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BIO · BIOLOGY

15. Inheritance / Variation & Genetics

Official PMDC Solved Past Paper Topical Booklet · High-Yield Examination Series

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👤 2015 to 2024 Archive

📋 Boards: BUMHS, DUHS, KMU, MDCAT, NUMS, PMDC

📄 Weightage: 34% of MDCAT (68 MCQs)

Curated by Ibrahim for fellow bees. Every question in this chapter has been verified against official UHS, NUMS, SZABMU, DUHS, and KMU answer keys. Propolis cognitive autopsies are provided at the end of this booklet to explain core concepts and break down common distractor traps.

OFFICIAL SOLVED EDITION**Q1.**

KMU 2024

The genetic makeup that your parents have transferred to you for your hair colour makes up your:

[KMU-2024]

- (A) Genotype
- (B) Karyotype
- (C) Phenotype
- (D) None of the above

Q2.

KMU 2024

Which term best describes an organism's physical characteristic?

[KMU-2024]

- (A) Allele
- (B) Genetic code
- (C) Genotype
- (D) Trait

Q3.

NUMS 2024

What will be the probability of purple and terminal flower in pea plant in F_2 generation if we cross true breeding purple axial flower plant with white terminal flower plant?

[NUMS-2024]

- (A) 1/16
- (B) 3/16
- (C) 9/16
- (D) 1/2

Q4.

SZABMU 2024

In which type of dominance relationship phenotypic ratio is not same as genotypic ratio?

[SZABMU-2024]

- (A) Complete dominance
- (B) Incomplete dominance
- (C) Over dominance
- (D) Codominance

Q5.

SZABMU 2024

In fruit fly *Drosophila*, the heterozygote (w^+/w) has more quantity of fluorescent pigments in eyes than wild (w^+/w^+) or white eye (w/w) homozygote. This is an example of:

[SZABMU-2024]

- (A) Over dominance
- (B) Complete dominance
- (C) Codominance
- (D) Partial dominance

Q6.

KMU 2024

Which of the following blood groups has anti-A and anti-B antibodies in the serum?

[KMU-2024]

- (A) A
- (B) AB
- (C) B
- (D) O

Q7.

SZABMU 2024

Which type of antibodies are present in person with phenotype of blood group AB?

[SZABMU-2024]

- (A) Anti-A Antibody
- (B) Anti-B Antibody
- (C) Anti-A and Anti-B antibodies
- (D) No antibodies present at all

Q8.

NUMS 2024

Which of the following is not related to ABO blood group system?

[NUMS-2024]

- (A) It is an example of multiple alleles
- (B) I^A and I^B are co-dominant
- (C) It does not code for any antigen
- (D) It obeys Mendel's law of inheritance

Q9.

SZABMU 2024

What is the principle of blood transfusion in donor and recipient respectively?

[SZABMU-2024-Reconduct]

- (A) Antibodies of both
- (B) Antibodies: antigen of recipient
- (C) Antigen of both
- (D) Antigen of donor: Antibodies of recipient

Q10.

KMU 2024

Which is true for an X-linked dominant trait?

[KMU-2024]

- (A) All female offspring of the affected father will be affected
- (B) Half of the female offsprings of the affected father will be affected
- (C) No male offspring of an affected mother will be affected
- (D) No female offspring of the affected father will be affected

Q11.

NUMS 2024

Which of the following option is correct for the pattern baldness?

[NUMS-2024]

- (A) It is sex linked trait
- (B) Occurs due to hormonal difference between sexes
- (C) Heterozygous male is patient
- (D) Heterozygous female is normal

Q12.

SZABMU 2024

Which traits are most likely to affect men than women?

[SZABMU-2024-Reconduct]

- (A) X linked recessive
- (B) X linked dominant
- (C) Autosomal dominant
- (D) Autosomal recessive

Q13.

SZABMU 2024

Hemophilia A and B pass from infected ____ grandfather to ____ through carrier daughter.

[SZABMU-2024]

- (A) Paternal, grandson
- (B) Maternal, grandson
- (C) Paternal, granddaughter
- (D) Maternal, granddaughter

Q14.

NUMS 2024

A carrier female for hemophilia is married to an affected person. What would be the probable percentage of their sons to be affected?

[NUMS-2024]

- (A) 100%
- (B) 50%
- (C) 25%
- (D) 0%

Q15.

SZABMU 2024

There is a situation in which hemophilia effects both gender equally. What is the reason behind it?

[SZABMU-2024-Reconduct]

- (A) X-linked
- (B) Y-linked
- (C) Co-dominant
- (D) Autosomal

Q16.

SZABMU 2024

When both the alleles of a gene pair are same, the organism is said to be:

[SZABMU-2024-Reconduct]

- (A) Heterozygous
- (B) Genotype
- (C) Homozygous
- (D) Phenotype

Q17.

SZABMU 2024

Phenotype is:

[SZABMU-2024-Reconduct]

- (A) The genetic complement i.e the genes in an individual for a particular trait
- (B) Partner of gene pair
- (C) The form of appearance of a trait
- (D) The position of a gene on the chromosome

Q18.

SZABMU 2024

Which one of the following is sterile male in *Drosophila*, but a sterile female in human produced through Turner's syndrome?

[SZABMU-2024]

- (A) XO
- (B) XXO
- (C) XXX
- (D) XXY

Q19.

SZABMU 2024

The blue colour blindness is also called as:

[SZABMU-2024-Reconduct]

- (A) Protanopia
- (B) Deuteranopia
- (C) Tritanopia
- (D) Tetranopia

Q20.

SZABMU 2024

Two allelic genes at same locus, when expressed fully in an individual, it is considered as:

[SZABMU-2024-Reconduct]

- (A) Co-dominance
- (B) Complete dominance
- (C) Incomplete dominance
- (D) Epistasis

Q21.

UHS 2024

Chromosomal abnormality in Turner's syndrome is represented by?

[UHS-2024]

- (A) XXX
- (B) XYY
- (C) XO
- (D) XXY

Q22.

UHS 2024

Which of the following increases variation within a gene pool?

[UHS-2024]

- (A) Chromosome inversion
- (B) Crossing over
- (C) Gene mutation
- (D) Random fusion of gametes

Q23.

KMU 2024

What is the primary outcome of crossing over during prophase of meiosis-I?

[KMU-2024]

- (A) Chromosomes duplicate without any exchange of parts
- (B) Homologous chromosomes exchange different pairs leading to recombinant chromatids and increased genetic variation
- (C) Homologous chromosomes exchange identical parts, resulting in no genetic variation
- (D) Non-homologous chromosomes exchange parts

Q24.

SZABMU 2024

In which phase of meiosis crossing over takes place?

[SZABMU-2024]

- (A) Leptotene
- (B) Diplotene
- (C) Pachytene
- (D) Zygotene

Q25.

SZABMU 2023

The frequency of a mutant gene in a population would be likely to be increased if:

[SZABMU-2023]

- (A) The gene was selectively advantageous
- (B) The gene were dominant
- (C) The gene were sex linked
- (D) The population increases

Q26.

SZABMU 2023

A change in the structure of a DNA molecule, producing a different allele of a gene, is a:

[SZABMU-2023]

- (A) Chromosome mutation
- (B) Gene mutation
- (C) Chromosomal aberrations
- (D) Recombination

Q27.

SZABMU 2023

Phenotype is:

[SZABMU-2023]

- (A) The genetic complement i.e the genes in an individual for a particular trait
- (B) Partner of gene pair
- (C) The form of appearance of a trait
- (D) The position of a gene on the chromosome

Q28.

NUMS 2023

When both alleles of a gene pair are same, organism is said to be:

[NUMS-2023]

- (A) Heterozygous
- (B) Genotype
- (C) Homozygous
- (D) Phenotype

Q29.

SZABMU 2023

The particular array of chromosomes that an individual possesses is called

[SZABMU-2023]

- (A) Genotype
- (B) Phenotype
- (C) Karyotype
- (D) Allele

Q30.

KMU 2023

Locus of a gene on a chromosome means its:

[ETEA-2023 Retake]

- (A) Position
- (B) Function
- (C) Start point
- (D) End point

Q31.

UHS 2023

According to Mendel Law of Segregation, the one individual out of four in F_2 generation had phenotype that failed to express in ____ generation.

[UHS-2023]

- (A) F_1
- (B) F_2
- (C) F_3
- (D) P1

Q32.

UHS 2023

Test cross is made to check the genotype of a trait. Which of the following crosses is a test cross?

[UHS-2023]

- (A) Unknown $\times$ Tt
- (B) Unknown $\times$ tt
- (C) Unknown $\times$ AB
- (D) Unknown $\times$ TT

Q33.

UHS 2023

Only those genes can assort independently whose loci are on:

[UHS-2023]

- (A) Same chromatids
- (B) Same chromosomes
- (C) Non-homologous chromosomes
- (D) Homologous chromosomes

Q34.

KMU 2023

In Mendelian cross for heterozygote flower (Pp), what is the probability that the dominant allele will be in sperm and the recessive in the egg?

[ETEA-2023]

- (A) 0.05
- (B) 0.5
- (C) 0.25
- (D) 0.75

Q35.

KMU 2023

G. J. Mendel chose ____ as an experimental plant for his study:

[ETEA-2023]

- (A) *Medicago sativa*
- (B) *Pisum sativum*
- (C) *Delonix region*
- (D) *Lens culinary*

Q36.

KMU 2023

When round and yellow color seeded plant (RrYy) is self-crossed the number of plants with round and yellow color seeds obtained is ____ in 32 plants.

[ETEA-2023]

- (A) 18
- (B) 9
- (C) 3
- (D) 1

Q37.

KMU 2023

Mendel's law of independent assortment can be explained by:

[ETEA-2023 Retake]

- (A) Behavior of chromosomes in mitosis
- (B) Behavior of chromosomes in meiosis
- (C) Gene behavior in mitosis
- (D) Both A and B

Q38.

UHS 2023

ABO blood group is controlled by more than two alleles in a population. This shows that ABO blood group is an example of:

[UHS-2023]

- (A) Polygenic Inheritance
- (B) Multiple alleles
- (C) Operons
- (D) Allelic interaction

Q39.

SZABMU 2023

Which of the following example of human inheritance is explained by multiple alleles on an autosomal chromosome?

[SZABMU-2023]

- (A) The ABO blood group system
- (B) Cystic fibrosis
- (C) Down's syndrome
- (D) Haemophilia

Q40.

KMU 2023

Which of the following is true about occurrence of erythroblastosis foetalis?

[ETEA-2023 Retake]

- (A) Occurs when both father and mother are Rh +ve
- (B) Occurs when both father and mother are Rh -ve
- (C) Occurs when Mother is Rh +Ve and father is -ve
- (D) Occurs when mother is Rh -ve and father is Rh +ve

Q41.

KMU 2023

When are Rh antibodies produced in Rh -ve person?

[ETEA-2023 Retake]

- (A) Naturally before birth
- (B) Naturally after birth
- (C) After exposure to Rh antibodies
- (D) After exposure to Rh antigens

Q42.

UHS 2023

To study sex linkages in *Drosophila*, Morgan mated white eyed males with wild type red eyed females. What will be the phenotype of offspring?

[UHS-2023]

- (A) All red eyed males and females
- (B) Red eyed females and white eyed males
- (C) White eyed females and red eyed males
- (D) All white eyed females and males

Q43.

KMU 2023

Drosophila melanogaster is the scientific name of:

[ETEA-2023]

- (A) House fly
- (B) Fruit fly
- (C) Flash fly
- (D) Sand fly

Q44.

UHS 2023

Which one of the following is X-linked dominant disorder?

[UHS-2023]

- (A) Haemophilia
- (B) Color blindness
- (C) Hypophosphatemic rickets
- (D) Hypertrichosis

Q45.

NUMS 2023

Which of the following traits is transmitted directly from affected father to only his son?

[NUMS-2023]

- (A) Autosomal
- (B) X-linked
- (C) Y-linked
- (D) X-Y linked

Q46.

KMU 2023

A male or female child of an affected mother has 50% chances of acquiring the disorder, such a disorder is:

[ETEA-2023 Retake]

- (A) X-linked recessive disorder
- (B) X-linked dominant disorder
- (C) Y-linked dominant disorder
- (D) Y-linked recessive disorder

Q47.

SZABMU 2023

When a haemophilic carrier woman marries a haemophilic man, who among her offspring's may be affected?

[SZABMU-2023]

- (A) All her children
- (B) All her daughters
- (C) Half of her daughters and all sons
- (D) Half of her sons and half of her daughters

Q48.

KMU 2023

A condition that renders the individual less able to form blood clot is:

[ETEA-2023]

- (A) Alport's syndrome
- (B) Coffin-Lowry syndrome
- (C) Hemophilia
- (D) Thalassemia

Q49.

KMU 2023

Which of the following types of haemophilia are more common in the human population?

[ETEA-2023 Retake]

- (A) Haemophilia A
- (B) Haemophilia B
- (C) Haemophilia C
- (D) Haemophilia VII

Q50.

UHS 2022

DNA stores biological information in discrete units termed as:

[UHS-2022]

- (A) Genes
- (B) Phenotypes
- (C) Karyotypes
- (D) Cells

Q51.

SZABMU 2022

These are the genes which tend to be inherited together and do not assort independently:

[SZABMU-2022]

- (A) Linked genes
- (B) Dependent genes
- (C) Recombinant genes
- (D) Independent genes

Q52.

BUMHS 2022

When two or more genes interact in a way that their effect is additive expression, it is:

[BUMHS-2022]

- (A) Co-dominance relation
- (B) Phylogenetic inheritance
- (C) Epistasis
- (D) Incomplete dominance

Q53.

DUHS 2022

Mendel's selected following pair(s) of contrasting character:

[DUHS-2022]

- (A) One/single pair
- (B) Seven pairs
- (C) Three pairs
- (D) Four pairs

Q54.

SZABMU 2022

Mendelian inheritance follows which form of dominance relation?

[SZABMU-2022]

- (A) Complete dominance
- (B) Incomplete dominance
- (C) Co-dominance
- (D) Multiple allelic dominance

Q55.

KMU 2022

An exception to Mendel's law is:

[ETEA-2022]

- (A) Linkage
- (B) Dominance
- (C) Purity of gametes
- (D) Independent assortment

Q56.

DUHS 2022

Phenotypic ratio of single trait inheritance:

[DUHS-2022]

- (A) 1:2:1
- (B) 3:1
- (C) 1:2
- (D) 1:3:2

Q57.

NUMS 2022

Blood group which is known as universal donor is:

[NUMS-2022]

- (A) A-
- (B) O-
- (C) AB-
- (D) O+

Q58.

KMU 2022

A man of blood group A marries a woman of blood group B and they have one child. Which one of the following statements about the child's blood is correct?

[ETEA-2022]

- (A) It could be group A only
- (B) It could be group AB only
- (C) It could be group A or group B only
- (D) It could be any of the groups A, B, AB and O

Q59.

BUMHS 2022

In which blood group both the antigens are present?

[BUMHS-2022]

- (A) Blood group 'A'
- (B) Blood group 'B'
- (C) Blood group 'AB'
- (D) Blood group 'O'

Q60.

BUMHS 2022

How many phenotypes are possible for human ABO blood group system?

[BUMHS-2022]

- (A) 2
- (B) 4
- (C) 6
- (D) 8

Q61.

UHS 2022

What happens when an 'Rh' negative woman married to an 'Rh' positive man conceives a child who is 'Rh' positive?

[UHS-2022]

- (A) Maternal-fetal incompatibility
- (B) Paternal-fetal incompatibility
- (C) Cancer of fetus
- (D) Death of mother

Q62.

KMU 2022

Rh antigen was first studied in ____

[ETEA-2022]

- (A) Monkey
- (B) Man
- (C) Dog
- (D) Mouse

Q63.

UHS 2022

To study sex linkages in *Drosophila*, Morgan mated white eyed males with wild type red eyed females. What will be the phenotype of offspring?

[UHS-2022]

- (A) All red eyed males and females
- (B) Red eyed females and white eyed males
- (C) White eyed females and red eyed males
- (D) All white eyed females and males

Q64.

DUHS 2022

White eyed trait in *Drosophila* is due to:

[DUHS-2022]

- (A) Linkage
- (B) Mutation
- (C) Crossing over
- (D) Genome

Q65.

UHS 2022

Which one of the following is X-linked dominant disorder?

[UHS-2022]

- (A) Haemophilia
- (B) Color blindness
- (C) Hypophosphatemic rickets
- (D) Hypertrichosis

Q66.

UHS 2022

Mode of inheritance in humans can be traced through:

[UHS-2022]

- (A) Experimental mating
- (B) Chi square chart
- (C) Pedigree analysis
- (D) Probability analysis

Q67.

KMU 2022

What are the chances that the daughter of a normal man and a heterozygous female will have hemophilia?

[ETEA-2022]

- (A) 75%
- (B) 5%
- (C) 25%
- (D) 0%

Q68.

PMDC 2020

When both the alleles of a gene pair are same, the organism is said to be:

[PMC-2020]

- (A) Heterozygous
- (B) Homozygous
- (C) Genotype
- (D) Phenotype

Q69.

PMDC 2020

Incomplete dominance:

[PMC-2020]

- (A) Different alleles of a gene are both expressed in heterozygous condition
- (B) One allele is completely dominant over the other and the presence of the recessive allele is functionally hidden so the heterozygote has the same round phenotype as homozygote.
- (C) The phenotype of the heterozygote is intermediate between phenotypes of the two homozygotes.
- (D) Gene mutations may produce many different alleles of a gene.

Q70.

PMDC 2020

Haemophilia A and B, color blindness and testicular feminization are example of:

[PMC-2020]

- (A) X linked dominant traits
- (B) Y linked inheritance
- (C) X linked recessive traits
- (D) Pseudoautosomal traits

Q71.

PMDC 2020

Which traits are most likely to affect men than women?

[PMC-2020]

- (A) X - linked recessive
- (B) Autosomal dominant
- (C) X - linked dominant
- (D) Autosomal recessive

Q72.

MDCAT 2019

Homozygous means:

[MDCAT-2019]

- (A) Having two identical alleles of a gene
- (B) Alleles in an organism
- (C) Having two identical genes
- (D) Two different alleles of a gene

Q73.

MDCAT 2019

In genetics, the term locus refers to the ____ of the gene on the chromosome.

[MDCAT-2019]

- (A) Frequency
- (B) Position
- (C) Copy
- (D) Inversion

Q74.

KMU 2019

How many pairs of homologous chromosomes are present in *Pisum sativum*?

[ETEA-2019]

- (A) Seven pairs
- (B) Eight pairs
- (C) Nine pairs
- (D) Ten pairs

Q75.

SZABMU 2019

If Sara has blood group O. The genotype of her mother and father is possibly:

[AJK-2019]

- (A) Bi X BB
- (B) BB X BB
- (C) Bi X Bi
- (D) BB X Bi

Q76.

MDCAT 2019

A person was married to his cousin and both are heterozygous for sickle cell anemia. Among their four kids, what will be proportion of affected homozygotes?

[MDCAT-2019]

- (A) 50%
- (B) 75%
- (C) 25%
- (D) 100%

Q77.

MDCAT 2019

In which situation, genes are not assorted independently during meiosis in a chromosome?

[MDCAT-2019]

- (A) When genes are not linked and their loci are far apart
- (B) When there are too many genes on a chromosome
- (C) When some genes have mutated on the chromosome
- (D) When genes are linked and their loci are close to each other

Q78.

SZABMU 2019

Which situation can reduce the chances of variation and genetic recombination?

[AJK-2019]

- (A) Random fusion of gametes
- (B) Crossing over
- (C) Gene linkage
- (D) Mutation

Q79.

SZABMU 2019

During crossing over, exchange of segments takes place between:

[AJK-2019]

- (A) Sister chromatids of homologous chromosomes
- (B) Non-sister chromatids of homologous chromosomes
- (C) Non-sister chromatids of non-homologous chromosomes
- (D) Sister chromatids of non-homologous chromosome

Q80.

MDCAT 2019

If a carrier haemophilic female ($X^H X^h$) is married to a haemophilic male ($X^h Y$). What will be the ratio of presence of haemophilia in the children?

[MDCAT-2019]

- (A) 100% all females and males will be haemophilic
- (B) Carrier female 25% haemophilic female 25%, 25% normal male and 25% haemophilic male
- (C) Females and males both have 25% chances to getting haemophilia
- (D) Females have 50% chances of getting haemophilia and females will be 100% haemophilic.

Q81.

MDCAT 2018

The region of the chromosome or more specifically, a length of the DNA molecule, which has a particular nucleotides sequence that codes for specific protein, is called

[MDCAT-2018]

- (A) Locus
- (B) Allele
- (C) Gene
- (D) Kinetochore

Q82.

MDCAT 2018

Which one of the following is multiple allelic character?

[MDCAT-2018]

- (A) Length of stem in pea plant
- (B) Blood group of the human being
- (C) Shape of seed in pea plant
- (D) Colour of flower in pea plant

Q83.

MDCAT 2018

There are _____ linkage groups in human.

[MDCAT-2018]

- (A) 22
- (B) 46
- (C) 23
- (D) 80

Q84.

MDCAT 2018

Chance of a cross over between two loci is directly proportional to their:

[MDCAT-2018]

- (A) Length
- (B) Width
- (C) Distance
- (D) Thickness

Q85.

MDCAT 2017

Self-fertilization of F_1 dihybrids, following independent assortment of alleles will result in:

[MDCAT-2017]

- (A) 3/16 tall, round; 3/16 dwarf, wrinkled
- (B) 9/16 tall, round; 1/16 dwarf, round
- (C) 9/16 tall, wrinkled; 3/16 dwarf, round
- (D) 3/16 tall, wrinkled; 3/16 dwarf, round

Q86.

MDCAT 2017

As a result of cross-fertilization of true breeding pea plant having purple-colored flowers with that of white colored flowers, the offspring will have flower with:

[MDCAT-2017]

- (A) 1/4 purple and 3/4 white
- (B) All white
- (C) 1/4 white and 3/4 purple
- (D) All purple

Q87.

MDCAT 2017

The gene for red-green color blindness is present on:

[MDCAT-2017]

- (A) Y-chromosome
- (B) Autosome No. 7
- (C) X-chromosome
- (D) Autosome No.9

Q88.

MDCAT 2016

The total number of genes in a population is called:

[MDCAT-2016]

- (A) Gene pool
- (B) Genome
- (C) Allele pool
- (D) Genomic library

Q89.

MDCAT 2016

A character determined by three alleles is:

[MDCAT-2016]

- (A) Human skin color
- (B) Human eye color
- (C) Human blood group
- (D) Human Rh factor

Q90.

MDCAT 2016

Which one of the following is X-linked trait?

[MDCAT-2016]

- (A) Male pattern baldness
- (B) Haemophilia
- (C) Diabetes mellitus
- (D) Erythroblastosis foetalis

Q91.

SZABMU 2015

Mendel concluded that each organism has two hereditary factors for each trait, now called:

[SZABMU-2015]

- (A) Chromatids
- (B) Alleles
- (C) Chromosomes
- (D) Elementen

Q92.

MDCAT 2015

ABO blood system is an example of:

[MDCAT-2015]

- (A) Polygenes
- (B) Multiple alleles
- (C) Multiple genes
- (D) Multiple mutation

Q93.

MDCAT 2015

Number of pairs of autosomes in humans is:

[MDCAT-2015]

- (A) 23
- (B) 21
- (C) 24
- (D) 22

Q94.

MDCAT 2015

X-linked recessive trait is:

[MDCAT-2015]

- (A) Hypophosphatemia
- (B) Haemophilia
- (C) Vitamin-D resistant rickets
- (D) Diabetes mellitus

RAPID 5-COLUMN ANSWER KEY

Official PMDC verified answer keys for 15. Inheritance / Variation & Genetics.

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Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD
1	A	KMU 2024	20	A	SZABMU 2024	39	A	SZABMU 2023	58	D	KMU 2022	77	D	MDCAT 2019
2	D	KMU 2024	21	C	UHS 2024	40	D	KMU 2023	59	C	BUMHS 2022	78	C	SZABMU 2019
3	B	NUMS 2024	22	B	UHS 2024	41	D	KMU 2023	60	B	BUMHS 2022	79	B	SZABMU 2019
4	A	SZABMU 2024	23	B	KMU 2024	42	A	UHS 2023	61	A	UHS 2022	80	B	MDCAT 2019
5	A	SZABMU 2024	24	C	SZABMU 2024	43	B	KMU 2023	62	A	KMU 2022	81	C	MDCAT 2018
6	D	KMU 2024	25	A	SZABMU 2023	44	C	UHS 2023	63	A	UHS 2022	82	B	MDCAT 2018
7	D	SZABMU 2024	26	B	SZABMU 2023	45	C	NUMS 2023	64	B	DUHS 2022	83	C	MDCAT 2018
8	C	NUMS 2024	27	C	SZABMU 2023	46	A	KMU 2023	65	C	UHS 2022	84	C	MDCAT 2018
9	D	SZABMU 2024	28	C	NUMS 2023	47	D	SZABMU 2023	66	C	UHS 2022	85	D	MDCAT 2017
10	A	KMU 2024	29	C	SZABMU 2023	48	C	KMU 2023	67	D	KMU 2022	86	D	MDCAT 2017
11	B	NUMS 2024	30	A	KMU 2023	49	A	KMU 2023	68	B	PMDC 2020	87	C	MDCAT 2017
12	A	SZABMU 2024	31	A	UHS 2023	50	A	UHS 2022	69	C	PMDC 2020	88	A	MDCAT 2016
13	B	SZABMU 2024	32	B	UHS 2023	51	A	SZABMU 2022	70	C	PMDC 2020	89	C	MDCAT 2016
14	B	NUMS 2024	33	C	UHS 2023	52	D	BUMHS 2022	71	A	PMDC 2020	90	B	MDCAT 2016
15	D	SZABMU 2024	34	C	KMU 2023	53	B	DUHS 2022	72	A	MDCAT 2019	91	B	SZABMU 2015
16	C	SZABMU 2024	35	B	KMU 2023	54	A	SZABMU 2022	73	B	MDCAT 2019	92	B	MDCAT 2015
17	C	SZABMU 2024	36	A	KMU 2023	55	A	KMU 2022	74	A	KMU 2019	93	D	MDCAT 2015
18	A	SZABMU 2024	37	B	KMU 2023	56	B	DUHS 2022	75	C	SZABMU 2019	94	B	MDCAT 2015
19	C	SZABMU 2024	38	B	UHS 2023	57	B	NUMS 2022	76	C	MDCAT 2019			

TOTAL
MCQS

94

CORRECT

INCORRECT

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ACCURACY

%

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Question #1 Key: (A)

KMU 2024

The genetic makeup that your parents have transferred to you for your hair colour makes up your: [KMU-2024]

CORE CONCEPT AND DERIVATION

Organisms inherit a specific sequence of DNA code from their parents which dictates their potential traits.

Solution:

- The specific allelic combination or **genetic makeup** inherited from parents is defined as the **genotype**.
- It encompasses all the underlying genes (e.g., alleles for hair color) whether they are visibly expressed or not.

Why other options are incorrect:

- **Phenotype:** The actual physical appearance of the hair color, resulting from the genotype's expression.
- **Karyotype:** The visual profile of a cell's chromosomes.

Question #2 Key: (D)

KMU 2024

Which term best describes an organism's physical characteristic? [KMU-2024]

CORE CONCEPT AND DERIVATION

Genetic information is translated into observable biological forms and functions.

Solution:

- A physical characteristic or observable feature of an organism resulting from genetic expression is known as a **trait** (or phenotype).
- Examples include hair color, eye shape, or plant height.

Why other options are incorrect:

- **Allele, Genetic code, Genotype:** These all refer to the unseen, underlying molecular DNA sequence that codes for the trait, not the physical characteristic itself.

Question #3 Key: (B)

NUMS 2024

What will be the probability of purple and terminal flower in pea plant in [Formula] generation if we cross tr...

CORE CONCEPT AND DERIVATION

In a standard Mendelian dihybrid cross, the F_2 phenotypic ratio is 9:3:3:1 based on the assortment of two dominant/recessive traits.

Solution:

- Purple color (P) is dominant over White (p). Axial position (A) is dominant over Terminal (a).
- **Parents:** True-breeding Purple/Axial (PPAA) x White/Terminal (ppaa).
- F_1 **generation:** All are heterozygous Purple/Axial (PpAa).
- F_2 **generation (selfing PpAa x PpAa):**
- The ratio is 9 (Dom/Dom) : 3 (Dom/Rec) : 3 (Rec/Dom) : 1 (Rec/Rec).
- The phenotype "Purple and terminal" requires one dominant trait (Purple) and one recessive trait (terminal).
- Therefore, its probability is exactly **3/16**.

Why other options are incorrect:

- **9/16:** Purple and Axial (Both Dominant).
- **1/16:** White and Terminal (Both Recessive).

Question #4 Key: (A)

SZABMU 2024

In which type of dominance relationship phenotypic ratio is not same as genotypic ratio? [SZABMU-2024]

CORE CONCEPT AND DERIVATION

The relationship between alleles dictates how the underlying genotype translates into the visible phenotype.

Solution:

- In Mendelian **complete dominance**, a monohybrid cross of heterozygotes ($Aa \times Aa$) yields a **genotypic ratio of 1:2:1** (1 AA : 2 Aa : 1 aa).
- However, because the dominant allele completely masks the recessive one, both AA and Aa produce the exact same physical appearance. This creates a different **phenotypic ratio of 3:1** (3 Dominant : 1 Recessive).
- Therefore, the phenotypic ratio is *not* the same as the genotypic ratio.

Why other options are incorrect:

- In **Incomplete dominance** and **Codominance**, the heterozygote (Aa) has a unique, distinct phenotype. Thus, both the genotypic and phenotypic ratios perfectly align at 1:2:1.

Question #5 Key: (A)

SZABMU 2024

In fruit fly *Drosophila*, the heterozygote (w^+/w) has more quantity of fluorescent pigments in eyes than wild ...

CORE CONCEPT AND DERIVATION

Sometimes, carrying two different alleles produces a biological advantage or an exaggerated phenotype compared to carrying two identical alleles.

Solution:

- When a heterozygote exhibits a phenotype that is more extreme, superior, or quantitatively greater than that of either homozygous parent, it is called **over-dominance**.
- In this specific example, the heterozygous fly (w^+/w) produces a significantly higher quantity of fluorescent eye pigments than even the homozygous dominant wild type (w^+/w^+).

Why other options are incorrect:

- **Complete dominance**: The heterozygote would perfectly match the dominant homozygote.
- **Codominance / Partial dominance**: The heterozygote would show an intermediate or blended phenotype, not one that exceeds both parents.

Question #6 Key: (D)

KMU 2024

Which of the following blood groups has anti-A and anti-B antibodies in the serum? [KMU-2024]

CORE CONCEPT AND DERIVATION

The immune system produces antibodies against red blood cell antigens that are *not* present in the individual's own body.

Solution:

- Individuals with **Blood Group O** have genotype ii .
- Their red blood cells completely lack both Antigen A and Antigen B.
- Because both antigens are viewed as foreign by their immune system, their blood plasma naturally produces both **anti-A and anti-B antibodies**.
- This makes them universal donors (no antigens to trigger a recipient) but limits them to only receiving Group O blood.

Why other options are incorrect:

- **Group A**: Has Antigen A, produces Anti-B.
- **Group B**: Has Antigen B, produces Anti-A.
- **Group AB**: Has both antigens, produces NO antibodies.

Question #7 Key: (D)

SZABMU 2024

Which type of antibodies are present in person with phenotype of blood group AB? [SZABMU-2024]

CORE CONCEPT AND DERIVATION

An individual's immune system will not produce antibodies against antigens that naturally exist on their own cells, otherwise it would trigger an autoimmune attack.

Solution:

- A person with **Blood Group AB** possesses both Antigen A and Antigen B on the surface of their red blood cells.
- Because both antigens are recognized as "self," the immune system does not generate antibodies against either.
- Therefore, there are **no anti-A or anti-B antibodies present at all** in their blood serum.
- This lack of antibodies makes them the universal recipient for blood transfusions.

Why other options are incorrect:

- Producing any of these antibodies would cause their own blood cells to agglutinate (clump) and be destroyed.

Question #8 Key: (C)

NUMS 2024

Which of the following is not related to ABO blood group system? [NUMS-2024]

CORE CONCEPT AND DERIVATION

The ABO blood group system is defined entirely by the presence or absence of specific glycoproteins on the cell membrane.

Solution:

- The statement "**It does not code for any antigen**" is factually incorrect and therefore the right answer.
- The entire ABO system is based on the *I* gene coding for specific enzymes that attach oligosaccharide **antigens** (Antigen A and Antigen B) to the surface of red blood cells.
- *Note: While Multiple Alleles and Co-dominance are non-Mendelian extensions, the underlying segregation of alleles still roughly obeys Mendel's Law of Segregation, making C the most glaringly false statement.*

Why other options are incorrect:

- Options A, B, and D are all true related characteristics of the ABO system.

Question #9 Key: (D)

SZABMU 2024

What is the principle of blood transfusion in donor and recipient respectively? [SZABMU-2024-Reconduct]

CORE CONCEPT AND DERIVATION

Safe blood transfusion relies on preventing an immune reaction that causes red blood cells to clump and undergo hemolysis.

Solution:

- The core principle of blood transfusion compatibility focuses on the **Antigen of the donor** and the **Antibodies of the recipient**.
- When donor blood is introduced, we must ensure that the recipient's pre-existing antibodies do not recognize the donor's red blood cell antigens as a threat.
- If the donor has an antigen that matches the recipient's antibodies (e.g., giving Type A blood with A-antigens to a Type B recipient with anti-A antibodies), a fatal immune reaction will occur.

Why other options are incorrect:

- The donor's antibodies are usually too diluted in the recipient's plasma to cause a severe reaction, making the donor's antigens the primary clinical concern.

Question #10 Key: (A)

KMU 2024

Which is true for an X-linked dominant trait? [KMU-2024]

CORE CONCEPT AND DERIVATION

In X-linked dominant inheritance, a single copy of the mutant allele is sufficient to cause the disorder.

Solution:

- An affected father has the genotype $X^D Y$ (where D is the dominant disease allele).
- He passes his Y chromosome to all his sons, who will therefore be completely unaffected.
- He passes his mutant X^D chromosome to **100% of his daughters**.
- Because the trait is dominant, receiving just one copy of X^D guarantees the disease. Thus, **all female offspring of the affected father will be affected**.

Why other options are incorrect:

- **Half of female offspring:** Incorrect, all daughters receive his X chromosome.
- **No male offspring of affected mother:** Incorrect, an affected mother ($X^D X^d$) has a 50% chance of passing it to her sons.

Question #11 Key: (B)

NUMS 2024

Which of the following option is correct for the pattern baldness? [NUMS-2024]

CORE CONCEPT AND DERIVATION

Pattern baldness is a classic example of a sex-influenced trait, not a sex-linked trait.

Solution:

- Pattern baldness is determined by an autosomal gene, not an X or Y chromosome gene.
- Its expression is heavily influenced by the presence of high levels of testosterone.
- Because of this **hormonal difference between sexes**, the baldness allele acts dominantly in males (requiring only one copy to cause baldness) but recessively in females (requiring two copies).

Why other options are incorrect:

- *Note: While C and D are technically true outcomes of the disease mechanics, Option B describes the fundamental biological reason why the trait behaves the way it does, making it the most comprehensive correct answer per the official key.*
- **Sex linked:** It is autosomal, not sex-linked.

Question #12 Key: (A)

SZABMU 2024

Which traits are most likely to affect men than women? [SZABMU-2024-Reconduct]

CORE CONCEPT AND DERIVATION

Biological males are hemizygous (XY), meaning they possess only one X chromosome.

Solution:

- **X-linked recessive** traits disproportionately affect men.
- Because males have only one X chromosome, inheriting a single recessive mutant allele (from their mother) is enough to fully express the disease, as they lack a second healthy X chromosome to mask it.
- Females (XX) must inherit two defective copies (one from each parent) to express the trait; otherwise, they are merely asymptomatic carriers.

Why other options are incorrect:

- **X-linked dominant:** Often affects more females because they have two chances to inherit the defective X chromosome.
- **Autosomal traits:** Generally affect both sexes at statistically equal rates.

Question #13 Key: (B)

SZABMU 2024

Hemophilia A and B pass from infected ____ grandfather to ____ through carrier daughter. [SZABMU-2024]

CORE CONCEPT AND DERIVATION

X-linked recessive traits characteristically exhibit a "zig-zag" pattern of inheritance across generations.

Solution:

- An affected male (X^hY) will pass his mutated X chromosome to his daughter, making her a carrier ($X^H X^h$). He does not pass it to his sons.
- This carrier daughter can then pass the mutated X^h chromosome down to her sons (who will express the disease) or daughters (who will be carriers).
- Therefore, the disease visibly skips a generation, moving from a **maternal grandfather** to his **grandson** via his carrier daughter.

Why other options are incorrect:

- It cannot pass paternally (father to son) because a father only gives a Y chromosome to his son, and the hemophilia gene is on the X chromosome.

Question #14 Key: (B)

NUMS 2024

A carrier female for hemophilia is married to an affected person. What would be the probable percentage of the...

CORE CONCEPT AND DERIVATION

The sex of an offspring is determined by the father (Y = son, X = daughter), but a son's X-linked traits are inherited exclusively from the mother.

Solution:

- **Mother's genotype:** Carrier ($X^H X^h$).
- **Father's genotype:** Affected ($X^h Y$).
- When determining the probability of traits in sons, we only look at the X chromosome provided by the mother (since the father must provide the Y).
- The mother has a 50% chance of passing the healthy X^H allele and a 50% chance of passing the mutant X^h allele.
- Therefore, exactly **50% of their sons** will be affected by hemophilia.

Why other options are incorrect:

- The father's affected status is irrelevant to the sons, as he only passes them a healthy Y chromosome. The probability is entirely dictated by the mother's heterozygosity.

Question #15 Key: (D)

SZABMU 2024

There is a situation in which hemophilia affects both gender equally. What is the reason behind it? [SZABMU-20...]

CORE CONCEPT AND DERIVATION

Traits that affect males and females at statistically equal rates are generally located on non-sex chromosomes.

Solution:

- Classic Hemophilia A and B are X-linked recessive, heavily skewing towards males.
- However, if a bleeding disorder (such as Hemophilia C, caused by Factor XI deficiency) affects both males and females equally, it must be located on an **autosomal** chromosome.
- Autosomes are homologous pairs inherited equally by both sexes, ensuring no gender bias in the expression of recessive or dominant traits.

Why other options are incorrect:

- **X-linked / Y-linked:** Inherently create a gender bias due to the structural differences between XX and XY chromosome pairings.

Question #16 Key: (C)

SZABMU 2024

When both the alleles of a gene pair are same, the organism is said to be: [SZABMU-2024-Reconduct]

CORE CONCEPT AND DERIVATION

Zygosity refers to the degree of genetic similarity for a specific trait inherited from parents.

Solution:

- If an organism inherits two identical alleles for a specific gene (e.g., **TT** or **tt**), its genetic state is termed **homozygous**.
- These alleles will produce the same outcome, making the organism "true-breeding" for that specific trait.

Why other options are incorrect:

- **Heterozygous:** The condition of having two different alleles (e.g., **Tt**).

Question #17 Key: (C)

SZABMU 2024

Phenotype is: [SZABMU-2024-Reconduct]

CORE CONCEPT AND DERIVATION

Genetic inheritance translates molecular codes into physical realities.

Solution:

- The term **phenotype** describes the observable physical properties, physiological properties, or **the form of appearance of a trait** in an organism.
- It is the direct result of the organism's underlying genotype interacting with the environment (e.g., eye color, blood type, height).

Why other options are incorrect:

- **Option A:** Describes the Genotype.
- **Option B:** Describes an Allele.
- **Option D:** Describes a Locus.

Question #18 Key: (A)

SZABMU 2024

Which one of the following is sterile male in *Drosophila*, but a sterile female in human produced through Turn...

CORE CONCEPT AND DERIVATION

The mechanisms of sex determination vary between species. Humans rely on the Y chromosome to dictate maleness, while *Drosophila* rely on the ratio of X chromosomes to autosomes.

Solution:

- The chromosomal genotype **XO** (having only one X chromosome and lacking a second sex chromosome) produces distinct outcomes across species.
- **In Humans:** The lack of a Y chromosome defaults development to female. However, lacking the second X chromosome causes **Turner's syndrome**, resulting in a sterile female.
- **In *Drosophila*:** The X to autosome ratio dictates sex. An XO fly develops physically as a **male**, but because it lacks the necessary sperm-motility genes located on the Y chromosome, it is entirely sterile.

Why other options are incorrect:

- **XXY:** In humans, this causes Klinefelter syndrome (sterile male). In *Drosophila*, it results in a fertile female.

Question #19 Key: (C)

SZABMU 2024

The blue colour blindness is also called as: [SZABMU-2024-Reconduct]

CORE CONCEPT AND DERIVATION

Color blindness is classified by which specific cone cells (red, green, or blue) in the retina are defective or absent.

Solution:

- **Tritanopia** is a rare, autosomal genetic condition characterized by a severe defect or absence of the short-wavelength (blue) cone cells in the retina.
- Consequently, it is commonly known as **blue color blindness**, impairing the ability to distinguish between blue and yellow shades.

Why other options are incorrect:

- **Protanopia:** Severe red color blindness (defective L-cones).
- **Deuteranopia:** Severe green color blindness (defective M-cones).

Question #20 Key: (A)

SZABMU 2024

Two allelic genes at same locus, when expressed fully in an individual, it is considered as: [SZABMU-2024-Reco...]

CORE CONCEPT AND DERIVATION

Alleles can interact in ways where neither acts recessively.

Solution:

- When two different alleles are present at the same locus and **both are expressed fully and distinctly** in the phenotype, the relationship is termed **co-dominance**.
- A classic example is the AB blood group, where both the I^A and I^B alleles are fully expressed to produce both A and B antigens on red blood cells without any blending.

Why other options are incorrect:

- **Incomplete dominance:** Results in a blended, intermediate expression (e.g., Pink flowers), not full, distinct expression of both.
- **Complete dominance:** Only one allele is expressed while the other is completely hidden.

Question #21 Key: (C)

UHS 2024

Chromosomal abnormality in Turner's syndrome is represented by? [UHS-2024]

CORE CONCEPT AND DERIVATION

Aneuploidy, the presence of an abnormal number of chromosomes, leads to severe developmental syndromes.

Solution:

- **Turner's syndrome** is a genetic condition affecting females, caused by monosomy of the sex chromosomes.
- It occurs due to the complete or partial absence of one X chromosome.
- This chromosomal abnormality is conventionally represented as **45, XO**.

Why other options are incorrect:

- **XXX:** Triple X syndrome.
- **XXY:** Klinefelter syndrome (affects males).
- **XXY:** Jacobs syndrome.

Question #22 Key: (B)

UHS 2024

Which of the following increases variation within a gene pool? [UHS-2024]

CORE CONCEPT AND DERIVATION

Sexual reproduction utilizes several mechanisms to shuffle genetic material and guarantee offspring diversity.

Solution:

- *Note: While mutation and random fusion also increase variation, the provided context and exam key specifically target meiotic mechanisms.*
- **Crossing over** occurs during Prophase I of meiosis.
- It physically shuffles alleles between maternal and paternal homologous chromosomes, breaking linkages and creating entirely new, recombinant chromatids.
- This mechanism is considered the primary, most consistent driver of genetic variation within a population's gene pool during reproduction.

Why other options are incorrect:

- While correct in a broader biological sense, standard medical entrance exams frequently point to Crossing Over as the definitive answer when asked for the primary mechanism of variation in a meiotic context.

Question #23 Key: (B)

KMU 2024

What is the primary outcome of crossing over during prophase of meiosis-I? [KMU-2024]

CORE CONCEPT AND DERIVATION

Crossing over is a highly precise physical exchange of DNA segments.

Solution:

- During Prophase I, homologous chromosomes align closely (synapsis).
- The primary outcome is that non-sister chromatids of these **homologous chromosomes exchange segments**.
- This reciprocal exchange creates new allelic combinations, directly **leading to recombinant chromatids and significantly increased genetic variation** in the resulting gametes.

Why other options are incorrect:

- **Exchange of identical parts:** This would defeat the purpose of the exchange; variation requires exchanging heterozygous differences.
- **Non-homologous chromosomes:** Exchanging parts between different, non-homologous chromosomes is a harmful mutation called translocation, not natural crossing over.

Question #24 Key: (C)

SZABMU 2024

In which phase of meiosis crossing over takes place? [SZABMU-2024]

CORE CONCEPT AND DERIVATION

Prophase I of meiosis is a complex, extended phase subdivided into five distinct stages based on chromosomal behavior.

Solution:

- **Zygotene:** Homologous chromosomes begin to pair up (synapsis) to form bivalents.
- **Pachytene:** The chromosomes fully thicken, and non-sister chromatids intertwine. It is in this specific stage that the physical exchange of genetic material (**crossing over**) actually takes place.
- **Diplotene:** The chromosomes begin to separate, and the points of crossing over become visible as chiasmata.

Why other options are incorrect:

- Crossing over is an active, enzymatic process that is exclusively localized to the **Pachytene** stage.

Question #25 Key: (A)

SZABMU 2023

The frequency of a mutant gene in a population would be likely to be increased if: [SZABMU-2023]

CORE CONCEPT AND DERIVATION

Natural selection acts on phenotypic variations, altering allele frequencies over generations based on environmental fitness.

Solution:

- A mutant gene will rapidly increase in frequency within a population if it is **selectively advantageous**.
- This means the mutation provides a survival or reproductive benefit, granting the carriers a better chance to survive, mate, and pass the beneficial allele to the next generation.

Why other options are incorrect:

- **Dominant / Sex-linked:** Dominance alone does not dictate frequency. A dominant allele will eventually disappear if it is lethal or highly disadvantageous.
- **Population increase:** A larger population does not inherently increase the frequency of a mutant gene unless selective pressures favor it.

Question #26 Key: (B)

SZABMU 2023

A change in the structure of a DNA molecule, producing a different allele of a gene, is a: [SZABMU-2023]

CORE CONCEPT AND DERIVATION

Mutations are broadly classified by the scale at which they alter genetic material (single nucleotide vs. large structural changes).

Solution:

- A localized change in the fundamental nucleotide sequence of a DNA molecule that alters a specific gene is explicitly called a **gene mutation** (or point mutation).
- This structural change directly produces a new or different allele of that specific gene.

Why other options are incorrect:

- **Chromosome mutation / aberration:** Refers to massive, macro-level changes affecting large segments of a chromosome (deletions, inversions, polyploidy), not a simple molecular change forming a new allele.
- **Recombination:** The reshuffling of *existing* alleles, not the creation of a fundamentally new allele structure.

Question #27 Key: (C)

SZABMU 2023

Phenotype is: [SZABMU-2023]

CORE CONCEPT AND DERIVATION

An organism's visible traits result from a complex interaction between its internal genetic code and external environmental factors.

Solution:

- **Phenotype** refers to the observable characteristics, physical traits, or **form of appearance of a trait** in an organism.
- For example, having the genetic code for tallness (TT) is a genotype, while the actual physical height (being visibly tall) is the phenotype.

Why other options are incorrect:

- **Option A:** The genetic complement is the definition of a *Genotype*.
- **Option B:** The partner of a gene pair is an *Allele*.
- **Option D:** The position on a chromosome is a *Locus*.

Question #28 Key: (C)

NUMS 2023

When both alleles of a gene pair are same, organism is said to be:
[NUMS-2023]

CORE CONCEPT AND DERIVATION

Zygoty describes the pairing of alleles inherited from the biological parents.

Solution:

- If an organism inherits the exact same allele from both its mother and its father for a given trait (e.g., **TT** or **tt**), the gene pair is identical.
- Such an organism is genetically termed **homozygous** for that trait.

Why other options are incorrect:

- **Heterozygous:** Occurs when the alleles are different (e.g., **Tt**).

Question #29 Key: (C)

SZABMU 2023

The particular array of chromosomes that an individual possesses is called [SZABMU-2023]

CORE CONCEPT AND DERIVATION

Cytogenetics involves visually profiling the complete chromosomal complement of a cell to detect abnormalities.

Solution:

- A **karyotype** is the particular visual array or profile of chromosomes an individual possesses.
- It showcases the exact number, size, and structure of chromosomes within a cell, organized logically in homologous pairs.
- This array is crucial for diagnosing chromosomal disorders like Down syndrome (Trisomy 21).

Why other options are incorrect:

- **Genotype:** The specific allele sequence of genes, not a visual array of whole chromosomes.

Question #30 Key: (A)

KMU 2023

Locus of a gene on a chromosome means its: [ETEA-2023 Retake]

CORE CONCEPT AND DERIVATION

Chromosomes act as the physical carriers of genes. Each gene is mapped to a specific physical coordinate.

Solution:

- The **locus** of a gene on a chromosome refers specifically to its physical **position** or location.
- It is the fixed address where all alleles for that particular gene can be found on homologous chromosomes.

Why other options are incorrect:

- **Function:** Describes the trait or protein the gene codes for, not its locus.
- **Start/End point:** Refers to promoters or terminators within the DNA sequence, not the overarching position of the gene itself.

Question #31 Key: (A)

UHS 2023

According to Mendel Law of Segregation, the one individual out of four in [Formula] generation had phenotype t...

CORE CONCEPT AND DERIVATION

Mendel observed that certain traits could disappear in one generation and reappear in the next, leading to the concept of dominant and recessive alleles.

Solution:

- When true-breeding parents (**P₁**) are crossed, all offspring in the **F₁ generation** display the dominant phenotype, effectively hiding the recessive trait.
- According to the Law of Segregation, these hidden recessive alleles separate when the **F₁** generation is self-crossed.
- This allows the recessive phenotype to reappear in the **F₂** generation at a ratio of 1 out of 4 (25%).

Why other options are incorrect:

- The trait is visibly expressed in the **P₁** (homozygous recessive parent) and the **F₂** generations. It is specifically masked in the **F₁** heterozygotes.

Question #32 Key: (B)

UHS 2023

Test cross is made to check the genotype of a trait. Which of the following crosses is a test cross? [UHS-2023...]

CORE CONCEPT AND DERIVATION

An organism displaying a dominant phenotype could be either homozygous dominant or heterozygous. A test cross reveals this hidden genotype.

Solution:

- A **test cross** involves crossing an individual with an unknown genotype (showing the dominant trait) with a completely **homozygous recessive** individual.
- If the unknown is **TT**, all offspring will show the dominant trait.
- If the unknown is **Tt**, 50% of the offspring will show the recessive trait.
- Therefore, crossing the unknown with **tt** is the correct format for a test cross.

Why other options are incorrect:

- Crossing with a dominant genotype (TT or Tt) would result in all offspring showing the dominant trait, masking any recessive alleles the unknown parent might be carrying.

Question #33 Key: (C)

UHS 2023

Only those genes can assort independently whose loci are on: [UHS-2023]

CORE CONCEPT AND DERIVATION

Mendel's Law of Independent Assortment relates to how different chromosomes align and separate during meiosis.

Solution:

- Genes assort independently during meiosis primarily when they are located on completely different, **non-homologous chromosomes**.
- Because non-homologous chromosomes orient randomly at the metaphase plate during Meiosis I, the genes on them segregate independently of one another.

Why other options are incorrect:

- **Same chromosomes / chromatids:** Genes located on the same chromosome are *linked* and tend to be inherited together, violating independent assortment (unless separated by crossing over).
- **Homologous chromosomes:** Contain the alleles for the same genes, which segregate (Law of Segregation), but independent assortment refers to *different* genes.

Question #34 Key: (C)

KMU 2023

In Mendelian cross for heterozygote flower (Pp), what is the probability that the dominant allele will be in s...

CORE CONCEPT AND DERIVATION

Joint probability in Mendelian gametic fusion.

Solution: In a heterozygote (Pp), the probability of a sperm carrying 'P' is 0.5, and the probability of an egg carrying 'p' is 0.5. The combined joint probability is $0.5 \times 0.5 = 0.25$ (Option C).

Question #35 Key: (B)

KMU 2023

G. J. Mendel chose _____ as an experimental plant for his study: [ETEA-2023]

CORE CONCEPT AND DERIVATION

Gregor Mendel required a model organism that was easy to cultivate, had distinct traits, and could be manually cross-pollinated.

Solution:

- Mendel famously conducted his foundational hybridization experiments on the common garden pea plant.
- The scientific botanical name for the garden pea is ***Pisum sativum***.

Why other options are incorrect:

- ***Medicago sativa*:** Alfalfa.
- ***Lens culinaris*:** Lentils.
- None of these were the primary model organism for Mendel's laws of inheritance.

Question #36 Key: (A)

KMU 2023

When round and yellow color seeded plant ($RrYy$) is self-crossed the number of plants with round and yellow col...

CORE CONCEPT AND DERIVATION

A standard dihybrid cross of two heterozygotes yields a predictable 9:3:3:1 phenotypic ratio.

Solution:

- The cross is $RrYy \times RrYy$.
- The proportion of offspring expressing both dominant traits (Round and Yellow) is $9/16$.
- To find the expected number in a specific population, multiply the fraction by the total number of plants:

$$\text{Expected} = \frac{9}{16} \times 32$$

$$\text{Expected} = 9 \times 2 = 18$$

- Therefore, **18 plants** out of 32 will have round and yellow seeds.

Why other options are incorrect:

- **9:** Is the numerator of the ratio, not the absolute number out of 32.
- **3:** Represents the proportion for single-dominant phenotypes (e.g., Round/Green).

Question #37 Key: (B)

KMU 2023

Mendel's law of independent assortment can be explained by: [ETEA-2023 Retake]

CORE CONCEPT AND DERIVATION

Mendel's abstract "laws" were later validated by the physical mechanics of cell division discovered decades later.

Solution:

- Mendel's Law of Independent Assortment is mechanistically explained by the **behavior of chromosomes during meiosis**.
- Specifically, during Metaphase I of meiosis, homologous chromosome pairs align at the cell equator randomly. The orientation of one bivalent does not influence the orientation of another.
- This random alignment ensures that maternal and paternal alleles for different genes segregate independently into the gametes.

Why other options are incorrect:

- **Mitosis:** Mitosis creates genetically identical somatic cells. It does not involve the pairing, crossing over, and independent assortment of homologous chromosomes that creates genetic diversity in gametes.

Question #38 Key: (B)

UHS 2023

ABO blood group is controlled by more than two alleles in a population. This shows that ABO blood group is an ...

CORE CONCEPT AND DERIVATION

While a diploid individual only holds two alleles for a single gene, the overall population may contain many variants of that gene.

Solution:

- The ABO blood group system is governed by a single gene locus (Gene I).
- However, it exists in three different allelic forms within the human population: I^A , I^B , and i .
- Because it is controlled by more than two alternative alleles, it is a classic example of **multiple alleles**.

Why other options are incorrect:

- **Polygenic inheritance:** Occurs when *multiple different genes* (often on different chromosomes) control a single trait (e.g., skin color). ABO is one gene, multiple alleles.

Question #39 Key: (A)

SZABMU 2023

Which of the following example of human inheritance is explained by multiple alleles on an autosomal chromosome...

CORE CONCEPT AND DERIVATION

Multiple allelism describes a gene with three or more variants in a population.

Solution:

- The **ABO blood group system** is controlled by three distinct alleles (I^A , I^B , i).
- These alleles are located on Gene I , which sits on Chromosome 9.
- Since Chromosome 9 is an autosome (not a sex chromosome), ABO inheritance is correctly categorized as multiple alleles on an autosomal chromosome.

Why other options are incorrect:

- **Cystic fibrosis:** An autosomal recessive trait, typically viewed through standard two-allele Mendelian genetics.
- **Down's syndrome:** A chromosomal abnormality (Trisomy 21), not a multiple allelic trait.
- **Haemophilia:** An X-linked (sex chromosome) recessive trait.

Question #40 Key: (D)

KMU 2023

Which of the following is true about occurrence of erythroblastosis foetalis? [ETEA-2023 Retake]

CORE CONCEPT AND DERIVATION

Erythroblastosis foetalis (Hemolytic Disease of the Newborn) is triggered by an Rh incompatibility between mother and fetus.

Solution:

- The condition arises specifically when an **Rh-negative mother** conceives a child with an **Rh-positive father**.
- If the fetus inherits the Rh-positive trait from the father, the mother's Rh-negative immune system will recognize the fetal Rh antigens as foreign.
- The mother produces anti-Rh antibodies, which can cross the placenta in subsequent pregnancies and destroy the red blood cells of an Rh-positive fetus.

Why other options are incorrect:

- If the mother is Rh-positive (Options A, C), her body already recognizes the Rh antigen as "self" and will not produce antibodies against an Rh-positive fetus.
- If both are Rh-negative (Option B), the fetus will be Rh-negative, and no immune conflict will occur.

Question #41 Key: (D)

KMU 2023

When are Rh antibodies produced in Rh -ve person? [ETEA-2023 Retake]

CORE CONCEPT AND DERIVATION

Unlike the ABO blood group system where antibodies (anti-A/anti-B) develop naturally, the Rh system requires sensitization.

Solution:

- An Rh-negative individual does not possess pre-existing anti-Rh antibodies in their blood plasma.
- These antibodies are strictly produced only **after exposure to Rh antigens** (Rh-positive blood).
- This exposure typically happens during a mismatched blood transfusion or when an Rh-negative mother is exposed to the blood of her Rh-positive fetus during childbirth.

Why other options are incorrect:

- **Naturally before/after birth:** Rh antibodies do not form spontaneously without a triggering exposure event.
- **Exposure to antibodies:** Exposure to the *antigen* (the foreign protein) triggers the immune response, not exposure to other antibodies.

Question #42 Key: (A)

UHS 2023

To study sex linkages in *Drosophila*, Morgan mated white eyed males with wild type red eyed females. What will...

CORE CONCEPT AND DERIVATION

In *Drosophila*, the wild-type red eye color is an X-linked dominant trait, while the mutant white eye color is X-linked recessive.

Solution:

- The cross is between a White-eyed male (X^wY) and a True-breeding wild type Red-eyed female ($X^{W+}X^{W+}$).
- **Females ($X^{W+}X^w$):** Inherit a dominant red allele from the mother. They will all have **red eyes**.
- **Males ($X^{W+}Y$):** Inherit a dominant red allele from the mother and a Y from the father. They will all have **red eyes**.
- Therefore, **all males and females will be red-eyed**.

Why other options are incorrect:

- Because the mother is homozygous dominant for the trait, she provides a dominant red allele to every single offspring, completely masking the father's recessive white allele.

Question #43 Key: (B)

KMU 2023

Drosophila melanogaster is the scientific name of: [ETEA-2023]

CORE CONCEPT AND DERIVATION

Model organisms are chosen for their ease of use, high reproductive rates, and simple genetic structures.

Solution:

- *Drosophila melanogaster* is the scientific nomenclature for the common **fruit fly**.
- It was extensively used by Thomas Hunt Morgan to discover the principles of sex-linked inheritance, linkage, and crossing over due to its short life cycle and visible genetic mutations (like eye color).

Why other options are incorrect:

- **House fly:** *Musca domestica*.
- **Sand fly:** *Phlebotomus* or *Lutzomyia*.

Question #44 Key: (C)

UHS 2023

Which one of the following is X-linked dominant disorder? [UHS-2023]

CORE CONCEPT AND DERIVATION

An X-linked dominant trait requires only one copy of the mutated allele on the X chromosome for the disorder to be expressed.

Solution:

- **Hypophosphatemic rickets** (Vitamin D-resistant rickets) is characterized by an X-linked dominant inheritance pattern.
- Because it is dominant, an affected father ($X^D Y$) will pass it to 100% of his daughters, but 0% of his sons. An affected heterozygous mother will pass it to 50% of all her children.

Why other options are incorrect:

- **Haemophilia & Color blindness:** These are classic X-linked recessive disorders.
- **Hypertrichosis:** A Y-linked trait passed strictly from father to son.

Question #45 Key: (C)

NUMS 2023

Which of the following traits is transmitted directly from affected father to only his son? [NUMS-2023]

CORE CONCEPT AND DERIVATION

The Y chromosome is unique because it is present only in biological males and determines male sex characteristics.

Solution:

- Males possess an XY chromosome pair, while females possess XX.
- A father passes his X chromosome to all his daughters and his Y chromosome to all his sons.
- Therefore, any gene or trait located exclusively on the Y chromosome (a **Y-linked** or holandric trait) is transmitted directly from an affected father to **only his sons**, and to 100% of them.

Why other options are incorrect:

- **Autosomal:** Passed to both sons and daughters equally.
- **X-linked:** An affected father passes an X-linked trait to his daughters, never to his sons.

Question #46 Key: (A)

KMU 2023

A male or female child of an affected mother has 50% chances of acquiring the disorder, such a disorder is: [E...]

CORE CONCEPT AND DERIVATION

X-linked recessive inheritance probabilities from a carrier mother.

Solution: A heterozygous carrier mother ($X^H X^h$) passes her mutated X^h allele to 50% of her offspring, resulting in a 50% chance of affected sons and a 50% chance of carrier daughters.

Question #47 Key: (D)

SZABMU 2023

When a haemophilic carrier woman marries a haemophilic man, who among her offspring's may be affected? [SZABMU...]

CORE CONCEPT AND DERIVATION

Haemophilia is an X-linked recessive disorder. We track the mutated X^h allele through a Punnett square.

Solution:

- **Mother's genotype:** Carrier ($X^H X^h$)
- **Father's genotype:** Affected ($X^h Y$)
- The cross yields the following four possibilities:
- **Daughters:** $X^H X^h$ (Carrier, 50%) and $X^h X^h$ (Affected, 50%).
- **Sons:** $X^H Y$ (Normal, 50%) and $X^h Y$ (Affected, 50%).
- Therefore, exactly **half of her sons and half of her daughters** will be affected by the disorder.

Why other options are incorrect:

- Options A, B, and C fail to account for the mother's dominant, healthy X^H allele, which protects 50% of the offspring.

Question #48 Key: (C)

KMU 2023

A condition that renders the individual less able to form blood clot is: [ETEA-2023]

CORE CONCEPT AND DERIVATION

Blood clotting requires a cascade of specific protein factors. Genetic mutations can impair the synthesis of these proteins.

Solution:

- **Hemophilia** is a genetic bleeding disorder that impairs the body's ability to form blood clots.
- This occurs due to a severe deficiency in specific clotting factors (like Factor VIII in Hemophilia A or Factor IX in Hemophilia B).
- Individuals with this condition experience prolonged bleeding after injuries.

Why other options are incorrect:

- **Thalassemia:** A blood disorder involving decreased production of hemoglobin, affecting oxygen transport, not clotting.
- **Alport's / Coffin-Lowry:** Genetic syndromes affecting kidney/hearing and cognitive/physical development, respectively.

Question #49 Key: (A)

KMU 2023

Which of the following types of haemophilia are more common in the human population? [ETEA-2023 Retake]

CORE CONCEPT AND DERIVATION

Haemophilia exists in different forms depending on which specific clotting factor is mutated.

Solution:

- **Haemophilia A**, caused by a deficiency of Clotting Factor VIII, is by far the most common type of haemophilia in the human population (accounting for about 80–85% of cases).
- It is an X-linked recessive disorder.

Why other options are incorrect:

- **Haemophilia B:** Factor IX deficiency, much less common (also known as Christmas disease).
- **Haemophilia C:** Factor XI deficiency, a rare autosomal recessive form.

Question #50 Key: (A)

UHS 2022

DNA stores biological information in discrete units termed as: [UHS-2022]

CORE CONCEPT AND DERIVATION

Biological information must be compartmentalized so it can be transcribed and translated efficiently.

Solution:

- DNA stores biological information in discrete, inheritable units called **genes**.
- Each gene is a specific sequence of nucleotides that encodes the instructions for synthesizing proteins or functional RNA molecules.

Why other options are incorrect:

- **Phenotypes:** The physical result of gene expression, not the storage unit itself.
- **Karyotypes:** A visual profile of an organism's chromosomes, not the discrete units of genetic information.

Question #51 Key: (A)

SZABMU 2022

These are the genes which tend to be inherited together and do not assort independently: [SZABMU-2022]

CORE CONCEPT AND DERIVATION

Mendel's Law of Independent Assortment only applies to genes located on different chromosomes or far apart on the same chromosome.

Solution:

- Genes located close together on the same chromosome tend to stay together during meiosis.
- This staying together of more than one gene on the same chromosome is called **gene linkage**.
- **Linked genes** do not assort independently and often do not separate during crossing over unless recombination occurs.

Why other options are incorrect:

- **Recombinant genes:** Genes that have undergone crossing over to create new combinations.
- **Independent genes:** These do assort independently.

Question #52 Key: (D)

BUMHS 2022

When two or more genes interact in a way that their effect is additive expression, it is: [BUMHS-2022]

CORE CONCEPT AND DERIVATION

Gene interactions can produce non-Mendelian phenotypic ratios depending on how alleles mask or blend with each other.

Solution:

- In **incomplete dominance**, the effects of two alleles are blended, and their expression results in an intermediate phenotype.
- This often shows an **additive effect** (where the dosage of the functional allele dictates the intensity of the phenotype, such as pink flowers from red and white parents).
- *Note: While polygenic inheritance is the classic example of additive gene effects across multiple loci, based on the provided exam key, incomplete dominance acts additively at a single locus.*

Why other options are incorrect:

- **Co-dominance:** Both alleles are fully and distinctly expressed without blending (e.g., AB blood group).
- **Epistasis:** One gene locus completely masks or modifies the expression of a second, different gene locus.
- **Phylogenetic inheritance:** A likely typographical error in the original exam for 'Polygenic inheritance'.

Question #53 Key: (B)

DUHS 2022

Mendel's selected following pair(s) of contrasting character: [DUHS-2022]

CORE CONCEPT AND DERIVATION

Mendel's success was largely due to his careful selection of distinct, easily distinguishable traits.

Solution:

- Mendel meticulously selected and studied **seven pairs** of contrasting traits in pea plants.
- These included: Seed shape (Round/Wrinkled), Seed color (Yellow/Green), Flower position (Axial/Terminal), Flower color (Violet/White), Pod shape (Inflated/Constricted), Pod color (Green/Yellow), and Stem height (Tall/Dwarf).

Why other options are incorrect:

- While he studied inheritance one or two traits at a time (monohybrid/dihybrid crosses), his overarching foundational research was based on exactly seven distinct pairs of characters.

Question #54 Key: (A)

SZABMU 2022

Mendelian inheritance follows which form of dominance relation? [SZABMU-2022]

CORE CONCEPT AND DERIVATION

Classical Mendelian genetics relies on straightforward dominant-recessive relationships between alleles.

Solution:

- Mendelian inheritance strictly follows **complete dominance**.
- When one allele is completely dominant over the other, the presence of the recessive allele is functionally hidden in a heterozygote.
- For example, in a heterozygous pea plant (**Rr**), 'R' is completely dominant over 'r', resulting in a round phenotype.

Why other options are incorrect:

- **Incomplete dominance & Co-dominance:** These are non-Mendelian extensions where alleles blend or express simultaneously.
- **Multiple allelic dominance:** Mendel only studied traits with two alternative alleles per gene locus.

Question #55 Key: (A)

KMU 2022

*An exception to Mendel's law is: [ETEA-2022]***CORE CONCEPT AND DERIVATION**

Mendel's Law of Independent Assortment assumes that the inheritance of one trait does not affect the inheritance of another.

Solution:

- **Linkage** is a major exception to Mendel's laws.
- The traits studied by Mendel happened to be controlled by genes on different chromosomes (or located very far apart), allowing them to assort independently.
- If genes are physically linked close together on the same chromosome, they are inherited together, violating the Law of Independent Assortment.

Why other options are incorrect:

- **Dominance, Purity of gametes (Law of Segregation), and Independent assortment** are the foundational principles of Mendel's work, not exceptions to it.

Question #56 Key: (B)

DUHS 2022

*Phenotypic ratio of single trait inheritance: [DUHS-2022]***CORE CONCEPT AND DERIVATION**

A monohybrid cross involves true-breeding parents differing in only a single trait.

Solution:

- When two heterozygotes (e.g., **Tt x Tt**) from the F_1 generation of a single trait inheritance are crossed, they segregate their alleles.
- The resulting phenotypic ratio in the F_2 generation between dominant and recessive plants is **3:1** (75% showing the dominant trait, 25% showing the recessive trait).

Why other options are incorrect:

- **1:2:1** represents the *genotypic* ratio of a monohybrid cross (1 TT : 2 Tt : 1 tt), or the phenotypic ratio in cases of incomplete dominance/co-dominance.

Question #57 Key: (B)

NUMS 2022

*Blood group which is known as universal donor is: [NUMS-2022]***CORE CONCEPT AND DERIVATION**

Blood transfusions depend on ensuring the donor's red blood cells do not possess surface antigens that the recipient's immune system will attack.

Solution:

- Blood group **O negative (O-)** is universally considered the universal donor.
- It lacks both A and B antigens on the surface of its red blood cells, meaning it will not trigger anti-A or anti-B antibodies in a recipient.
- Furthermore, being Rh-negative means it lacks the Rh antigen, ensuring compatibility with all recipient blood types regardless of their Rh factor.

Why other options are incorrect:

- **O+** has the Rh antigen and cannot be safely given to Rh-negative individuals.
- **A-** and **AB-** possess surface antigens (A or both A & B) that will trigger immune rejection in individuals with opposing antibodies.

Question #58 Key: (D)

KMU 2022

A man of blood group A marries a woman of blood group B and they have one child. Which one of the following st...

CORE CONCEPT AND DERIVATION

The ABO blood groups A and B can be either homozygous or heterozygous, which significantly affects the possible phenotypes of offspring.

Solution:

If the man (Group A) is heterozygous ($I^A i$) and the woman (Group B) is heterozygous ($I^B i$), the Punnett square is:

♀ \ ♂	I^A	i
I^B	$I^A I^B$ (AB)	$I^B i$ (B)
i	$I^A i$ (A)	ii (O)

- As shown, the cross can produce offspring of **all four possible phenotypes**: A, B, AB, and O.
- Therefore, the child could have any of these blood groups.

Why other options are incorrect:

- Options A, B, and C fail to account for the possibility that both parents carry the recessive i allele.

Question #59 Key: (C)

BUMHS 2022

In which blood group both the antigens are present? [BUMHS-2022]

CORE CONCEPT AND DERIVATION

Blood types are defined by the presence or absence of specific glycoproteins (antigens) on the surface of red blood cells.

Solution:

- The I^A and I^B alleles show co-dominance.
- In an individual with genotype $I^A I^B$ (**Blood group AB**), both alleles are fully expressed.
- Consequently, **both Antigen A and Antigen B** are present on the surface of their red blood cells.

Why other options are incorrect:

- Group A:** Only has Antigen A.
- Group B:** Only has Antigen B.
- Group O:** Lacks both Antigen A and Antigen B.

Question #60 Key: (B)

BUMHS 2022

How many phenotypes are possible for human ABO blood group system? [BUMHS-2022]

CORE CONCEPT AND DERIVATION

A phenotype is the observable expression of a genetic trait.

Solution:

- The human ABO blood group system is controlled by three alleles (I^A , I^B , i).
- While these alleles interact to form **six** possible genotypes ($I^A I^A$, $I^A i$, $I^B I^B$, $I^B i$, $I^A I^B$, ii), they manifest physically as only **four phenotypes**.
- The four phenotypes are: **Type A, Type B, Type AB, and Type O**.

Why other options are incorrect:

- 6:** Refers to the number of *genotypes*, not phenotypes.

Question #61 Key: (A)

UHS 2022

What happens when an 'Rh' negative woman married to an 'Rh' positive man conceives a child who is 'Rh' positiv...

CORE CONCEPT AND DERIVATION

Rh incompatibility occurs when the immune system of an Rh-negative mother is exposed to Rh-positive fetal blood cells.

Solution:

- If an Rh-negative woman carries an Rh-positive fetus, fetal red blood cells can cross the placenta during late pregnancy or birth.
- The mother's immune system recognizes the Rh antigen as foreign and begins producing Anti-Rh antibodies.
- In subsequent pregnancies with an Rh-positive fetus, these maternal antibodies can cross the placenta and destroy the fetal red blood cells.
- This life-threatening condition is known as Erythroblastosis foetalis, or **maternal-fetal incompatibility**.

Why other options are incorrect:

- The conflict is between the mother's immune system and the fetus, hence it is *maternal*, not paternal incompatibility. It does not cause fetal cancer or typically result in the death of the mother.

Question #62 Key: (A)

KMU 2022

Rh antigen was first studied in ____ [ETEA-2022]

CORE CONCEPT AND DERIVATION

The nomenclature of genetic discoveries often reflects the original organism in which they were found.

Solution:

- The Rh blood group is one of the most complex blood group systems in humans.
- It was discovered approximately 60 years ago by Karl Landsteiner and Alexander S. Wiener.
- It was first studied and identified in the blood of the Rhesus **monkey**, which is why it was named the 'Rh' factor.

Why other options are incorrect:

- While it is heavily studied in man, its initial discovery and naming origin belong specifically to the Rhesus macaque monkey.

Question #63 Key: (A)

UHS 2022

To study sex linkages in *Drosophila*, Morgan mated white eyed males with wild type red eyed females. What will...

CORE CONCEPT AND DERIVATION

In *Drosophila*, eye color is an X-linked trait where red eyes (wild type, X^{W+}) are dominant over white eyes (mutant, X^w).

Solution:

- The cross is between a white-eyed male (X^wY) and a true-breeding wild type red-eyed female ($X^{W+}X^{W+}$).
- **Females offspring ($X^{W+}X^w$):** Inherit a dominant red allele from the mother and a recessive white allele from the father. They will all have **red eyes** (carriers).
- **Male offspring ($X^{W+}Y$):** Inherit the Y chromosome from the father and a dominant red allele from the mother. They will all have **red eyes**.
- Therefore, **all males and females will be red-eyed**.

Why other options are incorrect:

- Because the mother is homozygous dominant, she guarantees a dominant red allele to all her offspring, masking any recessive allele passed by the father.

Question #64 Key: (B)

DUHS 2022

White eyed trait in *Drosophila* is due to: [DUHS-2022]**CORE CONCEPT AND DERIVATION**

New phenotypic traits in a population originally arise from alterations in the DNA sequence.

Solution:

- The wild-type eye color in *Drosophila melanogaster* is naturally red.
- The white-eyed trait is an X-linked recessive characteristic that arose specifically due to a genetic **mutation** in the eye color gene.
- Thomas Hunt Morgan discovered this white-eyed male mutant, providing the first solid evidence that specific genes reside on specific chromosomes.

Why other options are incorrect:

- Linkage and crossing over are processes related to the inheritance and shuffling of existing alleles, not the origination of a fundamentally new mutant allele like the white eye.

Question #65 Key: (C)

UHS 2022

Which one of the following is X-linked dominant disorder? [UHS-2022]

CORE CONCEPT AND DERIVATION

An X-linked dominant disorder requires only one defective copy of an X-chromosome gene to cause the disease, regardless of biological sex.

Solution:

- **Hypophosphatemic rickets** (also known as Vitamin D-resistant rickets) is a well-known **X-linked dominant** disorder.
- Because it is dominant, an affected father will pass the disorder to 100% of his daughters, but none of his sons.

Why other options are incorrect:

- **Haemophilia & Color blindness:** These are strictly X-linked **recessive**.
- **Hypertrichosis:** Heavy hair growth on the ear pinna is a holandric trait, meaning it is **Y-linked**.

Question #66 Key: (C)

UHS 2022

Mode of inheritance in humans can be traced through: [UHS-2022]

CORE CONCEPT AND DERIVATION

Because ethical and practical constraints prevent controlled breeding experiments in humans, geneticists must rely on historical family data.

Solution:

- One of the most powerful tools in human genetic studies is **pedigree analysis**.
- A pedigree is a visual chart that maps the presence or absence of a trait across multiple generations of a family.
- By analyzing these charts, geneticists can reliably trace and determine the mode of inheritance (e.g., autosomal dominant, X-linked recessive) for specific human traits.

Why other options are incorrect:

- **Experimental mating:** Crossing diverse lines is used in plant and animal genetics (like Mendel's peas), but is ethically impossible in humans.
- **Chi square chart:** A statistical tool to check if observed data fits expected ratios, not a tool for tracing family lineages.

Question #67 Key: (D)

KMU 2022

What are the chances that the daughter of a normal man and a heterozygous female will have hemophilia? [ETEA-2...]

CORE CONCEPT AND DERIVATION

Hemophilia is X-linked recessive. A female must inherit two defective X alleles to express the disease.

Solution:

- **Father's genotype:** Normal man = $X^H Y$.
- **Mother's genotype:** Heterozygous female (carrier) = $X^H X^h$.
- A daughter must inherit one X chromosome from her mother and her second X chromosome from her father.
- Since the father is perfectly normal, he can *only* pass on a healthy, dominant X^H allele to his daughters.
- Because every daughter receives at least one dominant X^H allele, none can be homozygous recessive ($X^h X^h$).
- Therefore, the chance of a daughter having hemophilia is exactly **0%**.

Why other options are incorrect:

- The daughters have a 50% chance of being *carriers* ($X^H X^h$), but zero chance of being afflicted with the disease.

Question #68 Key: (B)

PMDC 2020

When both the alleles of a gene pair are same, the organism is said to be: [PMC-2020]

CORE CONCEPT AND DERIVATION

The allelic composition of an individual determines their genetic state for a particular trait.

Solution:

- When both alleles of a gene pair are the same (e.g., **AA** or **aa**), the organism is structurally **homozygous**.
- In contrast, having two different alleles (e.g., **Aa**) makes the organism heterozygous.

Why other options are incorrect:

- **Genotype:** This is the overarching term for the genetic makeup of an organism, encompassing both homozygous and heterozygous states.
- **Phenotype:** The observable physical expression of the trait, not the underlying allele pairing itself.

Question #69 Key: (C)

PMDC 2020

Incomplete dominance: [PMC-2020]

CORE CONCEPT AND DERIVATION

Incomplete dominance is a form of intermediate inheritance where neither allele is completely dominant over the other.

Solution:

- In incomplete dominance, one allele does not completely mask the effects of the other.
- This results in a physical appearance that shows a blending of both alleles.
- Therefore, **the phenotype of the heterozygote is strictly intermediate** between the phenotypes of the two homozygous parents (e.g., Red x White = Pink flowers).

Why other options are incorrect:

- **Option A:** Describes co-dominance, where both alleles are fully and distinctly expressed (e.g., AB blood group).
- **Option B:** Describes complete Mendelian dominance.
- **Option D:** Describes the concept of multiple alleles.

Question #70 Key: (C)

PMDC 2020

Haemophilia A and B, color blindness and testicular feminization are example of: [PMC-2020]

CORE CONCEPT AND DERIVATION

These disorders cluster together phenotypically because they follow the exact same chromosomal inheritance rules.

Solution:

- Haemophilia A & B, red-green color blindness, and Testicular Feminization Syndrome (TFM) are all classic **X-linked recessive traits**.
- They occur when an individual possesses exclusively mutated copies of the associated gene on their X chromosome(s).
- Because males (XY) only have one X chromosome, they are much more frequently affected by these specific disorders than females (XX).

Why other options are incorrect:

- **X-linked dominant:** Requires only one copy of the gene to express the trait (e.g., Hypophosphatemia), which is not the case for these.
- **Y-linked:** Traits strictly passed from father to son (e.g., hypertrichosis of the ear).

Question #71 Key: (A)

PMDC 2020

Which traits are most likely to affect men than women? [PMC-2020]

CORE CONCEPT AND DERIVATION

The asymmetric distribution of sex chromosomes (XX vs XY) drastically impacts how recessive genes are expressed.

Solution:

- **X-linked recessive** traits overwhelmingly affect men more than women.
- A male possesses only one X chromosome (hemizygous). If he inherits just a single recessive mutant allele on his X chromosome, he will express the disorder since there is no dominant allele to mask it.
- A female has two X chromosomes, meaning she must inherit two copies of the recessive allele to express the disease; otherwise, she remains an asymptomatic carrier.

Why other options are incorrect:

- **X-linked dominant traits** actually tend to affect more women, because women have twice the statistical chance of inheriting the single defective X chromosome required for the disease.
- **Autosomal traits** generally affect males and females equally.

Question #72 Key: (A)

MDCAT 2019

Homozygous means: [MDCAT-2019]

CORE CONCEPT AND DERIVATION

Zygosity refers to the degree of similarity of the alleles for a trait in an organism.

Solution:

- When both alleles of a gene pair in an organism are exactly the same (e.g., **TT** or **tt**), the organism is said to be **homozygous** for that specific trait.

Why other options are incorrect:

- **Having two different alleles:** This defines a *heterozygous* condition (e.g., **Tt**).
- **Having two identical genes:** The correct terminology is identical *alleles* of the *same* gene, not identical genes.

Question #73 Key: (B)

MDCAT 2019

In genetics, the term locus refers to the ____ of the gene on the chromosome. [MDCAT-2019]

CORE CONCEPT AND DERIVATION

Chromosomes are highly organized structures of DNA. Every gene has a specific, fixed address on its designated chromosome.

Solution:

- The specific physical location or **position** of a gene on a chromosome is called its **locus**.

Why other options are incorrect:

- **Frequency:** Refers to how often an allele appears in a population (allele frequency).
- **Inversion:** A chromosomal mutation where a segment breaks off and reattaches in reverse order.

Question #74 Key: (A)

KMU 2019

How many pairs of homologous chromosomes are present in *Pisum sativum*? [ETEA-2019]

CORE CONCEPT AND DERIVATION

Pisum sativum (the garden pea) was the model organism used by Gregor Mendel due to its easily observable traits and short generation time.

Solution:

- The total diploid number of chromosomes in *Pisum sativum* is $2n = 14$.
- Therefore, there are exactly **seven pairs** of homologous chromosomes.
- Coincidentally, Mendel also studied exactly seven contrasting traits in these pea plants.

Why other options are incorrect:

- Eight, nine, and ten pairs refer to the chromosomal numbers of other plant species, not the garden pea.

Question #75 Key: (C)

SZABMU 2019

If Sara has blood group O. The genotype of her mother and father is possibly: [AJK-2019]

CORE CONCEPT AND DERIVATION

Blood group O is a recessive trait. To express a recessive phenotype, the individual must be homozygous for the recessive allele.

Solution:

- Sara has blood group O, meaning her genotype is strictly ii .
- She must have inherited one recessive i allele from her mother and one recessive i allele from her father.
- Looking at the options, only the cross between two heterozygous individuals ($I^B i \times I^B i$, denoted here as **Bi x Bi**) allows both parents to donate an i allele to the offspring.

Why other options are incorrect:

- **BB x BB** and **BB x Bi**: The homozygous parent (BB) can only pass on a dominant B allele, making it impossible to produce a child with blood group O (ii).

Question #76 Key: (C)

MDCAT 2019

A person was married to his cousin and both are heterozygous for sickle cell anemia. Among their four kids, wh...

CORE CONCEPT AND DERIVATION

Sickle cell anemia is an autosomal recessive disorder.

Solution:

- Both parents are heterozygous carriers (Genotype: **Ss**).
- We set up a simple Mendelian cross for two heterozygotes ($Ss \times Ss$).
- The statistical probabilities for the offspring are:
- **SS (Normal)**: 25%
- **Ss (Carriers)**: 50%
- **ss (Affected homozygotes)**: 25%

Why other options are incorrect:

- **50%**: Represents the proportion of carrier offspring.
- **75%**: Represents the proportion of all phenotypically normal offspring ($SS + Ss$).

Question #77 Key: (D)

MDCAT 2019

In which situation, genes are not assorted independently during meiosis in a chromosome? [MDCAT-2019]

CORE CONCEPT AND DERIVATION

Independent assortment is hindered by the physical linkage of genes on a DNA molecule.

Solution:

- Mendel's law of independent assortment assumes genes behave independently.
- However, if genes reside on the same chromosome and their loci are physically **close to each other**, they are inherited as a single block.
- Such **linked genes** do not obey the law of independent assortment and will stay together during meiosis, preventing independent segregation.

Why other options are incorrect:

- **Option A**: Genes that are far apart on the same chromosome often undergo crossing over, allowing them to effectively assort independently.

Question #78 Key: (C)

SZABMU 2019

Which situation can reduce the chances of variation and genetic recombination? [AJK-2019]

CORE CONCEPT AND DERIVATION

Genetic variation depends on the shuffling of alleles during meiosis. Anything that locks alleles together decreases variation.

Solution:

- **Gene linkage** minimizes the chances of genetic recombination.
- Because linked genes sit close together on the same chromosome, they are strongly inclined to be inherited together as an intact unit.
- This physical grouping restricts independent assortment and reduces the probability that crossing over will separate them, thereby limiting new genetic combinations.

Why other options are incorrect:

- **Random fusion, Crossing over, and Mutation:** These are all primary biological mechanisms that actively increase genetic variation.

Question #79 Key: (B)

SZABMU 2019

During crossing over, exchange of segments takes place between: [AJK-2019]

CORE CONCEPT AND DERIVATION

Recombination requires the physical exchange of genetic material between paternal and maternal DNA sequences.

Solution:

- During Prophase I of meiosis, homologous chromosomes pair up to form bivalents.
- Crossing over specifically occurs between the **non-sister chromatids** of these **homologous chromosomes**.
- One chromatid from the maternal chromosome exchanges equivalent segments with a chromatid from the paternal chromosome, introducing genetic diversity.

Why other options are incorrect:

- **Sister chromatids:** Exchanging segments between identical sister chromatids would yield no genetic variation.
- **Non-homologous chromosomes:** An exchange here represents a deleterious chromosomal mutation known as a translocation, not natural crossing over.

Question #80 Key: (B)

MDCAT 2019

If a carrier haemophilic female ([Formula]) is married to a haemophilic male ([Formula]). What will be the...

CORE CONCEPT AND DERIVATION

Haemophilia is an X-linked recessive disorder. We track the X and Y chromosomes through a standard Mendelian cross.

Solution:

- The cross is between a Carrier Female ($X^H X^h$) and an Affected Male ($X^h Y$).
- The Punnett square yields the following 4 distinct offspring probabilities (25% each):
- $X^H X^h$: 25% Carrier Female (phenotypically normal)
- $X^h X^h$: 25% Haemophilic Female
- $X^H Y$: 25% Normal Male
- $X^h Y$: 25% Haemophilic Male
- Option B perfectly lists this 1:1:1:1 distribution.

Why other options are incorrect:

- The other options present statistically inaccurate percentages that fail to reflect the equal 25% split among the four possible genetic combinations.

Question #81 Key: (C)

MDCAT 2018

The region of the chromosome or more specifically, a length of the DNA molecule, which has a particular nucleo...

CORE CONCEPT AND DERIVATION

The functional unit of heredity is defined by its ability to code for a specific polypeptide or functional RNA.

Solution:

- **Genes** are specific segments of DNA comprising a basic sequence of nucleotides.
- This sequence carries the genetic code required to synthesize a specific protein or trait.

Why other options are incorrect:

- **Locus:** This is the physical location or position of a gene on a chromosome, not the DNA sequence itself.
- **Allele:** An alternative version of a gene.
- **Kinetochores:** A protein structure on the centromere where spindle fibers attach during cell division.

Question #82 Key: (B)

MDCAT 2018

Which one of the following is multiple allelic character? [MDCAT-2018]

CORE CONCEPT AND DERIVATION

Multiple allelism occurs when more than two alternative forms of a gene exist at a specific locus in a population.

Solution:

- The **ABO blood group** in humans is determined by three distinct alleles: I^A , I^B , and i .
- This makes it a quintessential example of a multiple allelic character.

Why other options are incorrect:

- **Length of stem, Shape of seed, Colour of flower:** These are all classic Mendelian traits in pea plants controlled by exactly two distinct alleles (e.g., Tall/Dwarf, Round/Wrinkled, Purple/White).

Question #83 Key: (C)

MDCAT 2018

There are ____ linkage groups in human. [MDCAT-2018]

CORE CONCEPT AND DERIVATION

A linkage group encompasses all the genes situated on a single chromosome that tend to be inherited together.

Solution:

- The number of linkage groups in a species generally corresponds to its haploid number of chromosomes (the number of homologous pairs).
- Humans have 23 pairs of chromosomes. Therefore, there are universally considered to be **23 linkage groups** in a typical human cell (specifically in females, as they have 22 autosomes + X. Males technically have 24 distinct linkage groups due to X and Y, but standard genetic convention for human haploid linkage groups is cited as 23).

Why other options are incorrect:

- **46:** The total diploid number of chromosomes, not the number of linkage groups.
- **22:** The number of autosomal linkage groups only, ignoring the sex chromosomes.

Question #84 Key: (C)

MDCAT 2018

Chance of a cross over between two loci is directly proportional to their: [MDCAT-2018]

CORE CONCEPT AND DERIVATION

Genetic mapping relies on the frequency of recombination between linked genes.

Solution:

- During meiosis, crossing over occurs between non-sister chromatids.
- The physical **distance** separating two gene loci on a chromosome directly dictates how likely a chiasma will form between them.
- The value of crossing over or recombination frequency is **directly proportional to the distance** between the genes on the genetic map. The further apart they are, the higher the chance of crossing over.

Why other options are incorrect:

- Length, width, and thickness of a chromosome have no direct bearing on the statistical probability of recombination between two specific mapped loci.

Question #85 Key: (D)

MDCAT 2017

Self-fertilization of [Formula] dihybrids, following independent assortment of alleles will result in: [MDCAT-...]

CORE CONCEPT AND DERIVATION

In a standard Mendelian dihybrid cross involving two traits showing complete dominance, the phenotypic ratio in the F_2 generation is 9 : 3 : 3 : 1.

Solution:

- A dihybrid cross (e.g., Tall/Round x Dwarf/Wrinkled) yields an F_1 generation of all Tall, Round heterozygotes.
- Selfing the F_1 produces the following probabilities:
- **9/16** Tall, Round (Dominant/Dominant)
- **3/16** Tall, Wrinkled (Dominant/Recessive)
- **3/16** Dwarf, Round (Recessive/Dominant)
- **1/16** Dwarf, Wrinkled (Recessive/Recessive)
- Option D perfectly isolates the two recombinant phenotypes: **3/16 tall, wrinkled; 3/16 dwarf, round.**

Why other options are incorrect:

- Option A incorrectly lists the double recessive as 3/16 instead of 1/16.
- Option B incorrectly mixes the dominant fraction with an incorrect recessive fraction.

Question #86 Key: (D)

MDCAT 2017

As a result of cross-fertilization of true breeding pea plant having purple-colored flowers with that of white...

CORE CONCEPT AND DERIVATION

The Law of Dominance states that in a heterozygote, the dominant allele will completely mask the presence of the recessive allele.

Solution:

- A true-breeding purple plant has the genotype **PP**.
- A true-breeding white plant has the genotype **pp**.
- Purple color is entirely dominant over white color.
- Crossing **PP x pp** results in an F_1 generation where 100% of the offspring have the heterozygous genotype **Pp**.
- Since **P** is dominant, **all offspring will have purple flowers**.

Why other options are incorrect:

- Fractions like 3/4 and 1/4 only appear in the F_2 generation resulting from the cross of two heterozygotes ($Pp \times Pp$).

Question #88 Key: (A)

MDCAT 2016

The total number of genes in a population is called: [MDCAT-2016]

CORE CONCEPT AND DERIVATION

Population genetics studies the variations and frequencies of alleles within groups of individuals. The collective genetic information of a population is defined by its gene pool.

Solution:

- The total aggregate of genes in a population at any given time is called the population's **gene pool**.
- It consists of all the alleles at all gene loci in all individuals of the breeding population.

Why other options are incorrect:

- **Genome:** Refers to the complete set of DNA present in a single individual or cell, not a population.
- **Genomic library:** A collection of cloned DNA fragments that represent the entire genome of an organism, used in genetic engineering.

Question #87 Key: (C)

MDCAT 2017

The gene for red-green color blindness is present on: [MDCAT-2017]

CORE CONCEPT AND DERIVATION

Human color vision relies on opsin proteins, and the genes encoding these proteins are distributed across different chromosomes.

Solution:

- Red-green color blindness is an **X-linked recessive** trait.
- The genes encoding the **red and green opsins** are situated exclusively on the **X chromosome**.
- Mutations in these specific X-chromosome genes lead to the inability to distinguish between red and green hues.

Why other options are incorrect:

- **Autosome No. 7:** This is where the gene for *blue* opsin (tritanopia) is located, making blue color blindness an autosomal trait.

Question #89 Key: (C)

MDCAT 2016

A character determined by three alleles is: [MDCAT-2016]

CORE CONCEPT AND DERIVATION

When a specific gene locus has more than two naturally occurring variants in a population, it exhibits multiple allelism.

Solution:

- The **Human ABO blood group** is encoded by a single polymorphic gene (Gene *I*) on chromosome 9.
- It is uniquely determined by **three alleles**: I^A , I^B , and i .

Why other options are incorrect:

- **Skin and Eye color:** These are polygenic traits, meaning they are controlled by *multiple different genes* (each with their own alleles) interacting additively, not three alleles at a single locus.
- **Rh factor:** Primarily determined by the presence (D) or absence (d) of a single antigen, generally behaving as a two-allele system.

Question #90 Key: (B)

MDCAT 2016

Which one of the following is X-linked trait? [MDCAT-2016]

CORE CONCEPT AND DERIVATION

X-linked traits are governed by genes located specifically on the X chromosome.

Solution:

- **Haemophilia** is a well-documented genetic disorder caused by a deficiency in clotting factors, with the responsible gene located on the X chromosome.
- It follows an X-linked recessive inheritance pattern.

Why other options are incorrect:

- **Male pattern baldness:** This is a sex-influenced trait, meaning it is governed by an autosomal gene whose expression is heavily dependent on male hormones (testosterone).
- **Erythroblastosis foetalis:** Caused by Rh factor incompatibility, which is determined by an autosomal gene.

Question #91 Key: (B)

SZABMU 2015

Mendel concluded that each organism has two hereditary factors for each trait, now called: [SZABMU-2015]

CORE CONCEPT AND DERIVATION

Gregor Mendel established the fundamental laws of inheritance. He postulated that hereditary traits are passed down by discrete factors.

Solution:

- Mendel originally termed these discrete units of inheritance as *Elementen*.
- In modern genetics, these two hereditary factors for each trait are **now called Alleles** (or genes).
- Therefore, the correct answer for what they are **now called** is **Alleles** (Option B).

Why other options are incorrect:

- **Option D (Elementen):** This was Mendel's original 19th-century terminology, not what they are *now called*.
- **Options A & C (Chromatids / Chromosomes):** Structural nuclear structures containing DNA, not the specific term for the paired hereditary factors for a trait.

Question #92 Key: (B)

MDCAT 2015

ABO blood system is an example of: [MDCAT-2015]

CORE CONCEPT AND DERIVATION

While an individual diploid organism can only carry two alleles for a given gene, a population can possess many more variations of that gene.

Solution:

- The ABO blood group system is the first discovered and most classic example of a **multiple allelic** system in humans.
- It is controlled by a single gene locus (Gene *I*) on chromosome 9, which exists in three distinct allelic forms in the human population: I^A , I^B , and i .

Why other options are incorrect:

- **Polygenes (Multiple genes):** Refers to traits controlled by two or more separate genes (e.g., skin color or height), not multiple alleles at a single gene locus.

Question #93 Key: (D)

MDCAT 2015

Number of pairs of autosomes in humans is: [MDCAT-2015]

CORE CONCEPT AND DERIVATION

Human chromosomes are categorized into autosomes (which determine general body traits) and sex chromosomes (which determine biological sex).

Solution:

- A normal human somatic cell contains a total of 46 chromosomes, arranged in 23 pairs.
- Out of these 23 pairs, exactly **22 pairs** are **autosomes** (homologous in both males and females).
- The 23rd pair consists of the sex chromosomes (XX in females, XY in males).

Why other options are incorrect:

- **23:** This is the *total* number of chromosomal pairs, not just the autosomes.

Question #94 **Key: (B)**

MDCAT 2015

*X-linked recessive trait is: [MDCAT-2015]***CORE CONCEPT AND DERIVATION**

Different genetic disorders are mapped to specific inheritance patterns on sex chromosomes or autosomes.

Solution:

- **Haemophilia** (along with color blindness) is a classic example of an **X-linked recessive** trait.
- It primarily affects males because they possess only one X chromosome; a single recessive allele will cause the disorder.

Why other options are incorrect:

- **Hypophosphatemia (Vitamin-D resistant rickets):** This is an X-linked *dominant* disorder.
- **Diabetes mellitus:** Typically has multifactorial inheritance heavily involving autosomal traits and environmental factors.