

CBSE Class 12 Biology
Important Questions
Chapter 5
Principles of Inheritance and Variation

1 Marks Questions

1. Give any two reasons for the selection of pea plants by Mendel for his experiments.

Ans.(i) Many varieties with contrasting forms of characters

(ii) Can easily be cross pollinated as well as self pollinated.

2. Name any one plant that shows the phenomenon of incomplete dominance during the inheritance of its flower colour.

Ans. Dog flower (Snapdragon or *Antirrhinum* sp.)

3. Name the base change and the amino acid change, responsible for sickle cell anaemia.

Ans. GAG changes as GUG, Glutamic acid is substituted by valine.

4. Name the disorder with the following chromosome complement.

(i) 22 pairs of autosomes + X X Y

(ii) 22 pairs of autosomes + 21st chromosome + XY.

Ans.(i) Klinefelters Syndrome **(ii)** Downs syndrome

5. A haemophilic man marries a normal homozygous woman. What is the probability that their daughter will be haemophilic?

Ans. Their daughter can never be haemophilic. (0%).

6. A test is performed to know whether the given plant is homozygous dominant or heterozygous. Name the test and phenotypic ratio of this test for a monohybrid cross.

Ans. Test cross 1 : 1.

7. Name the phenomena that occur when homologous chromosomes do not separate during meiosis.

Ans. Non – disjunction.

8. Name one trait each in humans & in drosophila whose genes are located on sex chromosome.

Ans. Humans - Colorblindness

Drosophila - Eye colour

9. What is meant by aneuploidy?

Ans. Aneuploidy is the phenomena of gain or loss of one or more chromosomes that results due to failure of separation of members of homologous pair of chromosomes during meioses.

10. What genetic principle could be derived from a monohybrid cross?

Ans. Law of dominance.

11. Which one change is the cause of sickle – cell anaemia ?

Ans. It is caused due to a point mutation at 6th position in B-chain of hemoglobin in which glutamic acid is replaced by valine.

12. What is a test cross?

Ans. It is a cross where offspring with dominant phenotype whose genotype is not known is crossed with an individual homozygous recessive for the trait.

13. What is mutagen? Give an example?

Ans. The physical or chemical agents that causes mutations are called mutagen eg x-rays, CNBr etc.

14. What was the total number of varieties of garden pea which Mendel had taken to start his experiment?

Ans. fourteen.

15. Name any one plant & its feature that shows the phenomena of incomplete dominance?

Ans. Antirrhium majus which shows incomplete dominance in flower colour.

2 Marks Questions

1. Identify the sex of organism as male or female in which the sex chromosome are found as

(i) ZW in bird (ii) XY in Drosophila (iii) ZZ in birds. (iv) XO in grasshopper.

Ans. (i) Female; (ii) Male; (iii) Female (iv) Male

2. Mention two differences between Turner s syndrome and Klinefelter's syndome.

Ans. Turners Syndrome : The individual is female and it has 45 chromosomes

i.e., one X chromosome is less.

Klinefelters Syndome : The individual is male and has 47 chromosomes

i.e., one extra X chromosome.

3. The human male never passes on the gene for haemophilia to his son. Why is it so?

Ans. The gene for haemophilia is present on X chromosome. A male has only one X chromosome which he receives from his mother and Y chromosome from father. The human male passes the X chromosome to his daughters but not to the male progeny (sons).

4. Mention four reasons why Drosophila was chosen by Morgan for his experiments in genetics.

Ans. (i) Very short life cycle (2-weeks)

(ii) Can be grown easily in laboratory

(iii) In single mating produce a large no. of flies.

(iv) Male and female show many hereditary variations

(v) It has only 4 pairs of chromosomes which are distinct in size and Shape.

5. Differentiate between point mutation and frameshift mutations.

Ans. Point Mutations : Arises due to change in a single base pair of DNA e.g., sickle cell anaemia. Frame shift mutations : Deletion or insertion/duplication/addition of one or two bases in DNA.

6. Give any two similarities between behavior of genes (Mendel's factor) during inheritance & chromosomes during cell division.

Ans. (i) In diploid cells, the chromosomes are found in pairs just like that of mendelian factors.

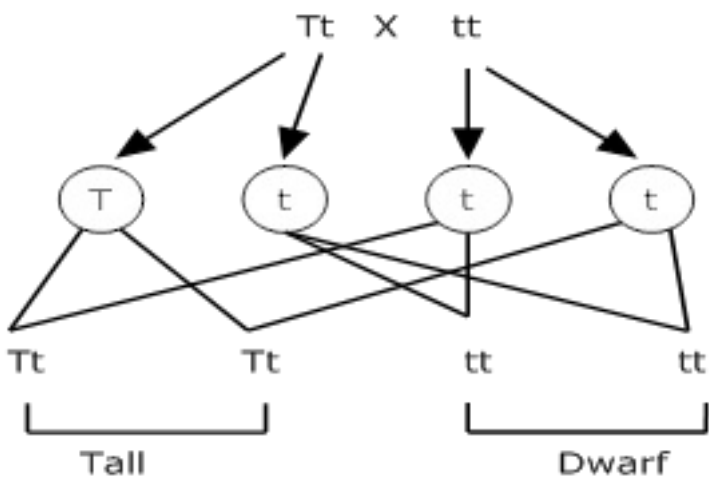
(ii) During meiosis, the chromosomes of different homologous pairs are assorted independently into gametes at random showing parallelism with mendelian factors.

7. Which law of Mendel is universally accepted? State the law?

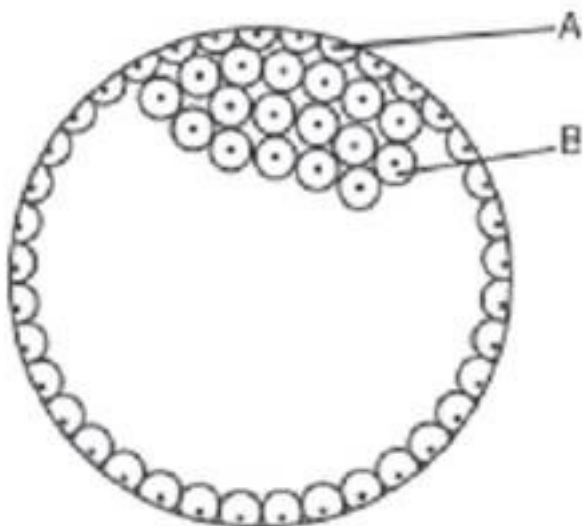
Ans. Mendel's law of segregation is universally accepted. It states that – “the two alleles of a gene remain separate & do not contaminate each other in F1 or the hybrid. At the time of gamete formation two alleles separate & pass into different gametes.

8. How will you find out whether a given plant is homozygous or heterozygous?

Ans. To test whether a plant is homozygous or heterozygous, test cross is performed in which individual is crossed with homozygous recessive for the trait. If plant is heterozygous, progeny of test cross consists of tall and dwarf plants in the ratio 1:1



If plant is homozygous, progeny of test cross will have all tall plants



9. Why do sons of haemophilic father never suffer from this trait?

Ans. Since haemophilic is a sex – linked character, it shows criss – cross inheritance i.e from father to his daughter therefore son of haemophilic father is never haemophilic.

10. How is the child affected if it has grown from the zygote formed by an XX-egg fertilized by Y-carrying sperm? What do you call this abnormality?

Ans. If a child has grown from the zygote formed by XX-egg fertilized by Y-sperm, the child will suffer from Klinefelter syndrome & will have XXY genotype. It is characterized by prominent feminine characters e.g. tall stature with feminised physique, Breast development, pubic hair pattern, poor beard growth & sterility.

11. The map distance in certain organism between genes A & B is 4 units, between B & C is 8 units, & between C & D is 12 units which one of these gene pairs will show more recombination frequency? Give reason.

Ans. C & D will show maximum gene recombination because genes which are more closely linked, frequency of recombination is least & vice versa.

12. Give the chromosomal constitution & related sex in each of the following :-

i) Turner syndrome

ii) Klinefelter syndrome

ans. i) Turner syndrome – XO females containing 45 chromosomes & lacking one X-chr .

ii) Klinefelter syndrome XXY males containing 47chr, one extra X-chromosome in males.

13. What is pedigree Analysis? How is it useful?

Ans. The analysis of family history about inheritance of a particular trait in several generations of a family is called pedigree Analysis. It provides a strong tool which is utilized to trace inheritance of specific trait or abnormality or disease.

14. What are multiple alleles? Give an example?

Ans. The presence of more than two alleles of a trait is called multiple alleles e.g. in human beings four types of blood groups are recognized and there different alleles I^A I^B & I^O of a gene determines the phenotype of four blood groups.

3 Marks Questions

1. A woman with O blood group marries a man with AB blood group

(i) work out all the possible phenotypes and genotypes of the progeny.

(ii) Discuss the kind of dominance in the parents and the progeny in this case.

Ans. (i) Blood group AB has alleles as I^A , I^B and O group has i which on cross gives the both blood groups A and B while the genotype of progeny will be $I^A i$ and $I^B i$.

(ii) I^A and I^B are equally dominant (co-dominant). In multiple allelism, the gene I exists in 3 allelic forms, I^A , I^B and i .

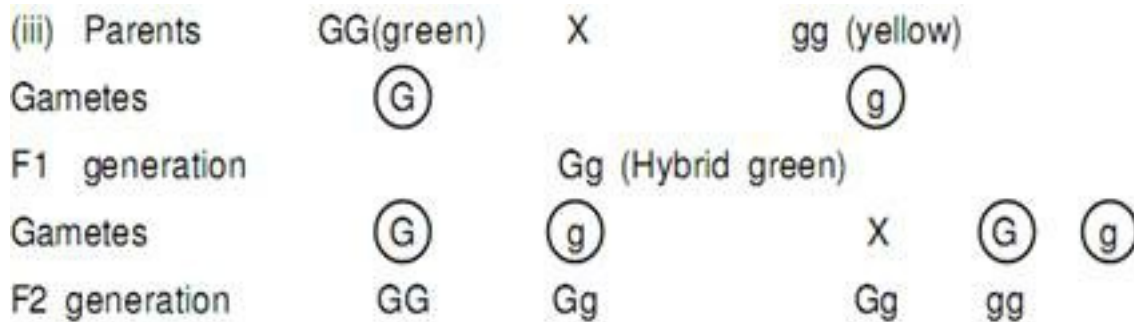
2. Explain the cause of Klinefelters syndrome. Give any four symptoms shown by sufferer of this syndrome.

Ans. Cause : Presence of an extra chromosome in male i.e., XXY. Symptoms : Development of breast, Female type pubic hair pattern, poor beard growth, under developed testes and tall stature with Feminized physique.

3. In Mendels breeding experiment on garden pea, the offspring of F₂ generation are obtained in the ratio of 25% pure yellow pod, 50% hybrid green pods and 25% green pods State (i) which pod colour is dominant (ii) The Phenotypes of the individuals of F₁ generation. (iii) Workout the cross.

Ans. (i) Green pod colour is dominant

(ii) Green pod colour

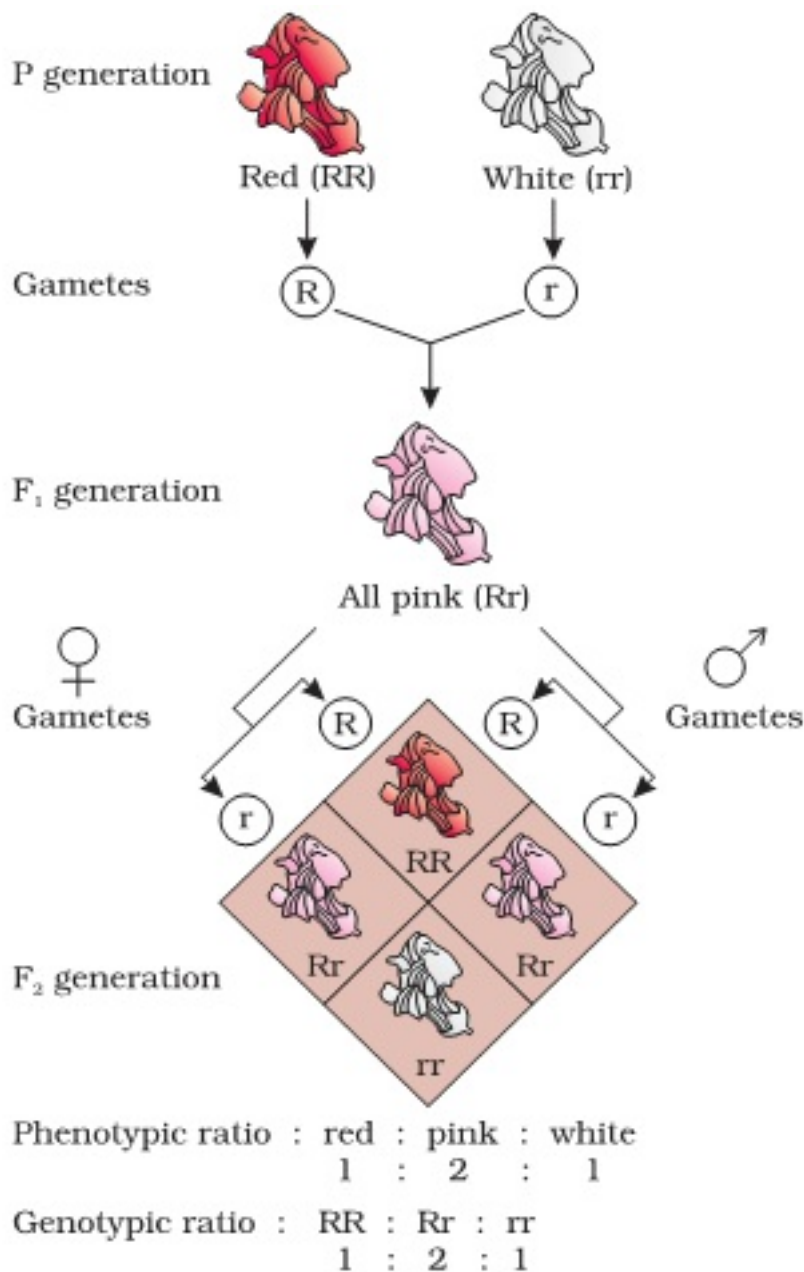


Phenotypic ratio 3 : 1

Genotypic ratio 1 : 2 : 1

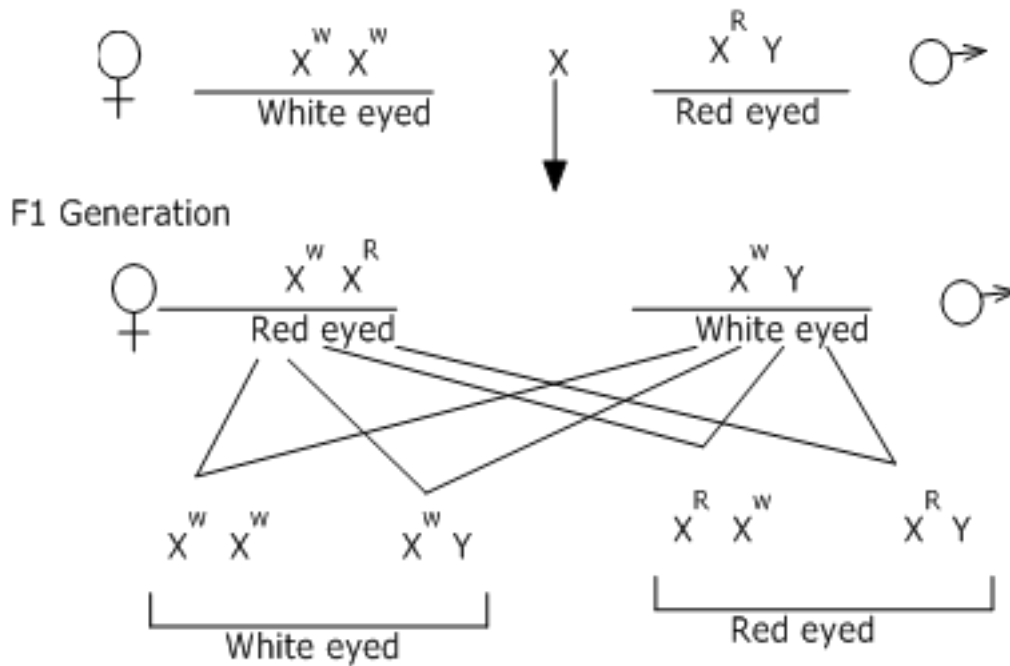
4. In *Antirrhinum majus* a plant with red flowers was crossed with a plant with white flowers. Work out all the possible genotypes & phenotypes of F1 & F2 generations comment on the pattern of inheritance in this case?

Ans. The inheritance of flower colour in snapdragon or *Antirrhinum majus* is an example of incomplete dominance. When a cross was made between a red flowered plant & a white flowered plant, the F1 hybrid was pink i-e-an intermediate between red & white which means that both red & white are incompletely dominant. When F1 individuals was self – pollinated, the F2 generation consists of red, pink & white flower appears in ratio 1:2:1 respectively.

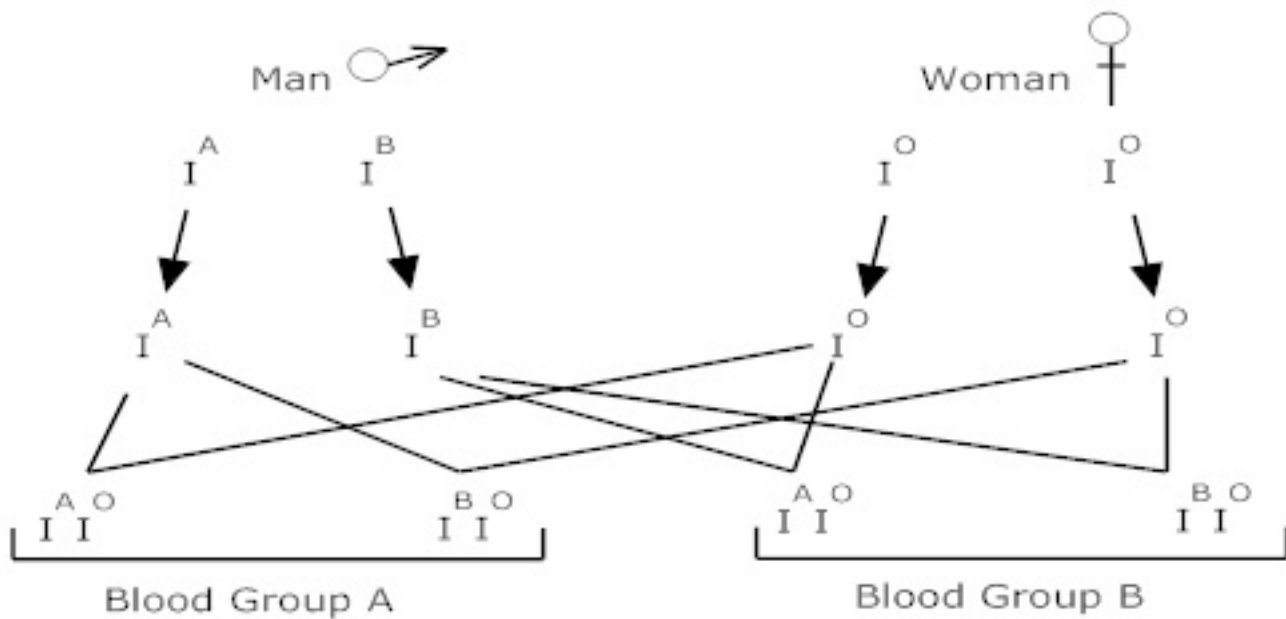


5. A red eyed male fruitfly is crossed with white eyed female fruitfly. Work out the possible genotype & phenotype of F₁ & F₂ generation. Comment on the pattern of inheritance in this cross?

Ans. When a red eyed is crossed with white eyed female fruitfly, offspring will have both white eyed male & red eyed female in 1:1 ration in F₁ generation. In F₂ generation, 50% females will be red – eyed & 50% will be white eyed, similarly, in males 50% will be red eyed & 50% will be white eyed. This result indicates that in sex-linked genes, males transmit their sex-linked characters to their grandson through their daughter; such type of inheritance is called criss-cross inheritance –



6. A man with AB blood group marries a woman with O group blood.



(i) Work out all the possible phenotypes & genotypes of the progeny.

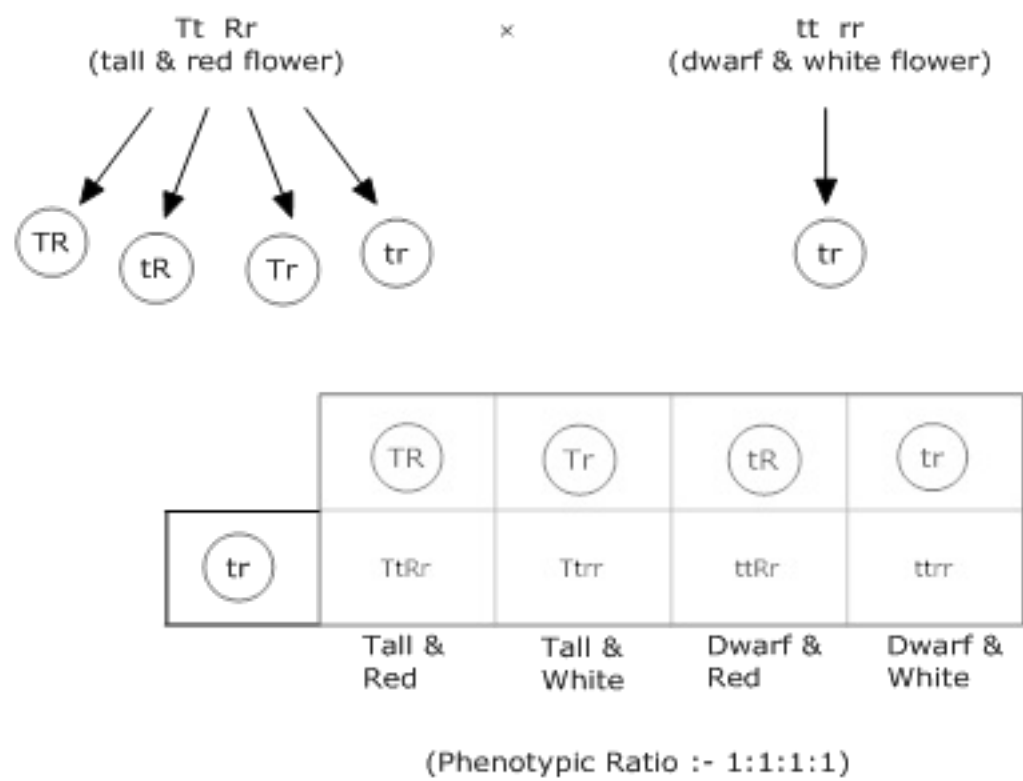
(ii) Discuss the kind of domination in parents & progeny in this case?

Ans. (i) Half the progeny will have blood group A with genotype $I^A I^O$ & half the progeny will have blood group B with genotype $I^B I^O$.

(ii) IA & IB both the genes are dominant over IO gene hence progeny shows either blood group A or B while in parents since both the dominant genes are present together man will have blood group AB & this phenomena is called co-dominance.

7. In an cross made between a hybrid tall & red plant (TtRr) with dwarf & white flower (ttrr). What will be the genotype of plants in F1 generation?

Ans.



8. How sex is determined in human beings?

Ans. In human beings, it was found that all the females bear a pairs of X-chromosome while males have one X-chr & also one Y-chr which is comparatively smaller in size.

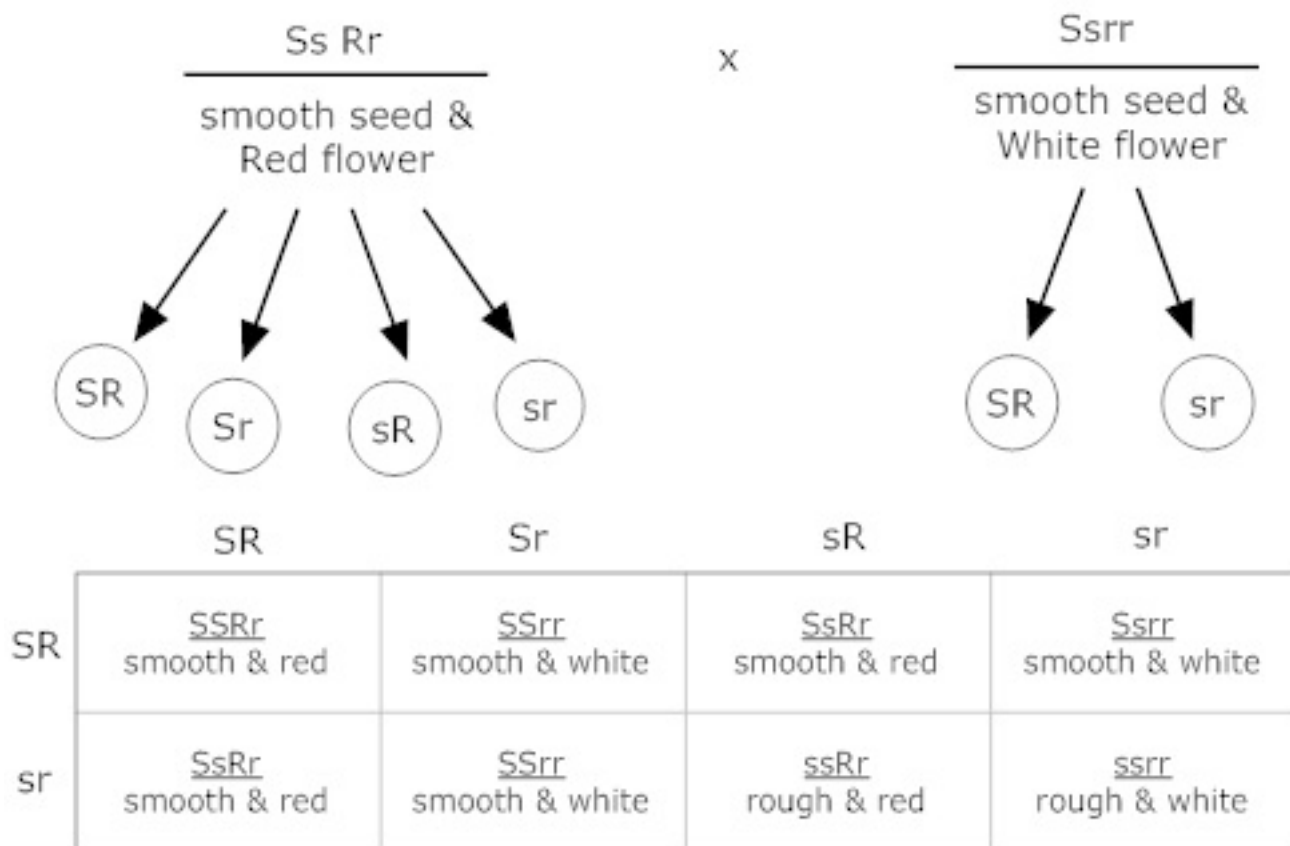
Thus in a cross between male & female there is equal probability of males & females in progeny & sex is determined by presence of a Y-chr. if Y-chr is present it is male otherwise it is a female.

9. A smooth seeded & red – flowered pea plant (SsRr) is crossed with smooth seeded &

white flowered pea plant (Ssrr). Determine the phenotypic & genotypic ratio in f1 progeny?

Ans.

1. Smooth seed & red flower =3
2. Smooth seed & white flower =3
3. Rough seed & red flower =1
4. Rough seed & white flower =1



5 Marks Questions

1. A dihybrid heterozygous round, yellow seeded garden pea (*Pisum sativum*) was crossed with a double recessive plant.

(i) What type of cross is this?

(ii) Work out the genotype and phenotype of the progeny.

(iii) What principle of Mendel is illustrated through the result of this cross?

Ans.(i) It is a dihybrid test cross

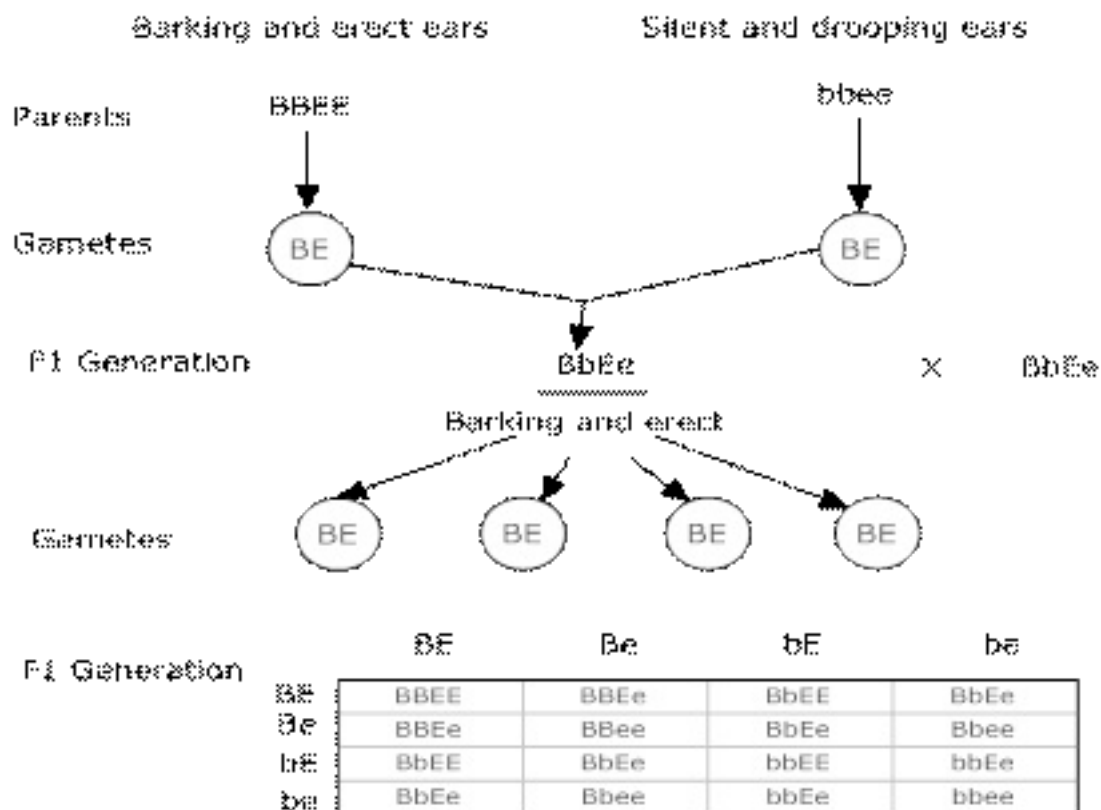
(ii)

Gametes		$\textcircled{\text{RY}}$, $\textcircled{\text{Ry}}$, $\textcircled{\text{rY}}$, $\textcircled{\text{ry}}$				X		$\textcircled{\text{ry}}$	
Gametes		RY	Ry			rY	ry		
F ₁ progeny	ry	RrYy	Rryy			rrYy	rryy		
		Round, Yellow	Round and Green			Wrinkled Yellow	Wrinkled, Green		
Phenotypic ratio		:	1	:	1	:	1	:	1
Genotypic ratio		:	1	:	1	:	1	:	1

(iii) It illustrates the Principle of independent assortment.

2. In dogs, barking trait is dominant over silent trait & erect ears are dominant over drooping ears. What is the expected phenotypic ratio of offspring when dogs heterozygous for both the traits are crossed?

Ans.



Ration :- Barking & erect = 9

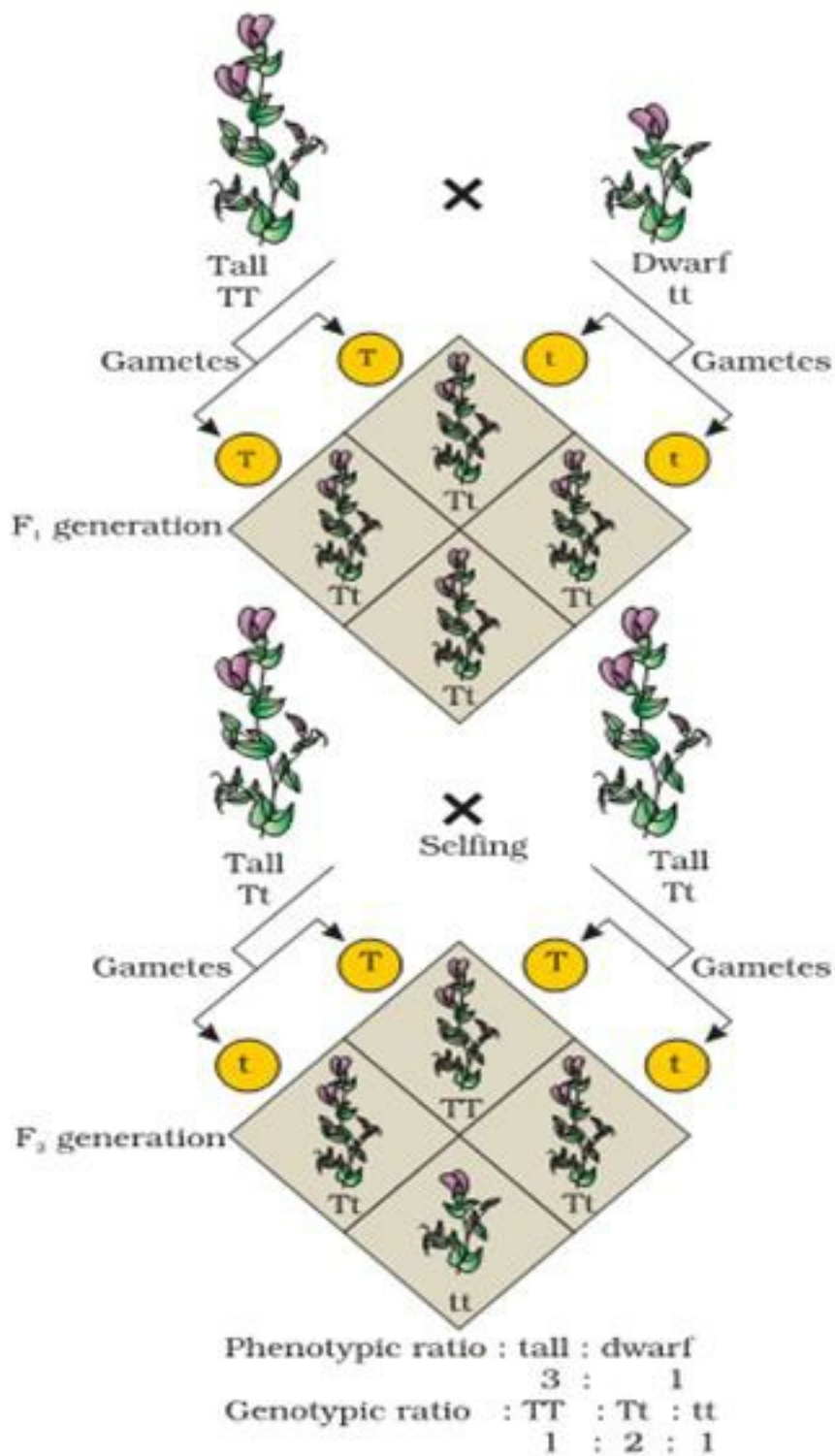
Barking & drooping = 3

Silent & erect = 3

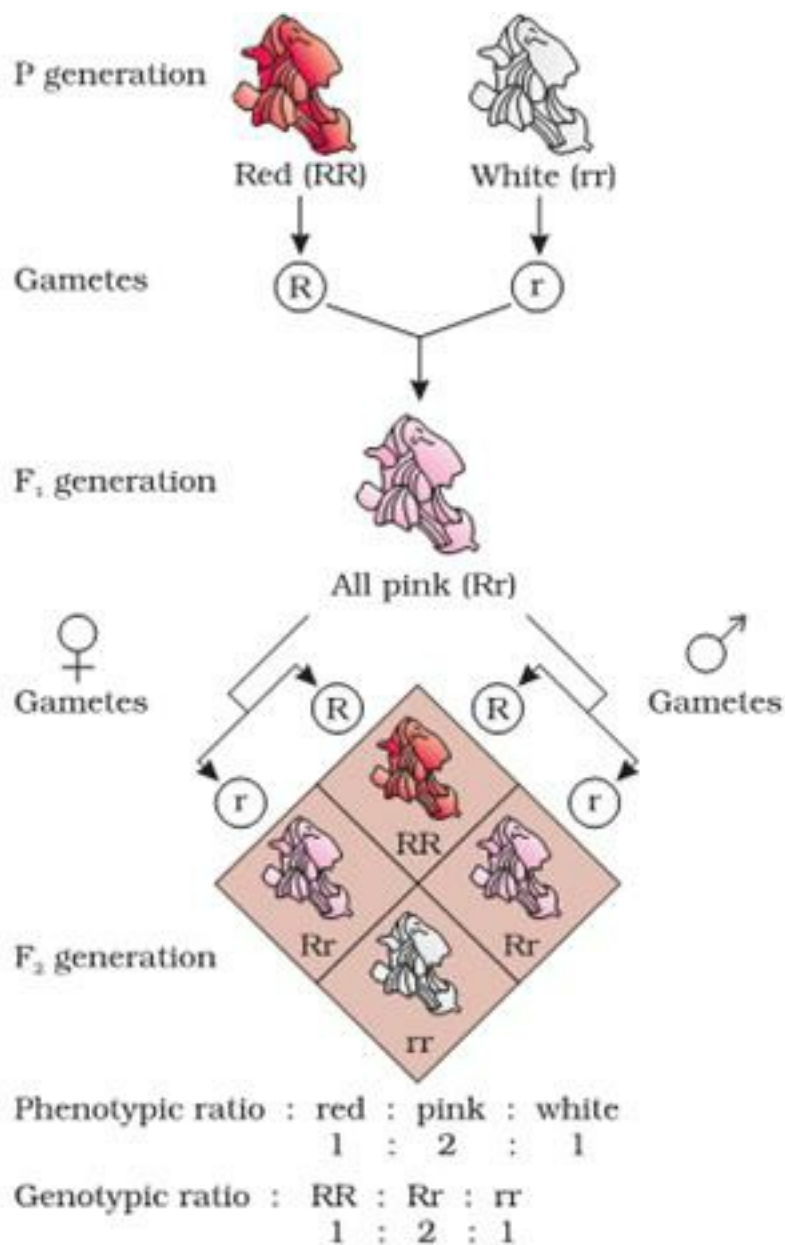
Silent & drooping = 1

Phenotypic ratio = 9 : 3 : 3 : 1

3. Differentiate between dominance, co-dominance & Incomplete dominance with one example each.



Ans. (i) Dominance :- When a cross is made between true – breeding tall pea plant & true – breeding dwarf pea plant, all the plants in F₁ generation are tall this shows that tall character is dominant over dwarf



(ii) Co-dominance :- If the two equally dominant genes are present together, both of them will be equally expressed, this phenomena is called co-dominance eg alleles of blood group IA & IB are dominant over IO but when both the alleles are present together, both of them will equally express & forms a phenotype AB.

Allele from Parent 1	Allele from Parent 2	Genotype of offspring	Blood types of offspring
I^A	I^A	$I^A I^A$	A
I^A	I^B	$I^A I^B$	AB
I^A	i	$I^A i$	A
I^B	I^A	$I^A I^B$	AB
I^B	I^B	$I^B I^B$	B
I^B	i	$I^B i$	B
i	i	$i i$	O

(iii) In complete dominance :- When a cross is made between two characters of which none of them is completely dominant then an intermediate character develops in the progeny eg. when a cross is made between red flower & white flower in snapdragon flower an intermediate pink colour appears in the progeny

4. A dihybrid heterozygous tall & yellow pea plant was crossed with double recessive plant.

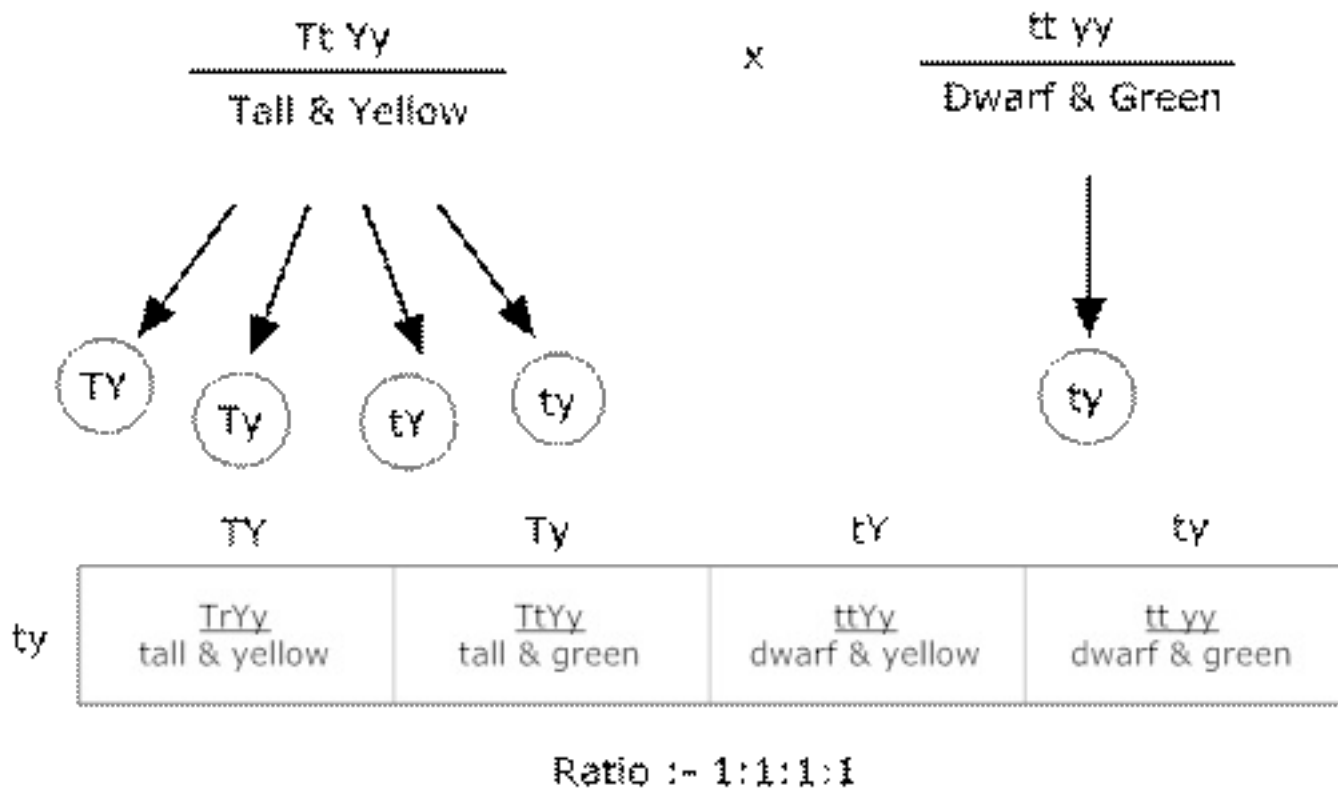
(i) What type of cross is this?

(ii) Work out the genotype & phenotype of progeny

(iii) What principle of Mendel is illustrated through result of this cross?

Ans. (i) Test cross.

(ii)



(iii) Principle of Independent Assortment – Acc to which, in the inheritance of contrasting characters the factors of each pair of character segregate independently of the factors of the other pair of characters.