Page No. : **52-76**

Total Pages : **25**

Questions Asked : **67**

2 QUESTION PER PAGE AT AN AVERAGE

BUT, LETS SEE WHICH PAGE HAS MAXIMUM WEIGHTAGE

- **Which page has the maximum**

60, 73 = 2 Page

27.3% QUESTIONS

2010-2024		Page No.
	0	52,53,63,66,68, 70,76,77,93
10,14,15,16(2), 18(2),19,,21(2),22(2)	1	56,57,58,62,64 70,71,74
11(2),17,20,22	2	54,69
10(2),11,12(2),14,15(3),16 17(2),18,19(2),20,21,22	4	55,59,60,75
10,11,13,14,15,16, 19, 20,22,24	6	56,58,60,61,67, 72,75,76
12(2),13,16(2), 18,20,22(2)	7	73
10,13(2),15(2), 16,17,20	8	60

PRINCIPLES OF INHERITANCE AND VARIATION

1. **Genetics** deals with the inheritance as well as variation of characters from parents to offsprings.
2. **Inheritance** is the process progeny by which characters are passed on from parent to progeny.
3. **Variation** is the degree by which progeny differs from their parents.
4. Indian breeds **(Sahiwal cows)** develop in **Punjab.**
5. Gregor mendel conducted **hydridisation experiment on Garden Peas for seven year** (1856-1563) & proposed laws of inheritance in living orgnaisms.

[NEET 2017][NCERT 54]

6. Mendal selected **14 true**-breeding pea plant varieties.

[NEET 2020] [NCERT 54]

7. **Seven pairs** of contrasting traits studied by mendel on pea plants

[NEET 2015] [NCERT 70]

Character	Dominant traid	Recessive traid

[NEET 2017,2015] [NCERT 55]

Seed shape	Round	Wrinkled
Seed colour	Yellow	Green
Flower colour	Voilet	White
Pod shape	Full	Constricted
Pod colour	Green	Yellow
Flower position	Axial	Terminal
Stem Height	Tall	Dwarf

8. **Genes -** unit of inheritance, contain the information that is required to express a particular trait.
9. Mendal called **factors** (Gene)
10. **Alleles -** Genes which code for a pair of contrasting traits, they are slightly different forms of the same gene.

[NEET 2024, 2022, 2015][NCERT 56]

11. **Punnett square -** Graphical representation to calculate the probability of all possible genotypes of offspring in a genetic cross.
    - Devloped by a british geneticist, Reginald C. Punnett.
12. **Monohybrid cross**
    - Study of inheritance of **one character** at a time in an organism
    - Phenotypic ratio = 3 : 1
    - Genotypic ratio = 1 : 2 : 1
13. Based on his observation on monohybrid crosses mendal proposed two general rules. These rules are called principles **or** law of interitance.
    1. Law of Dominance
    2. Law of Segregation
14. **Law of Dominance**

[NEET 2024, 2018,2016] [NCERT 58]

1. Characters are controlled by discrete units called factors.
2. Factors occur in pairs
3. In a dissimilar pair of factors one member of the pair dominates & other recessive.

- Law of Dominance used to explain the expression of only one of the parental characters in monohybrid cross in F_1 & expression of both in F_2.

15. **Law of Segregation**
    - This law is based on the fact that the alleles do not show any blending & both character are recovered as such in the F_2 generation.
    - The factors or alleles of a pair segregate from each other such that a gamete receive only one of the two factors.
    - **Law of Dominance have two exceptions**
        1. Incomplete Dominance
        2. Co-dominance

[NEET 2019, 2016, 2012, 2018] [NCERT 59]

INCOMPLETE DOMINANCE

- F_1 phenotype did not resemble either of the two parents & was in between the two
    - Phenotypic ratio change from 3 : 1 to 1 : 2 : 1
    - Phenotypic & Genotypic ratio = 1 : 2 : 1
    - Examples : Flower colour in the dog flower **(Snapdragon or Antirrhinum spl)** & Starch grain size

[RE-NEET-2024] [NEET 2024]

[NEET 2015, 2018, 2016] [NCERT 60]

16. Co-dominance
    - F1 Phenotype resembles both parents

[NEET 2013] [NCERT 61]

    - Phenotypic & Genotypic ratio = 1 : 2 : 1
    - Eg: AB blood group (I^AI^B)

[RE-NEET-2024] [NEET 2013] [NCERT 61]

17. ABO blood group in human Beings

[NEET 2020, 2018] [NCERT 61]

- ABO blood group controlled by the gene i.
- Gene i has three alleles I^A, I^B & i

• I^A & I^B produce slightly different form of sugar while alleles I doesn't produce any sugars.

GENETIC BASIS OF BLOOD GROUPS IN HUMAN POPULATION

Allele from Parent 1	Allele from Parent 2	Genotype of offspring	Blood types of offspring
I^A	I^A	I^AI^A	A
I^A	I^B	I^AI^B	AB
I^A	i	I^Ai	A
I^B	I^A	I^AI^B	AB
I^B	I^B	I^BI^B	B
I^B	i	I^Bi	B
i	i	i i	O

[NEET 2015,2024] [NCERT 61]

- ABO Blood grouping also provides a good example of multiple alleles

[RE-NEET-2024] [NEET 2015,2018][NCERT 62]

- Phenotype = 4, Genotypes=6, Alleles = 3

[NEET 2017] [NCERT 61]

- An individual only two alleles can present, multiple alleles can be found only when population studied are made.
- **Pleiotropy : A single gene** product may produce **more than one effect**

Eg: Starch synthesis in pea seeds

[NEET 2016] [NCERT 62]

18. **Dihybrid cross**
    - Study of inheritance of two characters at a time.
    - Phenotypic ratio = 9:3:3:1
    - Genotypic ratio = 1:2:2:4:1:2:1:2:1

19. **Law of Independent Assortment states that,** "when two pairs of traits are combined in a hybrid, segregation of one pair of characters i independent of the other pairs of characters".

[NEET 2022] [NCERT 64]

20. **Important formula**
    - Type of gamete/type of phenotypes = 2^n (n= no.of Heterozygous.)
    - Type of genotypes = 3^n

21. **Test cross :** It is used to find out the genotype of F1 individual.

[NEET 2012, 2016, 2024] [NCERT 58]

- F1 individual crossed with homozygous recessive parent.
- Test cross ratio : Monhybrid ⇨ 1 : 1

  Dihybrid ⇨ 1 : 1 : 1 : 1
- Mendel published his work on inheritance of characters in **1865** but if remained unrecognished **till 1900** due to several reason.

1. Communication was not easy in those days.
2. His concept of genes as stable & discrete unit
3. Use mathematics to explain biological phenomena

22. **In 1900, de vries, correns & Von tschermak** independently rediscovered mendel's results on the inheritance of characters.

23. **Walter sutton & Theodore Boveri** noted that behaviour of chromosomes was parallel to the behaviour of genes & used chromosomal movement in **1902.**

24. **Experimental verification** of the chromosomal theory of inheritance given by **Thomas Hunt Morgan & his colleagues.**

[NEET 2020] [NCERT 67]

25. **Morgan** work on fruit fly **(Drosophila melanogaster)** due to following reason
    - Grow in simple synthetic medium in lab.
    - Life cycle complete in two weeks
    - Many type of herediatary variations

26. **Linkage & Recombination**
    - Physical association or linkage of two genes called linkage & Recombination of describe the generation of non-parental gene combination.

[NEET 2015] [NCERT 67]

    - In linkage, the proportion of parental gene combination are much **higher** than non-parental type.
    - Tighly linked gene shows very low recombination while losely linked genes shows higher recombination

27. **Alfred sturtevant :** Distance betwen genes & mapped their position of chromosome

[NEET 2019,23] [NCERT 67]

    - Linkage 1/Distance b/w genes 1/ Recombination
    - Recombination Crossing over

28. **Sex determination**
    - Henking (1891) experiments carried out in insect & named **X-Body.** but on investigation by other scientist, conduded that **X-Body** of Henking are **X-chromosomes.**

29. **Sex determination in -**

Human : XY Type
Drosophila (Insect) XY Type
→ Male heterogametic (Determine sex of Baby)

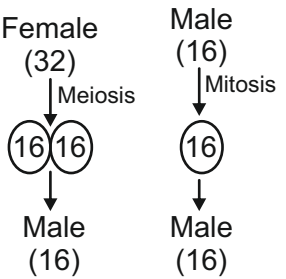
- **Most Insects (Grass hopper) :** XO type - Male heterogametic (Determine sex of baby)

[NEET 2022, 2018] [NCERT 70]

- **Birds : ZW type -** Female heterogametic (Determine sex of baby)
- It is also evident that in each pregnancy there is always **50%** probability of either a male or a female child.

30. **Sex determination in honey bee**

- Based on number of sets of chromosomes in individual receives.
- **Honey bee colony have -**



Queen, worker - Female (Diploid 32 chromosomes)

Drones - Male (16 chromosomes, Haploid)

- Known as **haplo-diploid sex-determination system**

MUTATION

- Results in **alteration** of DNA sequences & results in changes in genotype & phenotype of an organism & leads to variation in DNA
- Mutation are due to **loss (Deletions) OR Gain (insertion/ (Duplication)** of a segment of DNA result in alteration in chromosomes.
- Chromosomal alteration result in abnormalities/Aberrations.
- Chromosomal aberrations are commonly oberved in **Cancer cells.**

Point mutation - due to change in **single base pair of DNA**

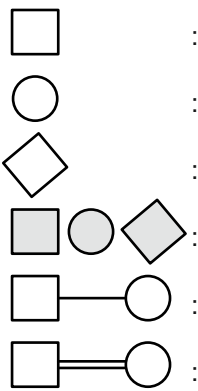
eg - Sickle cell Anaemia.

Frame shift mutation - Deletions **or** insertions of base pairs of DNA.

31. **Pedigree Analysis**

- Study of the family history about inheritance of a particular trait provides an alternative.
- Pedigree analysis provides a strong tool, utilised to trace the inheritance of a specific trait, abnormality or disease.

32. **Symbols used in human pedigree analysis.**



: Male

: Female

: Sex unspecified

: Affected Individuals

: Mating **[NEET 2023][NCERT 72]**

: Mating between relatives (consanguineous mating)

Genetic Disorders

Mendelian Disorder

- Colour blindness
- Haemophilia
- Sickle cell anaemia
- Phenylketonuria
- Thalassemia
- Cystic Fibrosis

Chromosomal Disorder

- Down syndrome
- Klinefelter's syndrome
- Turner's syndrome

33. **Colour blindness : sex-linked recessive disorder** due to defect in either red or green cone of eye resulting in failure to discriminate between red & green colour

[2022, 2012] [NCERT 73]

- Occurs in about **8 percent of males** & only about **0.4 percent of female.**

[NEET 2016, 2014] [NCERT 73]

34. **Haemophilia : sex-linked recessive disorder,** transmission from unaffected carrier female to some of the male progency

[NEET 2022, 2020, 2016, 2013] [NCERT 74]

- A single protein that is a part of cascade of proteins involved in the clotting of blood is affected.
- Possibility of female becoming a haemophilic is extremely rare.
- Queen victoria - carrier of the disease.

35. **Sickle-cell Anaemia :** Autosomal linked recessive disease.

[NEET 2022, 2021, 2020, 2016] [NCERT 74]

- Disease occurs when both partner are heterozygous (carrier)

- **Three pair of Alleles**

  Hb^AHb^A ⇨ Normal

  Hb^AHbS ⇨ Carrier

  Hb^SHb^S ⇨ Disease

- Defect is caused by **substitution** of Glutamic acid (Glu) by valine (val) at the **six** position of beta globin chain of Hb molecules.
- Change takes place from **GAG to GUG**
- Shape of RBCs changes from **Biconcave disc to elongated sickle shaped** due to low oxygen tension.

36. **Phenylketonuria :** Inborn error of metabolism, Autosomal recessive trait.
    - Affected individual **lack** the enzyme **phenylalanine hydroxylase** (that convert phenylalanine into tyrosine)
    - Due to **lack** of this enzyme phenylalanine ⇨ Phenyl pyruvic acid
    - Mental retardation, Hair loss & skin pigmentation takes place.
37. **Thalassemia : Autosomal linked reccesive** blood disease

[NEET 2024, 2022, 2020, 2013] [NCERT 75]

- Disease takes place when both partner are carrier
- Defect could due to **either deletion/Mutation** of globin molecule.
- **Anaemia** is the characteristic of this disease.
- **Two types**

1. Thalassemia (α globin chain affected)
2. Thalassemia (β globin chain affected)

- α **Thalassemia -** 16th chromosomes, controlled by two closely linked gene. HBA1 & HBA2

- β **Thalassermia** - 11th chromosomes, controlled by one linked gene HBB.
- Thalassemia differs from sickle cell anaemia is that thalassemia is quantitative problem & sickle cell anaemia is qualitative problem of Haemoglobin molecules.

[NEET 2017][NCERT 75]

38. **Chromosomal disorders -**
    - Caused due to **absence or excess or abnormal** arrangement of one **or** more chromosomes.
    - **Aneuploidy :** Gain **or** loss of chromosomes due to failure of segregation of chromatids. **[RE-NEET-2024]**

      Down's syndrome : First described by **Langdon down (1866)**
    - Trisomy of 21th chromosomes

      [NEET 2016, 2013, 2023, 2024] [NCERT 76]
    - **Affected individual shows -** Short statured with small round head, furrrowed tongue, partially open mouth, palm broad with crease.

      congential heart disease physical, psychomotor & mental retardation takes place.
39. **Klinefelter's syndrome**

    [NEET 2019, 2016, 2023. 2024] [NCERT 76]
    - Additional copy of X-chromosomes **(47,XXY)**
    - **Such individual has -**

      Overall masculine development

      Feminine development (Gynacomastia)

      Sterile individuals.

40. **Turner syndrome**

[NEET 2019][NCERT 76]

- Absence of one of the X-chromosomes. **(45+XO)**
- Such female are **sterile**
- Rudimentary ovary
- Lack of secondary sexual characters.

41. **Polygenic inheritance**

[NEET 2016] [NCERT 69]

- Single trait controlled by **three or more genes**
- Dark skin colour **(Dominant)** controlled by three genes - AABBCC
- Light skin colour **(Recessive)** controlled by three genes - aabbcc
- Intermediate skin coloure also present
- **Examples :** Human height & Human skin colour.

[RE-NEET-2024]

42. Single gene affecting multiple phenotypic expression.

[NEET 2023] [NCERT 69]