for single cell produces anaemia as well as resistance to malaria.

49 Alleles that produce independent effects in their heterozygous condition are called **[CBSE AIPMT 1996]**

(a) codominant alleles
(b) epistatic alleles
(c) complementary alleles
(d) supplementary alleles

Ans. *(a)*

Codominant alleles produce independent effects in their heterozygous condition. Both the genes produce their independent effect.

50 In a dihybrid cross AABB × aabb, F_2 progeny of AABB, AABb, AaBB and AaBb occurs in the ratio of **[CBSE AIPMT 1994]**

(a) 1 : 1 : 1 : 1 (b) 9 : 3 : 3 : 1
(c) 1 : 2 : 2 : 1 (d) 1 : 2 : 2 : 4

Ans. *(d)*

In a dihybrid cross the genotypic ratio can be represented as follows—assuming a cross between AABB and aabb

AABB × aabb — Parents
AB ↓ ab — Gametes
AaBb — F_1-generation
Selfing ↓ — F_2-generation

1AA, 2Bb, 1bb
1BB — 1AABB
2Bb — 2AABb
1bb — 1Aabb

2Aa, 1aa
2Aa: 1BB — 2AaBB; 2Bb — 4AaBb; 1bb — 2Aabb
1aa: 1BB — 1aaBB; 2Bb — 2aaBb; 1bb — aabb

So, the ratio of AABB, AABb, AaBB and AaBb will be 1 : 2 : 2 : 4.

51 A cross between pure tall pea plant with green pods and dwarf pea plant with yellow pods will produce dwarf F_2 plants out of 16 **[CBSE AIPMT 1994]**

(a) 9 (b) 3
(c) 4 (d) 1

Ans. *(c)*

This is an example of dihybrid cross because two characters are being studied simultaneously in which dwarfness is a recessive characters, so in F_2-generation 4 plants will be dwarf out of 16.

52 A child of blood group O cannot have parents of blood groups **[CBSE AIPMT 1994]**

(a) AB and AB/O
(b) A and B
(c) B and B
(d) O and O

Ans. *(a)*

Blood group of the child is determined by allelic genes, i.e. $I^A I^B$ and I^O in which I^A and I^B are dominant over I^O, so if one of the parent either mother or father is of blood group AB, then she or he will have both genes, i.e I^A and I^B and child of such parent cannot have blood group O.

53 Which of the following is suitable for experiment on linkage? **[CBSE AIPMT 1993]**

(a) aaBB × aaBB (b) AABB × aabb
(c) AaBb × AaBb (d) AAbb × AaBB

Ans. *(b)*

AABB × aabb is suitable for experiment on linkage. Linkage may be defined as the tendency of two genes of the same chromosome to remain together in the process of inheritance.

54 Mendel studied inheritance of seven pairs of traits in pea which can have 21 possible combinations. If you are told that in one of these combinations, independent assortment is not observed in later studies, your reaction will be **[CBSE AIPMT 1993]**

(a) independent assortment principle may be wrong
(b) Mendel might not have studied all the combinations
(c) it is impossible
(d) later studies may be wrong

Ans. *(b)*

Mendel's law of independent assortment is applicable to only those genes which are located on different chromosomes, so if in one of the combination independent assortment is not observed that means Mendel might not have studied all the combinations.

55 A polygenic inheritance in human beings is **[CBSE AIPMT 1993, 99, 2006, 07]**

(a) skin colour
(b) phenylketonuria
(c) colour blindness
(d) sickle-cell anaemia

Ans. *(a)*

Human skin colour is controlled by polygenic effect atleast by three separate genes. Skin colour is determined by cumulative genes and this hypothesis was designed by Devenport and Devenport in 1910.

56 An organism with two identical alleles is **[CBSE AIPMT 1992]**

(a) dominant
(b) hybrid
(c) heterozygous
(d) homozygous

Ans. *(d)*

An organism with two identical alleles is homozygous, e.g. rr, tt, RR, TT, etc.

57 Segregation of Mendelian factors (no linkage, no crossing over) occurs during **[CBSE AIPMT 1992]**

(a) anaphase-I
(b) anaphase-II
(c) diplotene
(d) metaphase-I

Ans. *(a)*

At the end of anaphase-I, two groups of chromosomes (one at each pole) are produced. Each such group is having half the original number of chromosomes present in the parent nucleus. So, anaphase-I results in the reduction of chromosome number to half and segregation of Mendelian factors.

58 An allele is dominant if it is expressed in **[CBSE AIPMT 1992, 2002]**

(a) both homozygous and heterozygous states
(b) second generation
(c) heterozygous combination
(d) homozygous combination

Ans. *(a)*

Dominant allele expresses itself both in homozygous and in heterozygous states.

59 A gene pair hides the effect of another. The phenomenon is **[CBSE AIPMT 1992, 95, 99]**

(a) epistasis (b) dominance
(c) mutation (d) None of these

Ans. *(a)*

Epistasis is the phenomenon by which a gene suppresses the phenotypic expression of a non-allelic gene.

60 RR (red) *Antirrhinum* is crossed with WW (white) one. Offspring RW are pink. This is an example of **[CBSE AIPMT 1991]**

(a) dominant-recessive
(b) incomplete dominance
(c) hybrid
(d) supplementary genes

Ans. *(b)*

The pink colour of the offspring is an example of incomplete dominance. In which the expression of the characters in F_1 individual is intermediate of the factors as found in homozygous state.

61 The allele which is unable to express its effect in the presence of another is called **[CBSE AIPMT 1991]**

(a) codominant
(b) supplementary
(c) complementary
(d) recessive

Ans. *(d)*

In heterozygous condition where both the contrasting alleles are present only one allele is able to express, called dominant, while other which remain suppressed is called recessive.

62 The contrasting pairs of factors in Mendelian crosses are called

(a) multiple alleles **[CBSE AIPMT 1991]**
(b) allelomorphs
(c) alloloci
(d) paramorphs

Ans. *(b)*

Two allelomorphs are the different forms of a gene which are responsible for different expression of same characters, e.g. for colour of flower is R and r.

63 First geneticist/father of genetics was **[CBSE AIPMT 1991]**

(a) De Vries
(b) Mendel
(c) Darwin
(d) Morgan

Ans. *(b)*

Mendel for his great contribution in genetics is now known as father of genetics.

64 Mendel's last law is **[CBSE AIPMT 1991]**

(a) segregation
(b) dominance
(c) independent assortment
(d) polygenic inheritance

Ans. *(c)*

Mendel's law of independent assortment is related with inheritance of two or more genes at one time. The distribution of genes in the gametes and in the progeny of subsequent generation is independent of each other.

65 A dihybrid condition is **[CBSE AIPMT 1991]**

(a) tt Rr (b) Tt rr
(c) tt rr (d) Tt Rr

Ans. *(d)*

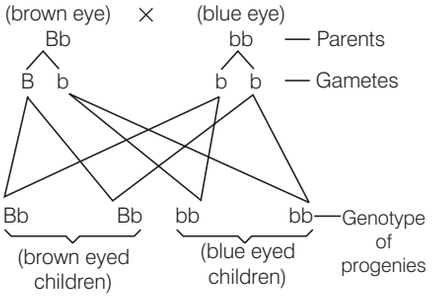
Dihybrid condition means simultaneous transmission of two pairs of genes. So, dihybrid condition is TtRr.

66 Blue eye colour is recessive to brown eye colour. A brown eyed man whose mother was blue eyed marries a blue eyed women. The children shall be **[CBSE AIPMT 1991]**

(a) both blue eyed and brown eyed 1 : 1
(b) all brown eyed
(c) all blue eyed
(d) blue eyed and brown eyed 3 : 1

Ans. *(a)*

A brown eyed man, whose mother was blue eyed must have the genotype Bb where B represents brown eye colour and b represents blue eye colour. When a man of such genotype will marry to a blue eyed woman, the children shall be



67 Multiple alleles control inheritance of **[CBSE AIPMT 1991]**

(a) phenylketonuria
(b) colour blindness
(c) sickle-cell anaemia
(d) blood groups

Ans. *(d)*

Multiple alleles control inheritance of blood groups in human. A, B, O blood group system is found in humans where the allele I^A for A antigen is codominant with the allele I^B for the B antigen.

Both I^A and I^B are completely dominant to the allele I^O.

Hierarchy of dominance relationships is symbolised as $(I^A = I^B) > I^O$.

68 Which contribute to the success of Mendel? **[CBSE AIPMT 1988]**

(a) Qualitative analysis of data
(b) Observation of distinct inherited traits
(c) His knowledge of Biology
(d) Consideration of one character at one time

Ans. *(d)*

Mendel took one trait at a time for his experiments, this contributed a lot to his success.

TOPIC 2
Chromosomal Theory of Inheritance and Linkage

69 Chromosomal theory of inheritance was proposed by **[NEET (Oct.) 2020]**

(a) Sutton and Boveri
(b) Bateson and Punnett
(c) TH Morgan
(d) Watson and Crick

Ans. *(a)*

Chromosomal theory of inheritance was proposed by Sutton and Boveri independently in 1902.

The two workers found a close similarity between the transmission of hereditary traits and behaviour of chromosomes while passing from one generation to the next through gametes.

70 Experimental verification of the chromosomal theory of inheritance was done by **[NEET (Sep.) 2020]**

(a) Sutton (b) Boveri
(c) Morgan (d) Mendel

Ans. *(c)*

Experimental verification of the chromosomal theory of inheritance was done by Thomas Hunt Morgan. Sutton and Boveri proposed chromosomal theory of inheritance but it was experimentally verified by TH Morgan. According to this theory, genes are the units of heredity and are found in the chromosomes.

71 Crossing over takes place between which chromatids and in which stage of the cell cycle? **[NEET (Odisha) 2019]**

(a) Non-sister chromatids of non-homologous chromosomes at zygotene stage of prophase I
(b) Non-sister chromatids of homologous chromosomes at pachytene stage of prophase I
(c) Non-sister chromatids of homologous chromosomes at zygotene stage of prophase I
(d) Non-sister chromatids of non-homologous chromosomes at pachytene stage of prophase I

Ans. *(b)*

Crossing over takes place between non-sister chromatids of homologous chromosomes at pachytene stage of prophase-I. This stage of prophase-I in meiosis is characterised by the appearance of recombination nodules, the site at which crossing over occurs between non-sister chromatids of the homologous chromosomes.

72 What map unit (Centimorgan) is adopted in the construction of genetic maps? **[NEET (National) 2019]**

(a) A unit of distance between two expressed genes representing 100% cross over
(b) A unit of distance between genes on chromosomes, representing 1% cross over
(c) A unit of distance between genes on chromosomes, representing 50% cross over
(d) A unit of distance between two expressed genes representing 10% cross over

Ans. *(b)*

In the construction of genetic maps, map unit or centimorgan is a unit or distance between genes on chromosomes, representing 1% crossover.

i. e. 1 map unit = 1% crossover

Hence, the genetic distance between genes is based on average number of cross over frequency between them.

73 The frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes was explained by **[NEET (National) 2019]**

(a) Gregor J Mendel
(b) Alfred Sturtevant
(c) Sutton-Boveri
(d) TH Morgan

Ans. *(b)*

Alfred Sturtevant was the first to explain the concept of chromosomal mapping. It is drawn on the basis of recombination frequency between gene pairs on the same chromosome. This frequency is directly proportional to the distance between these two genes.

It can be used to determine the exact location of a gene on the chromosome.

74 In a test cross involving F_1 dihybrid flies, more parental-type offspring were produced than the recombinant type offspring. This indicates **[NEET 2016, Phase I]**

(a) chromosomes failed to separate during meiosis
(b) the two genes are linked and present on the same chromosome
(c) both of the characters are controlled by more than one gene
(d) the two genes are located on two different chromosomes

Ans. *(b)*

When two genes in a dihybrid cross are situated on the same chromosome, the proportion of parental gene combinations are much higher than the non-parental or recombinant type as linked genes are inherited together in offspring.

75 The mechanism that causes a gene to move from one linkage group to another is called **[NEET 2016, Phase II]**

(a) inversion (b) duplication
(c) translocation (d) crossing over

Ans. *(c)*

Translocation is the process causing a gene to move from one linkage group to another. It is the separation of a chromosome segment and its union to a non-homologous chromosome. It is of two types–**simple** and **reciprocal**. In simple translocation one chromosome shows deletion or deficiency while a nonhomologous chromosome comes to have an additional segment. In reciprocal translocation two non- homologous chromosomes exchange segments between themselves to create new linkage groups in both the chromosomes. Hence, option (c) is correct.

76 The term "linkage" was coined by **[CBSE AIPMT 2015]**

(a) TH Morgan (b) T Boveri
(c) G Mendel (d) W Sutton

Ans. *(a)*

The term linkage was coined by TH Morgan. He carried out several dihybrid crosses in *Drosophila* to study genes that were sex-linked. He described the physical association of genes on a chromosome.

77 Which of the following statements is not true of two genes that show 50% recombination frequency? **[NEET 2013]**

(a) The genes may be on different chromosomes
(b) The genes are tightly linked
(c) The genes show independent assortment
(d) If the genes are present on the same chromosome, they undergo more than one crossovers in every meiosis

Ans. *(b)*

Out of the given statements (b) is incorrect because the tightly linked genes on chromosomes show 100% parental types and 0% recombinants. Two genes that undergo independent assortment indicated by a recombinant frequency of 50% are either on non- homologous chromosomes or located far apart in a single chromosome.

As the distance between two genes increases, crossover frequency increases. More recombinant gametes, fewer parental gametes.

78 Select the correct statement from the ones given below with respect to dihybrid cross. **[CBSE AIPMT 2010]**

(a) Tightly linked genes on the same chromosome show higher recombinations
(b) Genes far apart on the same chromosome show very few recombinations
(c) Genes loosely linked on the same chromosome show similar recombinations as the tightly linked ones
(d) Tightly linked genes on the same chromosome show very few recombinations

Ans. *(d)*

Morgan and his group found that when genes were grouped on the same chromosome, some genes were very tightly linked (showed very low recombination), while others were loosely linked (showed higher recombination).

Recombination is a process of rearrangement of genes during meiosis so that a gamete contains a haploid genotype with a new gene combination.

79 Two genes R and Y are located very close on the chromosomal linkage map of maize plant. When RRYY and rryy genotypes are hybridised, then F_2 segregation will show **[CBSE AIPMT 2007]**

(a) higher number of the recombinant types
(b) segregation in the expected 9 : 3 : 3 : 1 ratio
(c) segregation in 3 : 1 ratio
(d) higher number of the parental types

Ans. *(d)*

Higher number of the parental types formed when RRYY and rryy genotypes are hybridised giving the condition that R and Y genes are closely linked.

Law of independent assortment does not applicable when the gene of different character occupy the same homologous chromosome i.e. are linked gene.

80 In which mode of inheritance do you expect more maternal influence among the offspring? **[CBSE AIPMT 2006]**

(a) Autosomal
(b) Cytoplasmic
(c) Y-linked
(d) X-linked

Ans. *(b)*

The more maternal influence can be expected in the cytoplasmic inheritance, i.e. the inheritance of genes contained in the cytoplasm of a cell, rather than the nucleus.

The reason is that the female reproductive cell or the egg has a large amount of cytoplasm containing many such organelles which contain their own genes and can reproduce independently, e.g. mitochondria and chloroplast and which are consequently incorporated into the cytoplasm of all the cells of the embryo.

The male reproductive cells (sperm or pollen) consist almost solely of a nucleus. Cytoplasmic organelles are thus, not inherited from the male parent.

This is why, the cytoplasmic inheritance is also called maternal inheritance.

A gene located in the X-chromosome is said to be X-linked and its inheritance is called X-linked inheritance. In this, a male transmits his X-chromosome only to his daughters while a female transmits one of her X-chromosomes to the offspring of both sexes.

81 The recessive genes located on X-chromosome in humans are always **[CBSE AIPMT 2004]**

(a) lethal
(b) sublethal
(c) expressed in males
(d) expressed in females

Ans. *(c)*

The recessive genes located on X-chromosome in humans are always expressed in males because a female may be homozygous or heterozygous while male is always hemizygous (i.e. only one allele is present). Haemophilia, colour blindness are some human diseases which are frequently found in males.

82 Extranuclear inheritance is a consequence of presence of genes in **[CBSE AIPMT 2004]**

(a) mitochondria and chloroplasts
(b) endoplasmic reticulum and mitochondria
(c) ribosomes and chloroplast
(d) lysosomes and ribosomes

Ans. *(a)*

Extranuclear or extrachromosomal or cytoplasmic or organellar inheritance is a consequence of presence of genes in mitochondria and chloroplast.

Extrachromosomal units function either independently or in collaboration with nuclear genetic system.

83 Lack of independent assortment of two genes A and B in fruit fly *Drosophila* is due to **[CBSE AIPMT 2004]**

(a) repulsion (b) recombination
(c) linkage (d) crossing over

Ans. *(c)*

TH Morgan (1910) explained the lack of independent assortment in *Drosophila* due to the linkage. When genes closely present adhere or link together in a group and transmitted as a single unit, the phenomenon is called linkage. It stops the process of independent assortment. Incomplete linkage is broken down due to the crossing over.

84 Pattern baldness, moustaches and beard in human males are examples of **[CBSE AIPMT 2003]**

(a) sex differentiating traits
(b) sex determining traits
(c) sex linked traits
(d) sex limited traits

Ans. *(d)*

Sex limited traits are those which are limited to one sex only. Moustaches, beard are found in human males only. It was suggested on the basis of statistical analysis that premature baldness is controlled by a dominant gene, which expresses only in the presence of a certain level of male hormone (androgen).

85 The linkage map of X-chromosome of fruit fly has 66 units, with yellow body gene (y) at one end and bobbed hair (b) gene at the other end. The recombination frequency between these two genes (y and b) should be **[CBSE AIPMT 2003]**

(a) ≤50% (b) 100%
(c) 66% (d) >50%

Ans. *(b)*

The actual distance between two genes is said to be equivalent to the percentage of crossing over between these two genes. Since, the two genes lie at the ends of the chromosome, there are 100% chances of their segregation during crossing over.

86 When a cluster of genes show linkage behaviour they **[CBSE AIPMT 2003]**

(a) do not show independent assortment
(b) induce cell division
(c) do not show a chromosome map
(d) show recombination during meiosis

Ans. *(a)*

Linked genes do not show independent assortment because they are located on the same chromosome. But genes which are located on the same chromosomes (called linked genes) do not assort independently. Such type of genes are called linked genes and this phenomenon is called as linkage.

87 In recent years, DNA sequences (nucleotide sequence) of *mt*DNA and Y-chromosomes were considered for the study of human evolution, because **[CBSE AIPMT 2003]**

(a) their structure is known in greater detail
(b) they can be studied from the samples of fossil remains
(c) they are small and therefore, easy to study
(d) they are uniparental in origin and do not take part in recombination

Ans. *(d)*

Wilson and Sarich choose mitochondrial DNA (*mt*DNA) for the study of maternal line inheritance. While Y-chromosomes were considered for the study of human evolution particularly male domain. It is possible because they are uniparental in origin and do not take part in recombination.

88 Genetic map is one that **[CBSE AIPMT 2003]**

(a) shows the stages during the cell division
(b) shows the distribution of various species in a region
(c) establishes sites of the genes on a chromosome
(d) establishes the various stages in gene evolution

Ans. *(c)*

Genetic map is a diagram which shows the relative position of genes on a chromosome. **Strutevant** in 1911 prepared the first genetic map of two chromosomes of fruit fly.

89 Genes for cytoplasmic male sterility in plants are generally located in **[CBSE AIPMT 2003]**

(a) nuclear genome
(b) cytosol
(c) chloroplast genome
(d) mitochondrial genome

Ans. *(d)*

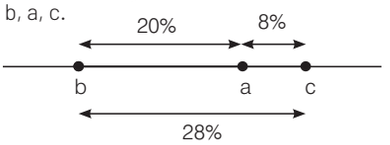
Mitochondria are originated from pre-existing mitochondria. These are semi-autonomous, living, organelles present in all eukaryotic cells. These contain DNA (*mt*DNA). The available evidences show that the genes located in *mt*DNA control the cytoplasmic male sterility.

90 There are three genes a, b, c, percentage of crossing over between a and b is 20%, b and c is 28% and a and c is 8%. What is the sequence of genes on chromosome? **[CBSE AIPMT 2002]**

(a) b, a, c (b) a, b, c
(c) a, c, b (d) None of these

Ans. *(a)*

According to the given question the sequence of gene son chromosome are b, a, c.



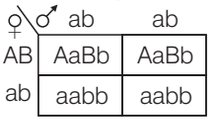
91 A and B genes are linked. What shall be the genotype of progeny in a cross between AB/ab and ab/ab? **[CBSE AIPMT 2001]**

(a) AAbb and aabb
(b) AaBb and aabb
(c) AABB and aabb
(d) None of these

Ans. *(b)*

Linked genes occur on the same chromosome and do not separate during inheritance (complete linkage).

AB ab × ab ab



Genotype is AaBb and aabb

92 Extranuclear inheritance occurs in **[CBSE AIPMT 2001]**

(a) Killer *Paramecium*
(b) Killer *Amoeba*
(c) *Euglena*
(d) *Hydra*

Ans. *(a)*

Extranuclear inheritance or cytoplasmic inheritance is the inheritance of the characters of only one parent (generally the female parent). e.g. some strains of *Paramecium* called killer strain.

93 Crossing over in diploid organism is responsible for **[CBSE AIPMT 1998]**

(a) dominance of genes
(b) linkage between genes
(c) segregation of alleles
(d) recombination of linked alleles

Ans. *(d)*

Crossing over in diploid organism is responsible for recombination of linked alleles.

94 The polytene chromosomes were discovered for the first time in **[CBSE AIPMT 1995]**

(a) *Drosophila*
(b) *Chironomus*
(c) *Musca nebulo*
(d) *Musca domestica*

Ans. *(b)*

Polytene chromosomes were first time discovered by the Italian cytologist ***EG Balbiani*** (1881) in the salivary gland cells of *Chironomus* larva.

95 Two dominant non-allelic genes are 50 map units apart. The linkage is **[CBSE AIPMT 1993]**

(a) *cis* type
(b) *trans* type
(c) complete
(d) absent/incomplete

Ans. *(d)*

Chromosome mapping is based on two genetic principles

(a) The frequency of crossing over between two genes is directly proportional to the distance between them in the chromosome.
(b) Genes are arranged in a linear order in the chromosome.

50 map unit distance between the genes is quite enough to change the *cis* arrangment of dominant genes into *trans*. So, there is no fixed linkage present.

96 Two linked genes a and b show 20% recombination. The individuals of a dihybrid cross between ++/++ × ab/ab shall show gametes **[CBSE AIPMT 1989]**

(a) ++80 : ab : 20
(b) ++50 : ab : 50
(c) ++ 40 : ab 40 : + a 10 : + b : 10
(d) ++ 30 : ab 30 : + a 20 : + b : 20

Ans. *(c)*

The gametes of a dihybrid cross between ++/++ × ab/ab will be
++ 40 : ab40 : +a10 : + b : 10

97 Crossing over in diploid organism is responsible for **[CBSE AIPMT 1998]**

(a) dominance of genes
(b) linkage between genes
(c) segregation of alleles
(d) recombination of linked alleles

Ans. *(d)*

The genes present on the same chromosome do not always remain together. These usually get separated and recombine with genes present on homologous chromosomes to form new combinations (recombinants).

98 A fruit fly heterozygous for sex-linked genes, is mated with normal female fruit fly. Male specific chromosome will enter egg cell in the proportion **[CBSE AIPMT 1997]**

(a) 1 : 1 (b) 2 : 1 (c) 3 : 1 (d) 7 : 1

Ans. *(a)*

Genes which are present on sex chromosomes are called sex linked genes. Male *Drosophila* contains XY sex chromosome, while female contains XX-chromosomes. During gamete formation male produces 50% male specific gametes and 50% female specific gametes while female produces only one type of gametes, i.e. female specific. As male produces two types of gametes in equal proportion. There is an equal opportunity to getting a male or female offspring.

99 After crossing two plants, the progenies are found to be male sterile. This phenomenon is found to be maternally inherited and is due to some genes which are present in **[CBSE AIPMT 1997]**

(a) nucleus (b) chloroplast
(c) mitochondria (d) cytoplasm

Ans. *(c)*

Factors responsible for cytoplasmic male sterility are located in mitochondrial DNA. Mitochondria are found only in eukaryotic cells.

They contain a single circular double stranded DNA molecule (*mt*DNA) and mitochondria of female parent are transferred to progeny during fertilisation.

100 When two genetic loci produce identical phenotypes in *cis* and *trans* position, they are considered to be **[CBSE AIPMT 1995]**

(a) pseudoalleles (b) different genes
(c) multiple alleles (d) parts of same gene

Ans. *(a)*

Pseudoalleles are closely placed genes producing related phenotypic effect which is distinguishable only through a rare crossing over, e.g. dominant star and recessive asteroid eye traits in *Drosophila.*

101 Genes located on Y-chromosome are **[CBSE AIPMT 1994]**

(a) mutant genes (b) sex-linked genes
(c) autosomal genes (d) holandric genes

Ans. *(d)*

Holandric genes are those that occur on the Y-chromosome only they are not expressed in females. These genes are directly transmitted from father to son. Hairy ears (hypertrichosis) in man is inherited through genes on Y-chromosomes.

102 Mr. Kapoor has Bb autosomal gene pair and d allele sex-linked. What shall be proportion of Bd in sperms? **[CBSE AIPMT 1993]**

(a) 0 (b) 1/2 (c) 1/4 (d) 1/8

Ans. *(c)*

Mr. Kapoor will have the genotype Bb, d, so 1/4th of the sperms will have Bd.

103 When a certain character is inherited only through female parent, it probably represents **[CBSE AIPMT 1992]**

(a) multiple plastid inheritance
(b) cytoplasmic inheritance
(c) incomplete dominance
(d) Mendelian nuclear inheritance

Ans. *(b)*

The amount of nuclear hereditary material contributed by the two sexes is almost equal but the cytoplasm in egg is always much more than that of the sperm, so when a certain character is inherited only through female parent it represents cytoplasmic inheritance.

104 Out of 8 ascospores formed in *Neurospora* the arrangement is 2a : 4a : 2a showing **[CBSE AIPMT 1992]**

(a) no crossing over
(b) some meiosis
(c) second generation division
(d) first generation division

Ans. *(c)*

In *Neurospora* after crossing over between the gene and centromere, the paired arrangement of ascospores is AA aaaa AA or 2a : 4a : 2a. This is known as second division segregation.

TOPIC 3
Sex-Determination

105 Match the items of Column I with Column II. **[NEET (Odisha) 2019]**

	Column I		Column II
1.	XX-XO method of sex-determination	i.	Turner's syndrome
2.	XX-XY method of sex-determination	ii.	Female heterogamety
3.	Karyotype-45	iii.	Grasshopper
4.	ZW-ZZ method of sex- determination	iv.	Female homogamety

Select the correct option from the following

	1	2	3	4
(a)	(ii)	(iv)	(i)	(iii)
(b)	(i)	(iv)	(ii)	(iii)
(c)	(iii)	(iv)	(i)	(ii)
(d)	(iv)	(ii)	(i)	(iii)

Ans. *(c)*

The correct matches are

1. XX-XO method of sex-determination is seen in (iii) Grasshopper, where males have only one X-chromosome besides autosomes and females have a pair of X-chromosome.
2. XX-XY method of sex-determination-(iv) Female homogamety as seen in human beings.
3. Karyotype-45 (i) Turner's syndrome with 45+XO.
4. ZW-ZZ method of sex-determination-(ii) Female heterogamety as seen in birds.

106 Select the incorrect statement. **[NEET (National) 2019]**

(a) In male grasshoppers, 50% of sperms have no sex-chromosome
(b) In domesticated fowls, sex of progeny depends on the type of sperm rather than egg
(c) Human males have one of their sex chromosomes much shorter than the other
(d) Male fruitfly is heterogametic

Ans. *(b)*

The statement "in domesticated fowls, sex depends on the type of sperm rather than egg" is incorrect. The correct form of statement is, in domesticated fowls, sex of progeny depends on the type of egg rather than type of sperm. In fowls, the females are heterogametic and produce two type of eggs containing either (A+Z) or (A+W) chromosomes. The males are homogametic and produce only one type of sperm containing (A+Z) chromosomes. Rest statements are correct.

107 Which one of the following pairs is wrongly matched? **[NEET 2018]**

(a)	XO type sex-determination	–	Grasshopper
(b)	ABO blood grouping	–	Codominance
(c)	Starch synthesis in pea	–	Multiple alleles
(d)	TH Morgan	–	Linkage

Ans. *(c)*

In the given pairs, option (c) is wrongly matched. Starch synthesis in pea is an example of pleiotropy. A pleiotropic gene is a single gene which produces many or multiple unrelated phenotypes. Rest of the pairs are correctly matched.

Concept Enhancer The gene for starch synthesis in pea seeds has two alleles B and b. In BB genotype, large starch grains are produced. After maturation the seeds are round. In bb homozygous condition, smaller starch grains are produced and mature seeds are wrinkled. Bb heterozygotes form round seeds so that B seems to be dominant allele. However, Bb seeds have starch grains of intermediate size, showing incomplete dominance.

108 Which one of the following conditions correctly describes the manner of determining the sex in the given example? **[CBSE AIPMT 2011]**

(a) XO type of sex chromosomes determine male sex in grasshopper
(b) XO condition in humans as found in Turner syndrome, determines female sex
(c) Homozygous sex chromosomes (XX) produce male in *Drosophila*
(d) Homozygous sex chromosomes (ZZ) determine female sex in birds

Ans. *(a)*

Grasshopper is an example of XO type of sex determination in which the males have only one X-chromosome besides the autosomes, whereas females have a pair of X-chromosomes.

109 In *Drosophila,* the sex is determined by **[CBSE AIPMT 2003]**

(a) the ratio of pairs of X-chromosomes to the pairs of autosomes
(b) whether the egg is fertilised or develops parthenogenetically
(c) the ratio of number of X-chromosomes to the set of autosomes
(d) X and Y-chromosomes

Ans. *(a)*

Calvin Bridges demonstrated that in *Drosophila,* the sex is determined by ratio of the number of X-chromosomes to the sets of autosomes. According to genic balance theory of sex-determination, Y-chromosome of *Drosophila* does not important for the determination of sex.

110 *Drosophila* flies with XXY genotype are females, but human beings with such genotype are abnormal males. It shows that **[CBSE AIPMT 2000]**

(a) Y-chromosome is essential for sex determination in *Drosophila*
(b) Y-chromosome is female determinating in *Drosophila*
(c) Y-chromosome is male determining in human beings
(d) Y-chromosome has no role in sex determination either in *Drosophila* or in human beings

Ans. *(c)*

In human beings, the presence of a Y-chromosome is required for the development of a male sex phenotype. X-chromosomes present in any number (XXX, XXXX) in the absence of a Y-chromosome gives rise to female.

Presence of even a single Y-chromosome confers maleness. In *Drosophila*, Y-chromosome plays no significant role in sex determination. In *Drosophila* male determines were located on autosomes. One X and two autosomes produce male while two X (X, X) and two autosomes produce female.

111 Foetal sex can be determined by examining cells from the amniotic fluid by looking for **[CBSE AIPMT 1997]**

(a) Barr bodies (b) autosomes
(c) chiasmata (d) kinetochore

Ans. *(a)*

Females have XX-chromosome, presence of Barr body indicates female child while absence indicates male. Amniotic fluid contains living cells flaked off from the skin of baby or amnion (derived from zygote and identical to foetus cells).

The non-dividing cells are examined. One X-chromosome always appears in the active state. If another is present, it is seen in a resting state as tightly coiled dark staining body (Barr body).

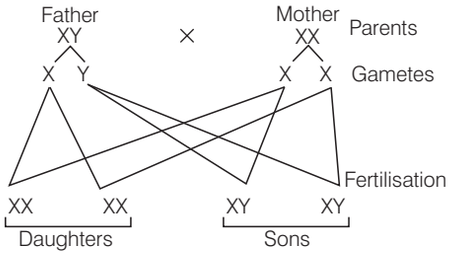
112 Genetic identity of a human male is determined by **[CBSE AIPMT 1997]**

(a) autosome (b) nucleolus
(c) sex chromosome
(d) cell organelles

Ans. *(c)*

Genetic identity of a human male is determined by sex chromosomes.

As sex of a child is determined at the time of fertilization. If male gamete containing X-chromosome fertilizes the ovum, the child would be female, if Y-chromosome does it, the child would be male.



113 An individual exhibiting both male and female sexual characteristics in the body is known as **[CBSE AIPMT 1996]**

(a) hermaphrodite (b) intersex
(c) gynandromorph (d) bisexual

Ans. *(c)*

Gynandromorph is typically male in certain portions of the body and typically female in others.

The cases of gynandromorphism has been reported in man. *Drosophila*, silkworm, bees, butterflies, beetles, etc

114 Sex is determined in human beings **[CBSE AIPMT 1993]**

(a) by ovum
(b) at the time of fertilisation
(c) 40 days after fertilisation
(d) seventh to eight week when genitals differentiate in foetus

Ans. *(b)*

In human beings male produces two types of sperms. 50% of them carry X-chromosome and 50% have Y-chromosome. Sex in human beings is determined at the time of fertilisation because sex of baby depends upon which sperm fertilises the ovum.

115 Diploid chromosome number in humans is **[CBSE AIPMT 1989]**

(a) 46 (b) 44 (c) 48 (d) 42

Ans. *(a)*

There are 23 pairs of chromosomes in humans in which 22 pairs of autosome and one pair of sex chromosome is present thus, total number of diploid chromosome is 23 pairs = 46 chromosomes.

116 A family of five daughters only is expecting sixth issue. The chance of its beings a son is **[CBSE AIPMT 1988]**

(a) Zero (b) 25% (c) 50% (d) 100%

Ans. *(c)*

Chances of a baby to be either boy or girl is always 50%. because in human beings there are 22 pairs of autosome and one pair of sex chromosome. Female is homozygous while male is heterozygous and genetically responsible for sex of the child. Sperms are of two types, i.e. sperms having X-chromosome responsible for producing a girl and sperms having Y-chromosome responsible for producing a boy.

TOPIC 4
Mutations

117 Now-a-days, it is possible to detect the mutated gene causing cancer by allowing radioactive probe to hybridise its complimentary DNA in a clone of cells, followed by its detection using autoradiography because **[NEET 2021]**

(a) mutated gene partially appears on a photographic film
(b) mutated gene completely and clearly appears on a photographic film
(c) mutated gene does not appear on a photographic film as the probe has no complementarity with it
(d) mutated gene does not appear on photographic film as the probe has complementarity with it

Ans. *(c)*

Autoradiography is an imaging technique that uses radioactive sources contained within the exposed sample.

The single-stranded DNA or RNA, tagged with a radioactive molecule (probe) is allowed to hybridise to its complementary DNA in a clone of cells followed by detection using autoradiography. The clone having the mutated gene will hence not appear on the photographic film, because the probe will not have complementarity with the mutated gene.

118 Under which of the following conditions will there be no change in the reading frame of following *m*RNA?
5′AACAGCGGUGCUAUU3′ **[NEET (National) 2019]**

(a) Deletion of G from 5th position
(b) Insertion of A and G at 4th and 5th positions, respectively
(c) Deletion of GGU from 7th, 8th and 9th positions
(d) Insertion of G at 5th position

Ans. *(c)*

The reading frame of given *m*RNA will not change even after the deletion of GGU from 7th, 8th and 9th positions. However, the amino acid glycine will not be formed at third position in this case which is being coded by GGU. In rest of the cases, insertion or deletion of one or two nucleotide bases would result in the complete alteration in the reading frame of *m*RNA.

119 A cell at telophase stage is observed by a student in a plant brought from the field. He tells his teacher that this cell is not like other cells at telophase stage. There is no formation of cell plate and thus the cell is containing more number of chromosomes as compared to other dividing cells. This would result in **[NEET 2016, Phase I]**

(a) polyploidy
(b) somaclonal variation
(c) polyteny
(d) aneuploidy

Ans. *(a)*

Polyploid cells have a chromosome number that is more than double the haploid number, e.g. *Triticum aestivum* (wheat) is a hexaploid (6*n*).

120 Point mutation involves **[CBSE AIPMT 2009]**

(a) insertion
(b) change in single base pair
(c) duplication
(d) deletion

Ans. *(b)*

The point mutations involve alterations in the structure of gene by altering the structure of DNA, i.e. change in single base pair.

Point mutations are of two types, i.e. base pair substitution and frameshift substitution.

Insertion is the addition of one or more nitrogenous bases to a nucleotide chain.

Duplication is the presence of one block of genes more than once in a haploid component.

Deletion is the removal of one or more nitrogenous bases from a nucleotide chain.

121 Select the incorrect statement from the following **[CBSE AIPMT 2009]**

(a) linkage is an exception to the principle of independent assortment in heredity
(b) galactosemia is an inborn error of metabolism
(c) small population size results in random genetic drift in a population
(d) baldness is a sex limited trait

Ans. *(d)*

Out of the given statements (d) is incorrect because baldness is not a sex-limited trait.

122 In a mutational event, when adenine is replaced by guanine, it is the case of **[CBSE AIPMT 2004]**

(a) frameshift mutation
(b) transcription
(c) transition
(d) transversion

Ans. *(c)*

In case of transition, purine base is replaced by another purine (e.g. $A \rightleftharpoons G$) and pyrimidine is replaced by another pyrimidine (e.g. $C \rightleftharpoons T$) and *vice versa*. In case of transversion purine is replaced by a pyrimidine and *vice versa*.

123 One of the parents of a cross has mutation in its mitochondria. In that cross, that parent is taken as a male. During segregation of F_2-progenies that mutation is found in **[CBSE AIPMT 2004]**

(a) one-third of the progenies
(b) none of the progenies
(c) all of the progenies
(d) fifty per cent of the progenies

Ans. *(b)*

In the present case the male parent (not female) had mutation in mitochondria, there are negligible chances of the mutation being inherited.

It is the female reproductive cell which usually carries more cytoplasm and cytoplasmic organelles than the male cell and hence, naturally would be expected to influence non-Mendelian traits.

124 Which of the following discoveries resulted in a Nobel Prize? **[CBSE AIPMT 2003]**

(a) Recombination of linked genes
(b) Genetic engineering
(c) X-rays induce sex-linked recessive lethal mutations
(d) Cytoplasmic inheritance

Ans. *(c)*

HJ Muller was awarded Nobel Prize in 1946 for his discovery of the production of mutations by X-ray radiation.

125 Change in the sequence of nucleotide in DNA is called as **[CBSE AIPMT 2002]**

(a) mutagen (b) mutation
(c) recombination (d) translation

Ans. *(b)*

Change in the sequence of nucleotide in DNA is called as mutation. The point mutations involve minor changes in the genetic material, while macro mutations involve large segments of chromosomes. 'Frameshift mutations' includes the addition or deletion of nucleotide (not involving 3 base pairs) so that the reading frame of the RNA is shifted to left or right during translation.

126 Male XX and female XY sometime occur due to **[CBSE AIPMT 2001]**

(a) deletion
(b) transfer of segments in X and Y-chromosomes
(c) aneuploidy
(d) hormonal imbalance

Ans. *(d)*

Hormonal inbalance may lead to development of male characters in female or *vice versa*. Deletion is the removal of one or few nitrogenous bases from a nucleotide chain. Aneuploidy is a chromosomal aberration in which certain chromosomes are present in extra copies or certain are deficient in number.

127 During organ differentiation in *Drosophila*, an organ is modified to another organ (such as wings may be replaced by legs). Genes responsible for such metamorphosis are called **[CBSE AIPMT 2000]**

(a) double dominant genes
(b) plastid genes
(c) complementary genes
(d) homeotic genes

Ans. *(d)*

Homeotic genes are control genes which either by getting expressed or by remaining silent during development, influence the differentiation of organs.

These have been found in insects, one nematode and some plants. A DNA sequence called homeobox, present in these genes, is involved in specification of organs.

A mutation that causes a body part to develop in appropriate position in an organism, is called homeotic mutation, e.g. in *Drosophila*, such mutation may cause legs to develop on the head in place of antennae.

128 Mutation generally produces **[CBSE AIPMT 2000]**

(a) recessive genes (b) lethal genes
(c) polygenes (d) dominant genes

Ans. *(a)*

Mutations generally produce recessive genes. Mutation is a sudden heritable change in the characteristics of an organism. The individual which shows these heritable changes is known as mutant.

129 Which of the following is the main category of mutation? **[CBSE AIPMT 1999]**

(a) Somatic mutation
(b) Genetic mutation
(c) Zygotic mutation
(d) All of these

Ans. *(b)*

Mutation is a sudden heritable change in genes structure of an organism. The term genetic mutation covers somatic mutation as well as germinal mutation (occurring during reproduction).

130 Albinism is known to be due to an autosomal recessive mutation. The first child of a couple with normal skin pigmentation was an albino. What is the probability that their second child will also be an albino? **[CBSE AIPMT 1998]**

(a) 100% (b) 25%
(c) 50% (d) 75%

Ans. *(b)*

Since, albinism is a recessive character, a child will be albino only if it is homozygous for albinism genes. Since, parents have normal skin, it means they are heterozygous.

As a result of cross between two heterozygous parents, 25% of the children will be homozygous recessive. The nature of the second child is not affected in any way by the nature of the first child because both are independent events.

131 Which base is responsible for hotspots for spontaneous point mutations? **[CBSE AIPMT 1998]**

(a) Guanine (b) Adenine
(c) 5-bromouracil (d) 5-methylcytosine

Ans. *(d)*

5-methylcytosine residues occur at the position of each hot spot. The term 'hot spots' was used by Benzer for the sites which are more mutable than other sites.

132 Loss of an X-chromosome in a particular cell, during its development, results into **[CBSE AIPMT 1998]**

(a) diploid individual
(b) triploid individual
(c) gynandromorphs
(d) Both (a) and (b)

Ans. *(c)*

Gynandromorphs are those individuals in which one part of the body is female while another part is male. It occurs due to the irregularity in mitosis at the first cleavage of the zygote.

One of the X-chromosomes of an XX (female) zygote lags in the spindle, one daughter nucleus receives only one X-chromosomes, while the other receives two X-chromosomes. A mosaic body pattern is thus established which is known as gynandromorph.

133 The formation of multivalents at meiosis in diploid organism is due to **[CBSE AIPMT 1998]**

(a) monosomy (b) inversion
(c) deletion
(d) reciprocal translocation

Ans. *(d)*

The formation of multivalents at meiosis in diploid organism is due to the reciprocal translocation.

134 A mutation at one base of the first codon of a gene produces a non-functional protein. Such a mutation is referred as **[CBSE AIPMT 1997]**

(a) frameshift mutation
(b) mis-sense mutation
(c) non-sense mutation
(d) reverse mutation

Ans. *(b)*

If mutation at one base of the first codon of a gene takes place then all the subsequent codons will be out of register (genetic code).

This results into the formation of mis-sense protein which is formed due to the mutation in the first base of first codon and thus called missense mutation.

135 Different mutations referrable to the same locus of chromosome give rise to **[CBSE AIPMT 1997]**

(a) pseudoalleles (b) polygenes
(c) oncogenes (d) multiple alleles

Ans. *(d)*

The phenomenon of multiple allelism is the simultaneous occurrence of more than two alleles (multiple alleles) at a given gene locus. Any mutation occurring within a gene (at the same locus) will give rise to a new form or new allele of that gene.

136 HJ Muller was awarded Nobel Prize for his **[CBSE AIPMT 1996]**

(a) discovery that chemicals can induce gene mutations
(b) discovery that ionizing radiations can induce gene mutations
(c) work on gene mapping in *Drosophila*
(d) efforts to prevent the use of nuclear weapons

Ans. *(a)*

HJ Muller was awarded Nobel Prize for discovering that ionizing radiations can induce gene mutations.

137 The most striking example of point mutation is found in a disease called **[CBSE AIPMT 1995]**

(a) thalassemia
(b) night blindness
(c) Down's syndrome
(d) sickle-cell anaemia

Ans. *(d)*

Sickle-cell anaemia is an example of point mutation. It is a genetic disease reported from negroes due to a molecular mutation of gene Hb^A on chromosome 11 which produces β-chain of adult haemoglobin.

In this disease nucleotide triplet CTC is changed to CAC, these changes takes place at a particular point of chromosome, so they are called as point mutation.

138 Out of A═T, G≡C pairing, bases of DNA may exist in alternate valency state owing to arrangement called **[CBSE AIPMT 1994]**

(a) analogue substitution
(b) tautomerisational mutation
(c) frameshift mutation
(d) point mutation

Ans. *(b)*

Tautomerisation occurs through rearrangement of electrons and protons of the molecules.

Due to this the purines and pyrimidines in DNA and RNA may exist in several alternate forms or tautomers.

139 A normal green male maize is crossed with albino female. The progeny is albino because **[CBSE AIPMT 1989]**

(a) trait for albinism is dominant
(b) the albinos have biochemical to destroy plastids derived from green male
(c) plastids are inherited from female parent
(d) green plastids of male must have mutated

Ans. *(c)*

Besides nucleus some genes are also present in the cytoplasm of the female parent, these genes are called plasmogenes.

In the given example the progeny is albino because of inheritance of plastids from female parent.

140 Haploids are able to express both recessive and dominant alleles/mutations because there are **[CBSE AIPMT 1988]**

(a) many alleles for each gene
(b) two alleles for each gene
(c) only one allele for each gene in the individual
(d) only one allele in a gene

Ans. *(c)*

In haploids there is only one allele for each gene in the individual, that's why haploids are better for mutation work because in them all mutations whether dominant or recessive are expressed.

TOPIC 5
Genetic Disorders

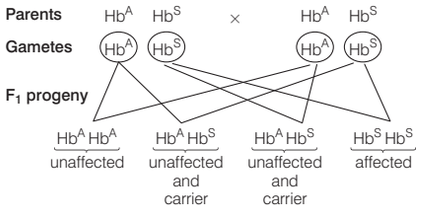
141 In a cross between a male and female, both heterozygous for sickle-cell anaemia gene, what percentage of the progeny will be diseased? **[NEET 2021]**

(a) 50% (b) 75% (c) 25% (d) 100%

Ans. *(c)*

The genotype of both male and female, heterozygous for sickle-cell anaemia gene can be represented as $Hb^A\ Hb^S$

Thus,



Thus, the percentage of diseased progeny will be 25%

142 The best example for pleiotropy is **[NEET (Oct.) 2020]**

(a) skin colour
(b) phenylketonuria
(c) colour blindness
(d) ABO blood group

Ans. *(b)*

The best example for pleiotropy is phenylketonuria which occurs in humans. In pleiotropy, a single gene can exhibit multiple phenotypic expressions. This gene is called pleiotropic gene. In phenylketonuria, a single gene mutation that codes for enzyme phenylalanine hydroxylase is seen. This manifests itself through phenotypic expression characterised by mental retardation and a reduction in hair and skin pigmentation.

143 Select the correct match. **[NEET (Sep.) 2020]**

(a)	Phenylketonuria	–	Autosomal dominant trait
(b)	Sickle-cell anaemia	–	Autosomal recessive trait, chromosome-11
(c)	Thalassemia	–	X-linked
(d)	Haemophilia	–	Y-linked

Ans. *(b)*

Option (b) is correct whereas option (a),(c) and (d) are incorrect because

Phenylketonuria is an autosomal recessive disorder.Due to this disorder, enzyme phenylalanine hydroxylase is not synthesised. This enzyme is required for conversion of phenylalanine (PA) into tyrosine. If enzyme production stops, the concentration of PA in body tissues increases,this accumulated PA gets converted into phenyl pyruvic acid which is responsible for damaging the brain.

Thalassemia is an autosomal recessive disorder. Thalassemia are of two types depending upon which protein chain of haemoglobin gets synthesised or not synthesised in a defective manner.

Haemophilia is an X- linked disorder in which the clotting time is delayed.

144 In which genetic condition, each cell in the affected person, has three sex chromosomes XXY? **[NEET (Odisha) 2019]**

(a) Thalassemia
(b) Klinefelter's syndrome
(c) Phenylketonuria
(d) Turner's syndrome

Ans. *(b)*

Klinefelter's syndrome is a genetic condition in which each cell in the affected person has three sex chromosomes XXY.

It is caused due to the presence of an additional copy of X-chromosome resulting into a karyotype of 47, XXY. Such individuals are sterile.

145 What is the genetic disorder in which an individual has an overall masculine development gynaecomastia and is sterile ? **[NEET (National) 2019]**

(a) Klinefelter's syndrome
(b) Edward syndrome
(c) Down's syndrome
(d) Turner's syndrome

Ans. *(a)*

In Klinefelter's syndrome, individual has overall masculine development, gynaecomastia and is sterile. This condition is represented as 44 + *X* (47) due to the presence of an extra X-chromosome in males.

Edward syndrome is 18 trisomy and it causes severe developmental delay.

Down's syndrome is 21-trisomy and it is identified as Mongolism due to the short stature of affected individual.

Turner's syndrome is characterised by a missing X-chromosome in females. It causes sterility in females.

146 Thalassemia and sickle-cell anaemia are caused due to a problem in globin molecule synthesis. Select the correct statement. **[NEET 2017]**

(a) Both are due to a qualitative defect in global chain synthesis
(b) Both are due to a quantitative defect in globin chain synthesis
(c) Thalassemia is due to less synthesis of globin molecules
(d) Sickle-cells anaemia is due to a quantitative problem of globin molecules

Ans. *(c)*

Thalassemia is a autosomal recessive disease, which occurs due to mutation in genes. This results in reduced rate of synthesis of the globin chains of haemoglobin. Anaemia is the main feature of this disease. There are two forms of Thalassemia, i.e. α-thalassemia (production of affected α-globin chain, which is governed by genes on 16th chromosome), and β-thalassemia (production of affected β-chain, which is governed by a gene on 11th chromosomes).

Concept Enhancer Thalassemia differs from sickle-cell anaemia in that the former is a quantitative problem of synthesising few globin molecules, while the later is a qualitative problem of synthesising an incorrectly functioning globin.

147 A disease caused by an autosomal primary non-disjunction is **[NEET 2017]**

(a) down's syndrome
(b) klinefelter's syndrome
(c) turner's syndrome
(d) sickle-cell anemia

Ans. *(a)*

Non-disjunction is the failure of chromosomes to disjoin or separate and move away to opposite poles.
Non-disjunction of 21st chromosome during oogenesis is the cause of down's syndrome. It occurs due to the presence of an additional copy of chromosome no. 21 (trisomy of 21st chromosome) is humans.

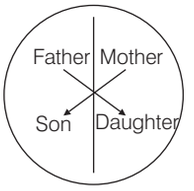
148 Which of the following most appropriately describes haemophilia? **[NEET 2016, Phase I]**

(a) X-linked recessive gene disorder
(b) Chromosomal disorder
(c) Dominant gene disorder
(d) Recessive gene disorder

Ans. *(a)*

Haemophilia is X-linked recessive gene disorder. It is a blood clotting disorder and shows criss-cross inheritance.

In this, characters from father are transmitted to daughter and from mother to son.



149 Pick out the correct statements. **[NEET 2016, Phase I]**

I. Haemophilia is a sex-linked recessive disease.
II. Down's syndrome is due to aneuploidy.
III. Phenylketonuria is an autosomal recessive gene disorder.
IV. Sickle-cell anaemia is an X - linked recessive gene disorder.

(a) II and IV are correct
(b) I, III and IV are correct
(c) I, II and III are correct
(d) I and IV are correct

Ans. *(c)*

Sickle-cell anaemia is an autosomal recessive gene disorder in which sickle-celled RBCs are formed instead of normal ones. They carry very less content of O_2 as their haemoglobin is malformed. The person suffering from this disease show symptoms of anaemia.

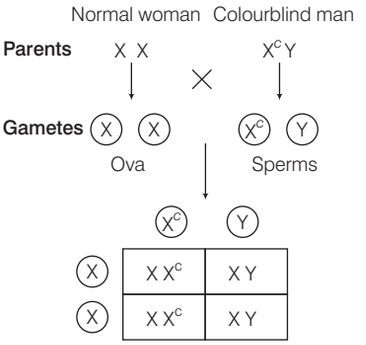
150 If a colourblind man marries a woman who is homozygous for normal colour vision, the probability of their son being colourblind is **[NEET 2016, Phase II]**

(a) 0 (b) 0.5
(c) 0.75 (d) 1

Ans. *(a)*

If a colourblind man marries a woman who is homozygous for normal colour vision, the probability of their son being colourblind is zero. Colour blindness is a recessive sex-linked trait in which the eye fails to distinguish between red and green colour. In females, colour blindness appears only when both sex chromosomes carry recessive gene (X^c X^c). However, in human males, the defect appears due to single recessive gene ($X^c Y$) because Y chromosome does not carry gene for colour vision.

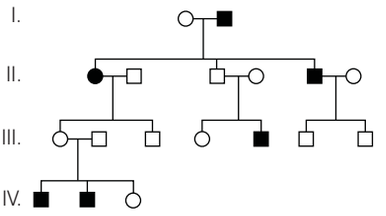
This disease shows criss-cross inheritance.



Offsprings : 2 Carrier girls; 2 Normal boys

Thus, there is zero probability of son being colourblind. Hence, option (a) is correct.

151 In the following human pedigree, the filled symbols represent the affected individuals. Identify the type of given pedigree. **[CBSE AIPMT 2015]**



(a) Autosomal dominant
(b) X-linked recessive
(c) Autosomal recessive
(d) X-linked dominant

Ans. *(c)*

The given pedigree shows the autosomal recessive disorder.

In this disorder, the individual inherit two mutated genes, one from each parent.

This disorder is usually passed on by two carriers. Health is rarely affected, but individual have one mutated gene (recessive gene) and one normal gene (dominant gene) for the condition.

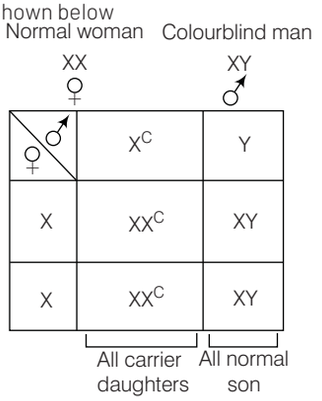
The carriers have a 25% chance of having an unaffected child with normal genes, 50% chance of having an unaffected child who also is a carrier and a 25% chance of having an affected child with recessive genes.

152 A colourblind man marries a woman with normal sight who has no history of colour blindness in her family. What is the probability of their grandson being colour blind? **[CBSE AIPMT 2015]**

(a) 0.5 (b) 1
(c) Nil (d) 0.25

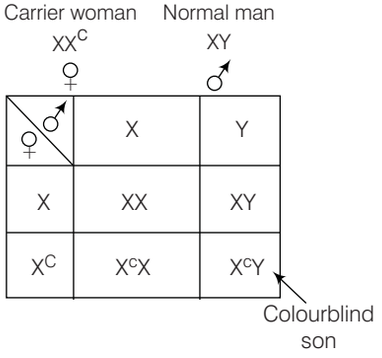
Ans. *(d)*

When a colourblind man (X^cY) marries to a woman with normal sight (XX) who has no family history of colour blindness, all of their sons will be normal pure and all of their daughters will be carriers as shown below

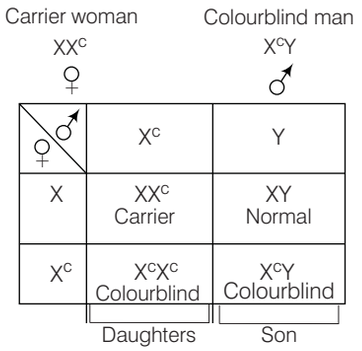


So in the next generation, the children of all of their son will be normal in all conditions (except the case in which the wife involved is not carrier neither colourblind). For carrier daughters.

(i) If they many to a normal man 50% of their grandsons will become colourblind as



(ii) If carrier daughter marries to a colourblind man 50% of their grandson will be colourblind along with 50% of the grand daughter while rest 50% of the grand daughters will be carriers as



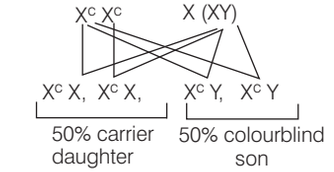
So in both the above cases the result shows 50% of grand sons will be colourblind which in terms of over all progenies (son + daughters) comes as 25% thus confirming the probability as 0.25.

153 A man whose father was colour blind marries a woman, who had a colour blind mother and normal father. What percentage of male children of this couple will be colour blind? **[CBSE AIPMT 2014]**

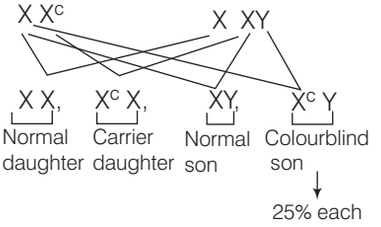
(a) 25% (b) 0%
(c) 50% (d) 75%

Ans. *(a)*

As colour blindness is a sex-linked recessive genetic disorder, for it is present at X-chromosome. Thus, according the gene to the situation given in the question, a man whose father was colour blind (will be, i.e. XY normal) marries a woman whose mother was colourblind and father was normal (i.e. this woman will be a carrier) according to the cross given below



Thus, when marriage will happen between a normal man and a carrier woman, in that case percentage of a male child to be colourblind is 25% (this can be easily observed from the cross given below)



154 A human female with Turner's syndrome **[CBSE AIPMT 2014]**

(a) has 45 chromosomes with XO
(b) has one additional X-chromosome
(c) exhibits male characters
(d) is able to produce children with normal husband

Ans. *(a)*

A human female with Turner syndrome has the absence of one of the X-chromosome, i.e. 45 with XO (or 44 + XO).

Turner syndrome is a chromosomal condition that affects the development in females.

The most common feature of Turner syndrome is short stature, which become evident by the age of 5. An early loss of ovarian function is also very common.

The ovaries develop normally at first, but egg cells usually die prematurely and most ovarian tissue degenerates before birth.

155 If both parents are carriers for thalassaemia, which is an autosomal recessive disorder, what are the chances of pregnancy resulting in an affected child? **[NEET 2013]**

(a) No chance
(b) 50%
(c) 25%
(d) 100%

Ans. *(c)*

In the given question since both parents carry a haemoglobinopathy trait of thalassemia the risk is 25% for each pregnancy for an affected child.

	R	r
r	RR	Rr
r	Rr	rr

RR–Unaffected (25%)

Rr–Carrier (50%)

rr–Affected (25%)

So, the chances of pregnancy resulting in an affected child is 25%.

156 The incorrect statement with regard to haemophilia is **[NEET 2013]**

(a) it is a sex-linked disease
(b) it is a recessive disease
(c) it is a dominant disease
(d) a single protein involved in the clotting of blood is affected

Ans. *(c)*

Out of the following statement (c) is incorrect because haemophilia is a sex linked recessive disease. In this disease, a single protein that is a part of the cascade of protein involved in the clotting of blood is affected.

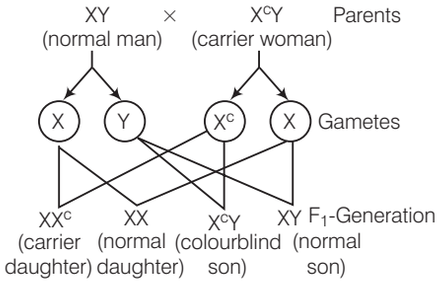
The heterozygous female for haemophilia may transmit the disease to sons.

157 A normal-visioned man whose father was colour blind, marries a woman whose father was also colour blind. They have their first child as a daughter. What are the chances that this child would be colour blind? **[CBSE AIPMT 2012]**

(a) 100% (b) 0%
(c) 25% (d) 50%

Ans. ***(b)***

Colour blindness is an X-linked disease. So, woman whose father was colour blind will be carrier for the disease.



So, possibility of a colour blind daughter (i.e., X^cX^c in F_1-generation is 0%.

158 Which one of the following symbols and its representation, used in human pedigree analysis is correct? **[CBSE AIPMT 2010]**

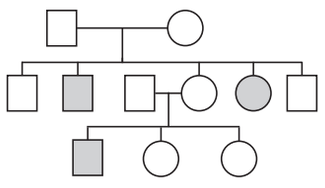
(a) ☐—○ = Mating between relatives
(b) ○ = Unaffected male
(c) ☐ = Unaffected female
(d) ◆ = Male affected

Ans. ***(a)***

The given symbol show the correct representation in human pedigree analysis

☐—○ = Mating between relatives.

159 Study the pedigree chart given below.



What does it show? **[CBSE AIPMT 2009]**

(a) Inheritance of a sex-linked inborn error of metabolism like phenylketonuria
(b) Inheritance of a condition like phenylketonuria as an autosomal recessive trait
(c) The pedigree chart is wrong as this is not possible
(d) Inheritance of a recessive sex-linked disease like haemophilia

Ans. ***(d)***

In the given pedigree chart, squares are representing males and circles females. In F_1-generation, 1-male and 1-female are diseased and in next generation only male is diseased. This shows the inheritance of a recessive sex-linked disease like haemophilia.

160 Which one of the following condition in humans is correctly matched with its chromosomal abnormality/linkage? **[CBSE AIPMT 2008]**

(a) Klinefelter's syndrome— 44 autosomes + XXY
(b) Colour blindness — Y-linked
(c) Erythroblastosis foetalis— X-linked
(d) Down syndrome— 44 autosomes + XO

Ans. ***(a)***

Klinefelter's syndrome is represented by 44 autosomes + XXY. When an abnormal egg with XX chromosome is fertilised by a sperm carrying Y-chromosome a zygote having XXY sex chromosomes is formed.

The resulting young one is an abnormal sterile male.

The 44 autosome + XO condition is due to Turner's syndrome. Such females are sterile and have short stature, webbed neck, broad shield-shaped chest, etc.

Down's syndrome is due to the trisomy of 21st pair of chromosome.

It is characterised by moderate mental retardation, large tongue, short stature, stubby fingers, an enlarged liver and spleen.

Colour blindness is an X-linked disease. The person suffering from this disease can't differentiate between red and green colours.

Erythroblastosis foetalis is caused due to Rh factor in a child born due to marriage between Rh^+ man and Rh^- woman.

161 A man and a woman, who do not show any apparent signs of a certain inherited disease, have seven children (2 daughters and 5 sons). Three of the sons suffer from the given disease but none of the daughters are affected. Which of the following mode of inheritance do you suggest for this disease ? **[CBSE AIPMT 2005]**

(a) Autosomal dominant
(b) Sex-linked dominant
(c) Sex-limited recessive
(d) Sex-linked recessive

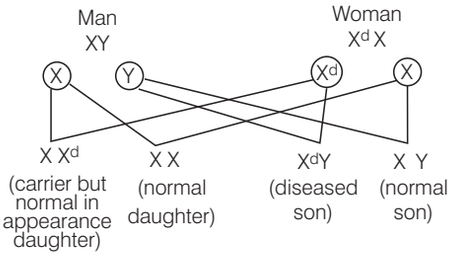
Ans. ***(d)***

In given problem, disease is the result of sex-linked recessive genes. As neither man nor woman shows signs of disease it means woman would be carrier for disease. In their children none of the daughters suffer from disease, while the sons were sufferred, it means daughters are also carrier (i.e. X-linked recessive).

Suppose, genotype of man = X Y

Genotype of woman = X^d X

(d-disease causing gene)



For each delivery the probability for each combination is 25%.

So, among seven children 2 normal daughter, 3 diseased sons and 2 normal sons are possible.

162 Haemophilia is more commonly seen in human males than in human females because **[CBSE AIPMT 2005]**

(a) this disease is due to an X-linked dominant mutation
(b) a greater proportion of girls die in infancy
(c) this disease is due to an X-linked recessive mutation
(d) this disease is due to a Y-linked recessive mutation

Ans. *(c)*

Haemophilia, a hereditary (recessive X-linked) disease is caused due to fault in genes controlling the factor VIII and IX, located on X-chromosome. The male carries only one X-chromosome, other sex chromosome carries no genes for blood clotting, so the condition is usually seen only in males where only one faulty chromosome is needed.

While a female with one faulty X-chromosome will be carrier. So, in females two faulty X-chromosomes are needed to cause the disease.

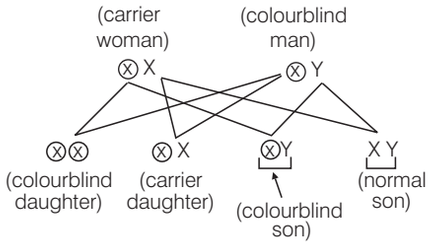
163 A woman with normal vision, but whose father was colour blind, marries a colour blind man. Suppose that the fourth child of this couple was a boy. This boy

[CBSE AIPMT 2005]

(a) must have normal colour vision
(b) will be partially colour blind since he is heterozygous for the colour blind mutant allele
(c) must be colour blind
(d) may be colour blind or may be of normal vision

Ans. *(d)*

A woman, whose father was colour blind, will be carrier for colour blind trait. Marriage of this woman with a colour blind man will result into following possibilities.



164 A normal woman whose father was colour blind is married to a normal man. The sons would be

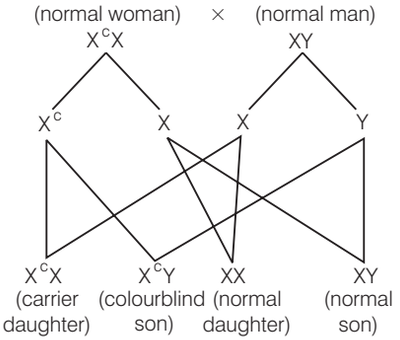
[CBSE AIPMT 2004]

(a) 75% colour blind
(b) 50% colour blind
(c) all normal
(d) all colour blind

Ans. *(b)*

The genotype of normal woman with colour blind father = XX^c

The genotype of normal man = XY



∴50% of the sons would be colour blind. Refer Ans 32.

165 Down's syndrome is caused by an extra copy of chromosome number 21. What percentage of offspring produced by an affected mother and a normal father would be affected by this disorder?

[CBSE AIPMT 2003]

(a) 50% (b) 25% (c) 100% (d) 75%

Ans. *(a)*

In the given question 50% of offsprings would be affected by this disorder because Down's syndrome is the result of trisomy, in which chromosome pair number 21st contains an extra copy of chromosome (2A + 1). Affected mother will produce 50% normal egg cells and rest 50% eggs are of abnormal type.

166 Which one of the following conditions though harmful in itself, is also a potential saviour from a mosquito borne infectious disease?

[CBSE AIPMT 2003]

(a) Pernicious anaemia
(b) Leukaemia
(c) Thalassemia
(d) Sickle-cell anaemia

Ans. *(d)*

Sickle-cell anaemia is a genetic disorder in which abnormal haemoglobin is formed because valine replaces glutamic acid at the sixth position in β-chain of haemoglobin, but the persons having this disease do not suffer from malaria as the parasite fails to thrive in sickle-shaped RBCs.

167 If a diploid cell is treated with colchicine then it becomes

[CBSE AIPMT 2002]

(a) triploid (b) tetraploid
(c) diploid (d) monoploid

Ans. *(b)*

Cholchicum autumnale provides an alkaloid called colchicine which is used in plant breeding for doubling the chromosome number. Treatment with 0.1% colchicine inhibits spindle formation so that chromatids fail to separate during anaphase.

168 Which of the following is the example of sex-linked disease?

[CBSE AIPMT 2002]

(a) AIDS (b) Colour blindness
(c) Syphilis (d) Gonorrhoea

Ans. *(b)*

Colour blindness and haemophilia are well known examples of sex-linked diseases.

169 Pleiotropic gene is

[CBSE AIPMT 2002]

(a) haemophilia
(b) thalassemia
(c) sickle-cell anaemia
(d) colour blindness

Ans. *(c)*

The ability of a gene to affect an organism in many ways is called pleiotropy (Gr. *Pleion* – more) and that gene is called as pleiotropic gene, e.g. individuals heterozygous for the sickle-cell anaemia (Hb^A Hb^S) are resistant to malaria.

170 Number of Barr bodies in XXXX female

[CBSE AIPMT 2001]

(a) 1 (b) 2 (c) 3 (d) 4

Ans. *(c)*

The number of Barr bodies in XXXX female are 3. Barr body is a condensed mass of chromatin found in the nuclei of placental mammals which contain one or more X-chromosomes, so named after its discoverer Murray Barr. The number of Barr bodies is one less than the number of X-chromosomes present.

171 Haemophilic man marries a normal woman. Their offspring will be

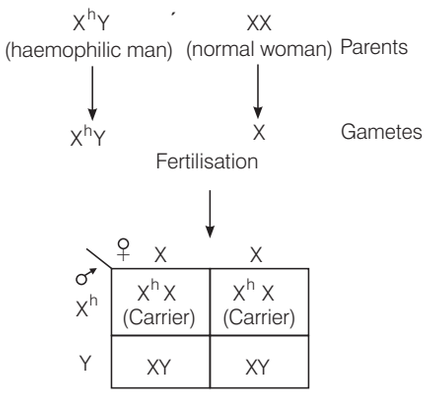
[CBSE AIPMT 1999]

(a) all boys haemophilic
(b) all normal
(c) all girls haemophilic
(d) all haemophilic

Ans. *(b)*

Haemophilia is also a sex-linked recessive disease (like colour blindness).

None of the children would suffer from haemophilia, though girls would be carriers of the disease.



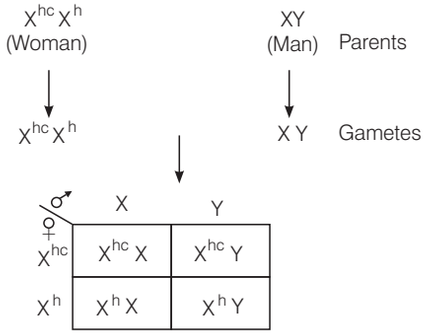
Results : All daughters are carrier while all sons are normal.

172 A woman with two genes (one on each X-chromosome) for haemophilia and one gene for colour blindness on the X-chromosomes marries a normal man. How will the progeny be? **[CBSE AIPMT 1998]**

(a) All sons and daughters haemophilic and colour blind
(b) Haemophilic and colour blind daughters
(c) 50% haemophilic colour blind sons and 50% haemophilic sons
(d) 50% haemophilic daughters and 50% colour blind daughters

Ans. *(c)*

Haemophilia and colour blindness both are recessive X-linked traits. They express in males when present in single copy (heterozygous) but in females they express only when present in homozygous condition.



Results

(a) 50% sons are colour blinds and haemophilic.
(b) 50% sons are haemophilic only.
(c) 50% daughters are carrier for colour blindness and haemophilia.
(d) 50% daughters are carrier for haemophilia only.

173 Mental retardation in man, associated with sex chromosomal abnormality is usually due to **[CBSE AIPMT 1998]**

(a) reduction in X-complement
(b) increase in X-complement
(c) moderate increase in Y-complement
(d) large increase in Y-complement

Ans. *(b)*

Sterile males with undeveloped testes, mental retardation, etc. are due to increase in their X-complement which takes place in a disorder called. Klinefelter's syndrome. These are formed by union of an XX egg and a normal Y sperm or normal X egg and abnormal XY sperm. The individual thus has 47 chromosomes (44 + XXY).

174 A man with a certain disease marries a normal woman. They have eight children (3 daughters and 5 sons). All the daughters suffer from their father's disease but none of the sons are affected. Which of the following mode of inheritance do you suggest for this disease? **[CBSE AIPMT 1996, 2002]**

(a) Sex-linked recessive
(b) Sex-linked dominant
(c) Autosome dominant
(d) Sex-limited recessive

Ans. *(b)*

Daughters have 2 X-chromosomes one of them is from father and other comes from mother, in this case all the daughters are suffering from the fathers disease hence, X-chromosome of father must be carrying a dominant trait, i.e. inheritance pattern is sex-linked dominant.

175 A person with 47 chromosomes due to an additional Y-chromosome suffers from a condition called **[CBSE AIPMT 1996, 97]**

(a) Down's syndrome
(b) Super female
(c) Turner's syndrome
(d) Klinefelter's syndrome

Ans. *(d)*

HF Klinefelter first described this condition in 1942. The chromosome number is $2n = 47$ with the formula 44A + XXY.

Phenotypically these individuals are males, but they can show some female secondary sexual characteristics and are usually sterile.

176 A woman with albinic father marries an albinic man. The proportion of her progeny is **[CBSE AIPMT 1994]**

(a) 2 normal : 1 albinic
(b) all normal
(c) all albinic
(d) 1 normal : 1 albinic

Ans. *(d)*

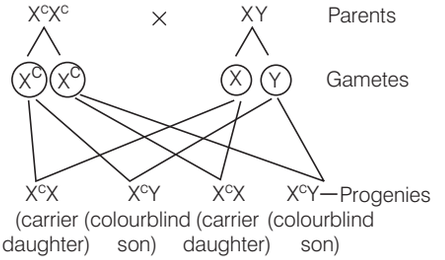
Daughter of an albinic father will be carrier of this disease, when such woman gets married to an albinic man, 50% of her progeny will be normal and 50% will be albinic.

177 A colourblind woman marries a normal visioned male. In the offspring **[CBSE AIPMT 1994]**

(a) both son and daughter are colour blind
(b) all daughters are colour blind
(c) all sons are normal
(d) all sons are colour blind

Ans. *(d)*

When a colour blind woman marries a normal visioned male, daughters will be carrier for this disease and all sons will be colour blind, this can be represented as follows



178 Of both normal parents, the chance of a male child becoming colour blind are **[CBSE AIPMT 1993]**

(a) no
(b) possible only when all the four grand parents had normal vision
(c) possible only when father's mother was colour blind
(d) possible only when mother's father was colour blind

Ans. *(d)*

Colour blindness is a X-linked recessive disease and the chance of a male child becoming colour blind of a normal parents is only when mother's father was colour blind.

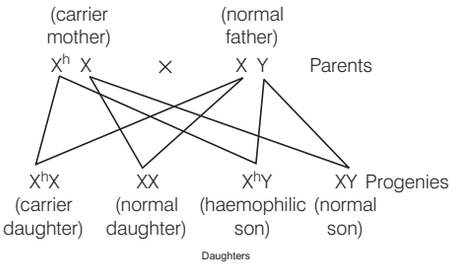
This is criss-cross inheritance in which genes are transferred to a child from his maternal grandfather through his mother.

179 Of a normal couple, half the sons are haemophilic while half the daughters are carriers. The gene is located on **[CBSE AIPMT 1993]**

(a) X-chromosome of father
(b) Y-chromosome of father
(c) one X-chromosome of mother
(d) both the X-chromosomes of mother

Ans. *(c)*

Haemophilia is a sex-linked disease. Gene of this disease is located on X-chromosome. In the given case where half the sons are haemophilic and half the daughters are carriers this is possible only when the gene responsible for haemophilia is located on one X-chromosome of mother.



50% = Carrier, 50% = Normal

Sons

50% = Haemophilic, 50% = Normal

180 In human beings 45 chromosomes/single X/XO abnormality causes **[CBSE AIPMT 1992]**

(a) Down's syndrome
(b) Klinefelter's syndrome
(c) Turner's syndrome
(d) Edward's syndrome

Ans. *(c)*

In human beings 45 chromosomes/XO abnormality causes Turner's syndrome.

Henery H Turner first described this condition in 1938. Chromosomal formula is 44+ XO.

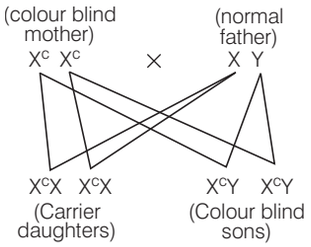
Phenotypically these individuals are females but ovaries are rudimentary and always sterile.

181 A colourblind mother and normal father would have **[CBSE AIPMT 1992, 99, 2006]**

(a) colour blind sons and normal/carrier daughters
(b) colour blind sons and daughters
(c) all colour blind
(d) all normal

Ans. *(a)*

A colourblind mother and normal father would have colour blind sons and carrier daughters. Daughters will be normal phenotypically but they will be carrier genotypically.



182 Down's syndrome is due to **[CBSE AIPMT 1992, 2000, 02, 03]**

(a) crossing over
(b) linkage
(c) sex-linked inheritance
(d) non-disjunction of chromosomes

Ans. *(d)*

Non-disjunction of 21st chromosome during oogenesis is the cause of Down's syndrome. It is also called mongolian syndrome.

183 A colourblind girl is rare because she will be born only when **[CBSE AIPMT 1991]**

(a) her mother and maternal grandfather were colourblind
(b) her father and maternal grandfather were colourblind
(c) her mother is colour blind and father has normal vision
(d) parents have normal vision but grand parents were colourblind

Ans. *(b)*

For a girl to be colourblind, the genotype of her father should be X^CY and of her mother either $X^C\ X$ or $X^C\ X^C$, where X^C represents colour blind gene.

In the given options this is only possible when her father and maternal grandfather were colour blind.

184 Which one is a hereditary disease? **[CBSE AIPMT 1990]**

(a) Cataract (b) Leprosy
(c) Blindness (d) Phenylketonuria

Ans. *(d)*

Phenylketonuria was discovered by the Norwegian physician A Fooling in 1934, an autosomal recessive mutation of gene on chromosome 12. Phenylketonuria results when there is a deficiency of liver enzyme phenylalanine hydroxylase that converts phenylalanine into tyrosine. Increased phenylalanine in the blood interferes with brain development, muscles and cartilage of the legs may be defective and the patients cannot walk properly.

185 Haemophilia is more common in males because it is a **[CBSE AIPMT 1990]**

(a) recessive character carried by Y-chromosome
(b) dominant character carried by Y-chromosome
(c) dominant trait carried by X-chromosome
(d) recessive trait carried by X-chromosome

Ans. *(d)*

Haemophilia is a disorder, which is sex-linked (X-chromosome) recessive condition. Males have only one X-chromosome, so this disease appears in them more then female as they have 2X-chromosomes.

186 Both husband and wife have normal vision though their fathers were colour blind. The probability of their daughter becoming colour-blind is **[CBSE AIPMT 1990]**

(a) 0% (b) 25% (c) 50% (d) 75%

Ans. *(a)*

In this case when the fathers of both husband and wife were colour blind and they have normal vision, husband have normal vision while wife is carrier of this disease. Daughter of such parents will be carrier but there is no chance of her to be colour blind.

187 In Down's syndrome of a male child, the sex complement is **[CBSE AIPMT 1990]**

(a) XO (b) XY (c) XX (d) XXY

Ans. *(b)*

XY is the sex complement of a male child with Down's syndrome. The cause of Down's syndrome is non-disjunction of 21st chromosome during oogenesis. This chromosomal abnormality is related with autosome so, the sex complement of a male child in this syndrome will be XY.