CLASS X LIFE SCIENCE.

Some Madhyamik Questions & Answers from the Chapter, "Heredity & Genetic diseases".

Q I. State with example how dominant trait is expressed in the experiment of hybridization. [2].

Ans. Expression of dominant trait can be explained by the hybridization experiment when tall plants were crossed with dwarf plants (P_1 or parents) by Mendel — where all plants in the F_1 generation were tall. When the F_1 plants were self-fertilized, both tall & dwarf plants were obtained in a ratio of 3:1.

This pattern of inheritance were also observed when these experiments were performed with other characters chosen by Mendel.

For any character, the F_1 individual derived from crosses between two different varieties having alternative characters, showed only one of the traits & never the other. This feature was expressed as <u>dominance</u> of one trait over the other. The trait which appeared in the F_1 generation was called <u>dominant</u> & the other which did not appear in the F_1 generation, but reappeared in 25% ($1/4^{th}$) of the F_2 generation was called <u>recessive</u>.

Therefore, in F_1 plants, both the factors for tallness & dwarfness are present. However, the factor for dwarfness is unable to express itself in the presence of factor for tallness. Hence, the factor for tallness is dominant over the factor for dwarfness (recessive).

Q2 What would be the ratio of phenotype & genotype of F_2 generation in monohybrid experiment in case of incomplete dominance? [2]

Ans: The law of dominance is not always found to be correct as there are many examples, where the complete dominance is absent. In incomplete dominance, the genes of an allelomorphic pair are not expressed as dominant & recessive but express themselves partially, when present together in the hybrid. As a result F_1 hybrids show characters, intermediate to the effect of two genes of the parents.

In Mirabilis jalapa, when a cross is made between red flowered (RR) & white flowered (rr) varieties, F_1 progeny (Rr) produced is an all pink flowered.

When these F_1 pink flower are self-pollinated or crossed among themselves to raise F_2 generation, they produce red (RR), pink (Rr) & white (rr) flowers giving 1:2:1 ratio.

P → RR × rr

Gametes → (R) (R) (r) (r)

F_1 → (Rr) (Rr) ------ All pink.

F_1 gametes → (R) (r) (R) (r)

F_2 generation →

	R	r
R	RR (red)	Rr (Pink)
r	Rr (Pink)	rr (white)

Phenotypic ratio:
Red 1 : Pink 2 : white 1

Genotypic ratio:
RR 1 : Rr 2 : rr 1

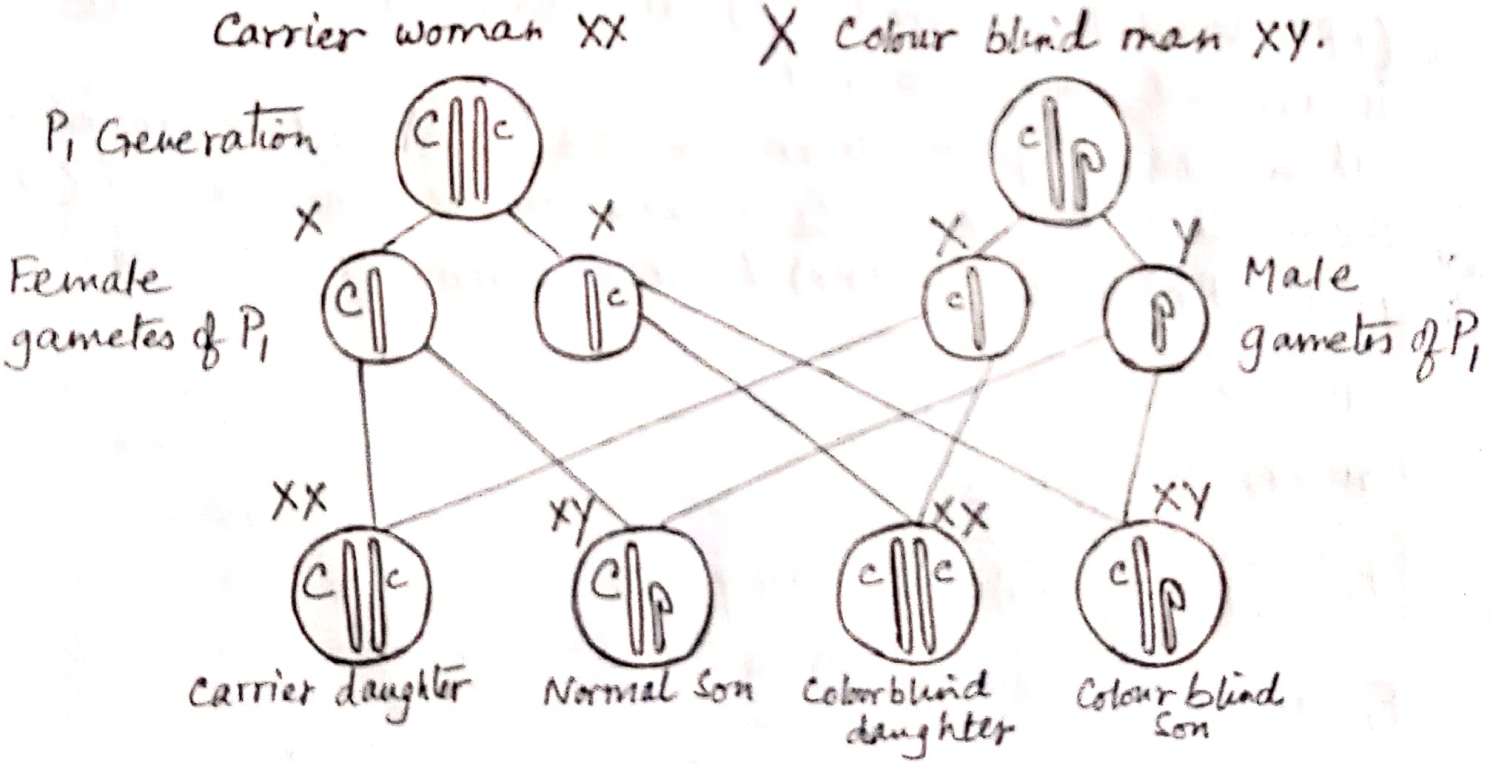
Therefore in incomplete dominance, F_2 phenotypic ratio is similar to Genotypic ratio, that is 1:2:1.

[3]

Q3. A daughter is born to a woman carrier for the colour blind disease who is married to a colour blind man. What would be the probability of expression of colour blindness in that girl child? Analyse your answer. [2]

Ans: As gene for colour blindness is sex-linked, so it resides in X-chromosome. As the gene is recessive, it will be expressed in hemizygous male (X^cY) but in homozygous female (X^cX^c)

To find out the mechanism of sex-linked inheritance, let us assume that capital 'C' stands for normal gene & small 'c' stands for recessive colour blind gene on the X-chromosome.



So from the above inheritance mechanism, if a carrier woman is married to colour blind man, then the offspring will be colour blind daughter & carrier daughter, but the sons will be colour blind & normal.

[4]

Alternatively, pattern of inheritance can be shown in the following way:

Parents → carrier woman X^cX × colour blind man X^cY

Gametes → X^cX → (X) (X^c) ova ; X^cY → (X^c) (Y) sperms

Offspring →

	X^c	Y
X	XX^c carrier daughter	XY Normal son
X^c	X^cX^c Colour blind daughter	X^cY colour blind son.

So children of carrier mother & colour blind father are:
1 carrier daughter &
1 Colour blind daughter.
1 normal son &
1 colour blind son.

Normal female - XX
Carrier female - XX^c
Colour blind female - X^cX^c
Normal male - XY
Colour blind male - X^cY

A marriage between a carrier woman & Colour blind man produces 50% normal sons & 50% colour blind sons, 50% of daughters will be carriers while the remaining 50% of daughters are colour blind.

Hence the daughter of the Colour blind carrier mother & Colour blind father would be either colour blind carrier or colour blind.

Q4. State with the help of a cross, how colour blindness is inherited. [2]

Ans Same as Ans no. 3.

Q5. One day students read an article in newspaper on Thalassemia & were very scared to know the fate of a thalassemic patient. Write what kind of measures they can take to eradicate this disease from the population. [2]

Ans: The measures, the students can take to eradicate the disease of Thalassemia are :

(a) They can conduct awareness drives, demonstrations in their locality or at their school, to make the common people aware of this disease.

(b) They should inform people of the necessity of genetic counselling of two individuals prior to their marriage, or prior to thinking of having children, because genetic counselor can help determine the risk for passing the genetic disorder to children. If genetic tests reveal any possibility of the child getting affected by major thalassemia, either marriage between such couple should be avoided, or they must not take the risk for producing a thalassemic child.

Thus eradication of the thalassemia disease from the population is possible.

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