

# GENETICS

Genetics is study of heredity and variation.

Gregor Johhann Mendel, father of genetics conducted hybridisation experiments on *Pisum sativum* to formulate the principles of inheritance .

# Principles of inheritance

## Principle of unit characters

In every organism a character is determined and transmitted by a definite gene or factor.

# Principle of dominance

In a cross between two pure breeding plants for a contrasting character, the progeny obtained in heterozygous condition expresses any one of the parental characters as dominant.

# Law of segregation

## Mendel's 1<sup>st</sup> law

When a pair of factors for a contrasting characters brought in a hybrid, they separate during gamete formation.

This law can be explained by monohybrid cross.

# Law of segregation

## Mendel's 1<sup>st</sup> law

Monohybrid phenotypic ratio – 3:1

Monohybrid genotypic ratio – 1:2:1

Monohybrid test cross ratio – 1:1

***Law of Independent assortment***  
**(Mendel's 2<sup>nd</sup> law)**

When more than a pair of factors for different contrasting characters are brought together in a hybrid, they assort independently during gamete formation. This law can be explained by dihybrid cross.

***Law of Independent assortment***  
**(Mendel's 2<sup>nd</sup> law)**

Phenotypic ratio – 9:3:3:1

Genotypic ratio – 1:2:2:4:1:2:1:2:1

Ttest cross ratio – 1:1:1:1

## Incomplete dominance

In a cross between two pure breeding plants for a contrasting character the progeny obtained in  $F_1$  generation shows an intermediate character of either parents.

E.g., Flower colour in *Mirabilis jalapa*

## Multiple allelele

A gene which expresses in more than two forms for a character in a population is multiple allelele. It is observed in the expression of human blood groups.

## Human blood groups

Karl Landsteiner - A, B, O groups

de Castella and Steni - AB group

The gp.AB is universal acceptor

The gp.O is universal donor.

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# Human blood groups

Landsteiner and Weiner - Rh-factor in Rhesus monkey and later in human.

The incompatibility of Rh-factor between mother and her foetus results in erythroblastosis foetalis .

# Sex-linked inheritance

## Criss-cross inheritance

The inheritance of X-linked gene from parental male to  $F_2$  male through  $F_1$  carrier female.

# Sex-linked inheritance

## Colour blindness

Inability of a person to differentiate red and green colours due to recessive gene on X-chromosome.

# Sex-linked inheritance

## Hypertrichosis

A tuft of hair on the external ear pinna due to a gene on Y-chromosome.

# Genetic disorders

## chromosomal disorders

Downs' syndrome –

$$45A + XY / XX = 47$$

Cri-do-chat syndrome –

5<sup>th</sup> partial monosomy

## Chromosomal disorders

Klinefelters' syndrome -

XXY-syndrome-  $44A + XXY = 47$

Turners' syndrome -

XO-syndrome-  $44A + XO = 45$

## Gene disorders

**Sickle cell anaemia** – Anaemia due to the formation of sickle celled RBC's by a defective gene Hb<sup>s</sup>. It may result in haemorrhage, coma and death due to rupture of blood capillaries.

## Gene disorders

### **Haemophilia** (Bleeder's disease)

Inability of blood to clot due to lack of clotting factors by a defective recessive gene on X-chromosome.

# Genetics examination weightage

## Annual exam weightage - 9 marks

1 mark - 1 or 2

2 marks - 1

5 marks - 1

## K-CET exam questions weightage-

4 to 5

**Q. How many types of gametes are produced by Homozygote?**

1. One
2. Two
3. Four
4. Many

**Q. Assortment or segregation of genes takes place during**

1. Fertilization
2. Separation of gametes
3. Formation of gametes
4. None of these

**Q. If there is no agglutination on adding antiserum A and antiserum B to a blood drop, then blood group is identified as**

**1. A**

**2. B**

**3. AB**

**4. O**

**Q. At the sixth position of amino acid in  $\beta$ -chain of the haemoglobin molecule of sickle cell anaemia persons, glutamic acid is replaced by**

**1. Serine**

**2. Valine**

**3. Methionine**

**4. Phenylalanine**

**Q. Persons with sickle cell anemia are resistant to malaria**

**1. True**

**2. False**

**3. Irrelevant**

**4. None of these**

**Q. A woman with B blood group marries a man with AB blood group, which of the following blood group of children indicate that woman is heterozygous ?**

**1. A**

**2. B**

**3. AB**

**4. O**

**Q. Which of the following is genotype of a person suffering from Klinefelter's syndrome?**

1. 44A+XXY

3. 44A+XY

2. 45A+XX

4. 44A+XO

**Q. A type of protein-antigen present on the surface of RBC is also called**

**1. Agglutinogen      2. Agglutinin**

**3. Albumin            4. Globulin**

**Q. A woman sues a estranged man for the support of her child. She has blood group A-ve and the man shows B-ve. What would be the possible answer relating to the legitimate child's blood group**

**1. A+ve**

**2. O+ve**

**3. AB+ve**

**4. O-ve**

**Q. Which of the following phenotypic character is exhibited by Holandric genes ?**

1. Red-green colour blindness
2. Profuse bleeding
3. Cat-cry syndrome
4. Hairy growth on external ear pinna

**Q. Which of the following is correct combination?**

1. Sickle cell anaemia - bleeder's disease
2. Haemophilia - recessive X linked
3. Colour blindness - Y linked
4. Hypertrichosis - X linked

**Q. A man has blood group O and his mother has blood gp A. The genotype of mother should be**

1.  $I^O I^O$

2.  $I^A I^O$

3.  $I^A I^B$

4.  $I^A I^A$

**Q. Cry-du-chat exhibits which of the following karyotypic chromosomal abnormality?**

1. Monosomy
2. Loss of segment of 21<sup>st</sup> autosome
3. Trisomy
4. Loss of short arm of one of the 5<sup>th</sup> autosome

Q. In a breeding experiment F2 generation has 200 offsprings, 50 of them are with genotype TT. The genotype of parental generation must be

1. TT and tt

2. Tt and tt

3. Tt and Tt

4. tt and tt

**Q. Which one of these statements is not associated with Rh-factor?**

1. Rh- stands for rhesus factor
2. Rhesus monkey is *Macaca mulata*
3. Protein associated with RBC membrane
4. Antibody on RBC membrane

**Q. Example for XY - linked inheritance is**

1. Haemophilia
2. Colour blindness
3. Xeroderma
4. Hypertrichosis

**Q. The significance of test cross is to test**

1. Heterozygosity of  $F_1$  parent
2. Heterozygosity of recessive parent
3. Homozygosity of recessive parent
4. Heterozygosity of  $F_2$  parent

**Q. Which of this blood transfusion can be made without risk?**

1. Group A to B
2. Group AB to O
3. Group A to O
4. Group B to AB

**Q. Green blindness is**

1. Protonopia
2. Deuteronopia
3. Daltonism
4. Tritanopia

**Q. Which of the following is gene disorder?**

1. Klinefelter's syndrome

2. Down's syndrome

3. Turner's syndrome

4. Sickle cell anaemia

**Q. Erythroblastosis foetalis will occur when**

1. Father is Rh+ve and mother is Rh-ve
2. Father is Rh-ve and mother is Rh+ve
3. Both father and mother are Rh-ve
4. Both father and mother are Rh+ve

**Q. What is an offspring of two homozygous parents differing from one another by alleles at only one gene locus called?**

1. Trihybrid
2. Dihybrid
3. Monohybrid
4. Back cross

**Q. The genetic concept of segregation and recombination are most likely to be associated with**

- 1. Meiosis and cleavage**
- 2. Meiosis and mitosis**
- 3. Meiosis and fertilization**
- 4. Meiosis and amitosis**

**Q. Which of the following is not true?**

1. Boys are haemophilic
2. Girls are carrier
3. Boys are carrier
4. Girls are haemophilic

**Q. Which Mendelian laws applied when factor for each character segregate and pass on to each gamete uncontaminated?**

- 1. Law of purity of gametes**
- 2. Law of Independent assortment**
- 3. Law of Unit characters**
- 4. Law of Dominance**

Q. If a tall plant is crossed with a dwarf one, about one half of the offsprings produced are tall and the other half dwarf in F1 generation. The genotype of parents is.

1.  $Tt \times tt$

2.  $Tt \times Tt$

3.  $TT \times tt$

4.  $tt \times tt$

**Q. In a cross  $TT \times tt$  what percentage of offsprings will have the same genotype as their parents in  $F_1$  generation**

1. 0 %

2. 25 %

3. 50 %

4. 100 %

**Q. The genotype of blood group AB is**

1. Homozygous and codominant
2. Heterozygous and codominant
3. Codominant only
4. Heterozygous and dominant

**Q. What is the cause for a child born with an extra chromosome in each of its cells?**

1. Segregation
2. Non-disjunction
3. Crossing over
4. Multiple sex

**Q. The gene for haemophilia is located on X - chromosome. Hence it is normally impossible for a**

1. Haemophilic father to pass the gene to his daughter
2. Carrier mother to pass the gene to her daughter
3. Carrier mother to pass the gene to her son
4. Haemophilic father to pass gene to his son

**Q. What is the probability of daughter born to a haemophilic mother and a colour blind father?**

1. She is colour blind
2. She is haemophilic
3. She is haemophilic and colourblind
4. She is carrier for both

**Q. If a man of blood group A<sup>+</sup> in heterozygous marries a woman of blood gp B<sup>+</sup> in heterozygous, their children can be of the blood group**

1. A<sup>+</sup>, B<sup>+</sup>, AB<sup>+</sup>, O<sup>+</sup>

2. A<sup>+</sup>, B<sup>+</sup>, AB<sup>+</sup>, O<sup>+</sup> A<sup>-</sup>, B<sup>-</sup>, AB<sup>-</sup>, O<sup>-</sup>

3. A<sup>-</sup>, B<sup>-</sup>, AB<sup>-</sup>, O<sup>-</sup>

4. A<sup>+</sup>, B<sup>+</sup>, A<sup>-</sup>, B<sup>-</sup>

**Q. If a boy's father has haemophilia and his mother has a gene for haemophilia. What is the chance that the boy will inherit the disease?**

**1. 0 %**

**2. 50 %**

**3. 75 %**

**4. 100 %**

**Q. Epicanthus condition is found in**

1. Down's syndrome
2. Klinefelter's syndrome
3. Turner's syndrome
4. Criminal syndrome

**Q. The disease reported in queen Victoria is**

- 1. Hemophilia-A**
- 2. Christmas**
- 3. Daltonism**
- 4. Hepatitis-B**

**Q. Sickle-cell anaemia is due to the mutated gene Hb<sup>s</sup> present on the chromosome**

1. 11

2. 16

3. 21

4. 5

**Q. Y-linked inheritance is from**

1. Female to male
2. Male to female
3. Father to son
4. Generation to generation

**Q. Bar-body is**

1. Highly heterochromatinised X-chromosome in male
2. Highly heterochromatinised X-chromosome in female
3. Barbels in cats
4. Y-chromosome in female

**Q. What is the probability of blood group of your homozygous child, suppose if you marry a person having 'O' group?**

**1. A,B,AB or O**

**2. A and B**

**3. O only**

**4. AB and O**

**Q. Marriage between woman and man with incompatible Rh-factor results in**

- 1. Blood clotting**
- 2. HDN**
- 3. Ag-Ab reaction**
- 4. Erythropoiesis**

**Q. Children born to colour blind woman and normal man are**

1. All are colour blind
2. Daughters are colour blind and sons are normal
3. Sons are colour blind and daughters are normal
4. Sons are colour blind and daughters are carriers

**Q. Criss-cross inheritance is between**

1. Male to male
2. Female to female
3. Opposite sex
4. Father to mother

**Q. The blood group AB was reported by**

1. Carl Landsteiner
2. Steiner and Weiner
3. de Castella and Steini
4. Burnstein

**Q. Which of the following are phenocopies with respect to length of pea plant?**

1. TT, Tt, tt
2. TT, tt
3. TT, Tt
4. Tt, Tt

**Q. Holandric characters are**

1. Albinism
2. Ichthyosis
3. Porcupine disorder
4. Ichthyosis & Porcupine disorder

**Q. Heamophilia was reported by**

1. Allec Jeffrey
2. John Cotto
3. Carl Correns
4. Elizabeth

**Q. Hemizygous condition is applicable to**

1. XX

2. XY

3. XXY

4. XO

Q. The principle of blood transfusion is

1. The antigen of donor reacts with antibody of recipient
2. The antibody of donor reacts with antigen of recipient
3. The antigen of donor reacts with antigen of recipient
4. Blood should be HIV negative

**Q. The rarest blood group is**

1. A

2. B

3. AB

4. O

**Q. The rediscoverers of mendelian principles are**

**1. de Vries**

**2. Correns and Mendel**

**3. Tschermak**

**4. de Vries, Correns, Tschermak**

**Q. Phenotypic ratio of dihybrid test cross is**

1. 1 : 1

2. 1 : 1 : 1 : 1

3. 9 : 3 : 3 : 1

4. 1 : 2 : 2 : 4 : 1 : 2 : 1 : 2 : 1

**Q. Which of the following is more likely to be heterozygous?**

1. Pure lines
2. Self-pollinated crops
3. Autopolyploids
4. Cross-pollinated crops

Q. If the cell of an organism heterozygous for alleles  $Xx$ ,  $Yy$  undergoes meiosis, then the possible genotype of gametes will be

1.  $XY$ ,  $xY$ ,  $Xy$ ,  $xy$
2.  $XY$ ,  $xy$
3.  $Xx$ ,  $Yy$
4.  $XxYy$

**Q. Segregation of genes takes place during**

1. Metaphase
2. Anaphase
3. Prophase
4. Zygote formation

**Q. If two heterozygous dihybrids are crossed, the percentage of recessive is**

1. 25%
2. 06%
3. 75%
4. 50%

**Q. The significance in using a Punnet square is know**

1. gametic combinations
2. genotypic ratios
3. phenotypic ratios
4. all genotypic & phenotypic ratios

**Q. If heterozygous round seeded pea plants are self-pollinated, the offsprings will be**

1. 75% round
2. 50% heterozygous
3. 25% recessive
4. Phenotypically 3 : 1 ratios

*THANK*



*YOU*