Solution

HEREDITY AND EVOLUTION

Class 10 - Science

Section A

1.

(d) Lamarck

Explanation:

Lamarckism - Theory of Inheritance of Acquired Characters is the first theory of evolution, which was proposed by Jean Baptiste de Lamarck (1744-1829), a French biologist. Although the outline of the theory was brought to notice in 1801, his famous book “Philosophic Zoologique” was published in 1809, in which he discussed his theory in detail.

2.

(b) Chrysemys picta

Explanation:

In Chrysemys picta, a species of turtle, high incubation temperature above 33^oC results in development of female progeny while a temperature below 28^oC produces only males. It is an example of sex determination under the effect of environmental factors.

3.

(b) In individuals of a given species, a specific gene is located on a particular chromosome.

Explanation:

In individuals of a given species, a specific gene is located on a particular chromosome.

4. **(a)** Both maternal & Paternal DNA

Explanation:

As during fertilisation, sperm only gives nucleus, but ova gives nucleus as well as cytoplasm. Therefore, the mitochondrial DNA and other cytoplasmic factors are inherited directly from mother. there are some traits which are exclusively linked with Y- chromosome and they are inherited by the male child directly from father.

5. **(a)** round and green

Explanation:

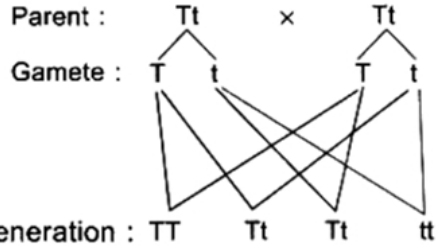
Since roundness and green colour are shown by capital letters in the genotype so they are dominant traits. We know that only dominant traits are expressed in F_1 generation.

6.

(d) 50%

Explanation:

In a monohybrid cross between two heterozygous individuals, percentage of heterozygous individuals obtained in F_1 generation is 50%. This can be explained by the following cross



Therefore, percentage of heterozygous individuals (Tt and Tt) obtained in F_1 generation is 50%.

7.

(d) 1 : 1

Explanation:

A cross between (TT) and (tt) would produce progenies with following genotypes-
In F_2 generation - selfing of F_1 progeny-

Gametes Tt	T	t
T	TT	Tt
t	Tt	tt

Pure tall (TT), Mixed tall (Tt) and Short (tt). The ratio of pure tall and pure short plant is 1 : 1.

8. **(a)** Sex chromosomes
Explanation:
Sex chromosomes possess the gene for maleness and femaleness in humans.
In humans, the sex chromosomes comprise one pair of a total of 23 pairs of chromosomes. The other 22 pairs of chromosomes are called autosomes.
Individuals having two X chromosomes (XX) are females; individuals having one X chromosome and one Y chromosome (XY) are males.

9. **(a)** This disease is due to an X-linked recessive mutation
Explanation:
Haemophilia is a bleeding disorder that slows down the blood clotting process. People who have haemophilia often have longer bleeding after an injury or surgery.
Haemophilia is inherited in an X-linked recessive pattern. A condition is considered X-linked when gene mutation that causes it is located on the X chromosome, one of the two sex chromosomes. In males (who have only one X chromosome), one altered copy of the gene in each cell is enough to cause the condition. Since females have two X chromosomes, a mutation must be present in both copies of the gene to cause haemophilia. Males are affected by X-linked recessive disorders much more frequently than females.

10. **(d)** 3 : 1
Explanation:
All of the colours in F_1 will be Vv (violet) when VV crosses with vv. When Vv crosses with Vv, the resulting F_2 will contain VV, Vv, vV, and vV, only one of which has white flowers while the others have violet ones. Ratio is thus 3 to 1.

11. **(c)** Friedrich
Explanation:
DNA isolation is a process of purification of DNA from a sample using a combination of physical and chemical methods. The first isolation of DNA was done in 1869 by Friedrich Miescher.

12. **(c)** 30
Explanation:
30

13. **(a)** (iii) and (iv)
Explanation:
Males have two distinct sex chromosomes (XY) and are called the heterogametic sex (Chromosome-23). Females have two of the same kind of sex chromosome (XX)(Chromosome-23) and are called the homogametic sex. In human males, all the chromosomes (22- Autosomes) are paired perfectly except one (23^{rd}). These unpaired chromosomes are X and Y (Chromosome-23).

14. **(b)** Genetics
Explanation:

Genetics is the study of genes, genetic variation, and heredity in living organisms. It is generally considered a field of biology, but intersects frequently with many other life sciences and is strongly linked with the study of information systems.

15.

(c) Gregor Mendel

Explanation:

Gregor John Mendel is considered as the father of genetics as he laid down the principles or laws of inheritance for the first time. Though his works were based on plants but the laws governing inheritance patterns are also applicable to humans and hence we call them as " Mendel's Laws of Inheritance".

16.

(d) Alleles

Explanation:

An alternative form of a gene is known as an allele. Alleles vary in their sequence which may or may not result in a variant phenotype of a particular trait. Alleles represent variations of a gene that is responsible for a particular trait.

17. **(a)** self pollination

Explanation:

i. Incomplete dominance results in F1 generation plants with all pink flowers when plants with pure red and white blooms cross.
ii. These plants on self-pollination or fertilization produce progenies (F2 generation) with red, pink, and white flowers in 1:2:1 ratio.
iii. This is a monohybrid cross as only one character or trait is involved in crossing.
iv. The relationship between two genetic variants is referred to as dominant.
v. Each gene has two alleles that an individual inherits from each parent.
vi. One allele of a gene, known as the dominant gene, will be expressed if the alleles are different.
vii. The impact of the other allele, known as the recessive one, is concealed.

18.

(b) Round and yellow

Explanation:

Since roundness and yellow colour are shown by capital letters in the genotype so they are dominant traits. We know that only dominant traits are expressed in the F1 generation.

19.

(d) tallness is the dominant trait

Explanation:

According to the law of dominance, the character that is expressed in the F_1 generation is called the dominant trait whereas character that is not expressed in F_1 generation is knowns as recessive trait. Thus, tallness is the dominant trait.

20. **(a)** 46

Explanation:

46

21.

(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

Explanation:

The dominant allele is an allele whose phenotype will be expressed even in the presence of another allele of that gene. It is represented by a capital letter, e.g. T. Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.

22.

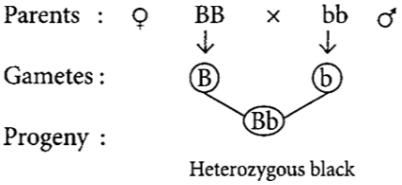
(b) Both A and R are true but R is not the correct explanation of A.

Explanation:
Both A and R are true but R is not the correct explanation of A.

23. **(a)** Both A and R are true and R is the correct explanation of A.
Explanation:
Mendel chose garden pea as plant material for his experiment because garden pea plants were easily available, they grow in one season and fertilization was easy.

24.
(d) A is false but R is true.
Explanation:
Changes in non-reproductive tissues cannot be passed on the DNA of the germ cells.
The traits developed during the lifetime of an individual that cannot be passed on to its progenies are acquired traits.

25.
(c) A is true but R is false.
Explanation:
Gene for black hair colour is dominant to gene for red hair colour in humans. Mother has black hair and can be represented by (BB) whereas father can be represented by (bb).



So, the child will be heterozygous for black hair colour.

26. **(a)** Both A and R are true and R is the correct explanation of A.
Explanation:
If a child inherits an X chromosome from the father will be a girl and one who inherits a Y chromosome will be a boy.

27.
(d) A is false but R is true.
Explanation:
A tall plant which always produces tall offspring is homozygous dominant with genotype (TT). It will always produce only one type of gamete (T).

28.
(c) A is true but R is false.
Explanation:
Pure breeding plants are homozygous for many traits, i.e., they will have either both dominant genes or both recessive genes for a particular trait.

29. **(a)** Both A and R are true and R is the correct explanation of A.
Explanation:
Both A and R are true and R is the correct explanation of A.

30. **(a)** Both A and R are true and R is the correct explanation of A.
Explanation:
Both A and R are true and R is the correct explanation of A.

31. No, because they cannot pass on to the DNA of germ cells.

32. Female

33. James Watson and Francis Crick proposed the double helical structure of the DNA. According to this structure,
    i. DNA Molecule consists of two polynucleotide strands forming a double helix. Each helical turn has a length of 3.4nm in which ten nucleotides are present.

ii. Each polynucleotide strand has a backbone of sugar and phosphate. The nitrogenous base is attached to the sugar.

iii. The nitrogenous bases of the two strands of a double helix form a pair with the help of hydrogen bonds. Adenine pairs with thymine by two hydrogen bonds, whereas guanine pairs with cytosine by the three hydrogen bonds.

iv. The hydrogen bonds hold the two strands of the helix together.

34. When the population of bacteria living in temperate waters is exposed to sudden rise in temperature of water, most of the bacteria will die, but the few variants resistant to heat will survive.
35. We are likely to find both attached and detached earlobe variants among the students in the class.
36. Gregor Johann Mendel
37. Genotype of father with blood group A are: I^AI^O , I^AI^A
38. Parents transmit some of their characteristics into their offsprings via inheritance or heredity.
39. Genes
40. Heredity refers to the passing of traits or characteristics from parents to offspring through genetic information encoded in DNA.

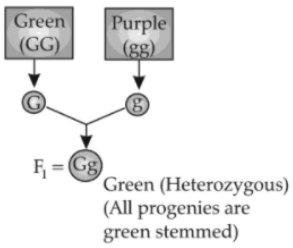
Section B

41. Male have pair of (22+X)(22+Y,) pair of chromosomes and female have (22+X)(22+X) pair of chromosome.If X crosses with X then it would be a female offspring and if Y crosses with X it would be a male offspring. Therefore the gender of the children will be determined by what they inherit from their fathers.
42. **Environmental cue:** In some reptiles environmental factors like temperature determines the sex of newborn. For example: In turtle high incubation temperature results in development of females whereas in lizard high incubation temperature results in development of males.

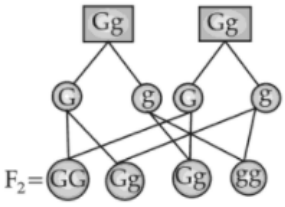
    Genetically determined: In human, the sex of child is determined by the type of sex chromosome X or Y combines during fertilization. If Y chromosome carrying sperms fuse with egg cell that contains X chromosome, the newborn will be a male. Similarly if X bearing sperms fuse with egg cell that contains X chromosome, the newborn will be a female.
43. Genes are located at a specific position on a chromosome.

    Chemical nature of gene: Chemically gene is a segment of deoxyribonucleic acid (DNA) consisting of specific sequence of the nucleotides. The sequence of the constituent nucleotides determines the functional property of a gene.
44. i. The branch of biology which deals with the study of heredity and variation.

    ii. The decrease in the number of surviving tigers is a cause of concern because fewer number of tigers impose extensive inbreeding among themselves, this limits the appearance of variation and put the species at a disadvantage if there are changes in the environment.
45. i. a. Colour of the stem in F1 progeny: All green



b. Percentage of brown stem: 25 %



c. GG: Gg is 1 : 2

ii. Based on the above cross, it can be concluded that green colour is dominant and get expressed in F_1 generation. The brown stem, which does not get express itself in the F_1 generation, is the recessive character. This is the law of dominance.

46. i. The secretions of the prostrate glands and seminal vesicles give the sperm nutrition. The sperm consists of 22 + X or 22 + Y chromosome

    ii. a. Female child represents XX pair of chromosomes.

    b. Male child represents XY pair of chromosomes.
47. Mendel selected pea plant (Pisum sativum) because:

i. Many varieties were available with observable alternative forms for a trait or characteristic.
ii. Peas are normally self pollinated: as their corolla completely enclose the reproductive organs until pollination is completed.
iii. It was easily available.
iv. It has pure lines for experimental purpose, i.e. they always breed true.
v. It has contrasting characters. The traits were seed colour, pod colour, pod shape, flower shape, position of flower, seed shape and plant height.
vi. Its life cycle was short and produced large number of offsprings.
vii. The plant is grown easily and does not require care except at the time of pollination.

48. Though human beings who look so different from each other in terms of colour, size and looks are said to belong to the same species because :
i. DNA studies i.e., study of DNA sequences through molecular phylogeny show that they belong to same species.
ii. Constant or same chromosome number.
iii. They have a common ancestor.
iv. They can interbreed among themselves to produce offspring of their own kind.
v. They have common body design, structure, physiology and metabolism.
vi. Study of fossils also reveals that humans belong to same species.

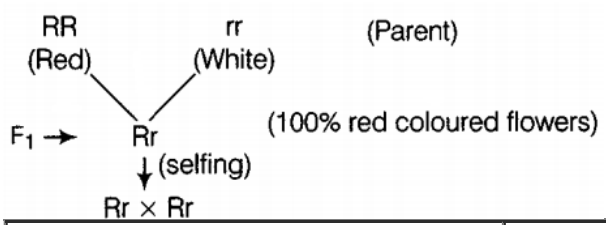
49. Equal contribution of male and female parents is ensured in progeny during sexual reproduction. Each trait of progeny is determined by a pair of alleles and gametes of male and female contain one allele. Each allele pairs during fertilisation combine together to determine traits. Thus, the traits of progeny are determined by equal genes from male and female.

50. **a) F_1 generation and F_2 generation;** F_1 generation or first filial (fitlus - son and filia - daughter) generation is the generation of hybrid produced from a cross between two genetically different individual called parents, e.g. Tt individuals are produced from cross between TT and tt parents.
F_2 generation: F_2 or second filial generation is generation of individuals of F_1 generation.
b) Monohybrid ratio: It is the ratio which is obtained in F_2 generation when a monohybrid ratio is usually 3 : 1 (Phenotypically) and 1 : 2 : 1 (genotypically)
Dihybrid ratio: It is the ratio which is obtained in the F_2 generation when a dihybrid cross is made and the offsprings of F_1 generation are self bred. It is 9 : 3 : 3 : 1.
Punnet square: (Proposed by R.C. Punnet). It is a chequer board used to show the results of a cross between two organisms and depicts both genotype and phenotype of the progeny.

Section C

51. Let the dominant trait be represented by PP.
Let the recessive trait be represented by pp.
Parents PP × pp
F_1-generation (p_p) (p_p) (p_p) (p_p) i.e. all pink colour flowers, but hybrid. i.e. none are pure homozygous all the progeny has heterozygous combination, but since, pink is dominant over white, all are pink.
F_2-generation when self-fertilised (p_p) × (p_p)
F_2-generation gives (PP) (Pp) (Pp) (pp)
Ratio 3 pink colour flowers : 1 white colour flower.

52. When two plants, A with white flowers and B with red flowers were crossed,
In F_1 generation all the plants have red coloured flowers and in F_2 generation the ratio of red : white is 3 : 1.
The dominant trait is red colour in flowers.
The recessive trait is white colour in flowers.



Gametes	**R**	**r**
R	RR(red)	Rr(red)
r	Rr(red)	rr(red)

53. The ratio of purple flowers to white flowers in F_2 generation was approximately 3 : 1. This ratio is termed Mendelian ratio or Monohybrid ratio. It explains:

    1) F_1 hybrids always exhibited only one of the parental form of a trait and showed dominance / recessive mechanism.

    2) Both parental forms of trait segregate and were expressed in F_2 (second filial) generation.

    3) The form of trait that appeared in F_1 offspring i.e. the dominant form was present in the F_2 generation about three times as frequently as its alternate form (470 : 162). It is approximately 3 : 1. It is due to mechanism of segregation at the time of gamete formation.

54. On this basis we cannot say that light eye colour is dominant or recessive until a cross is made between parent having light eye colour and another with dark eye colour is made. Only then it will be possible to predict the dominant or recessive nature of gene.

55. a. All the plants in F_1 progeny will be of green coloured stem.

	♂		♀
Parents	GG (Green)	×	gg (Purple)
Gametes	G		g
F_1 generation	Gg (All green stem)		

b. Cross for F_2 progeny is:

	♂		♀
Parents (selfing F_1)	Gg (Green)	×	Gg (Purple)
Gametes	G g		G g

F_2progeny-

♂	G	g
♀		
G	Gf (Green)	Gf (Green)
g	Gf (Green)	gg (Purple)

Phenotypic ratio = Green : Purple = 3 : 1

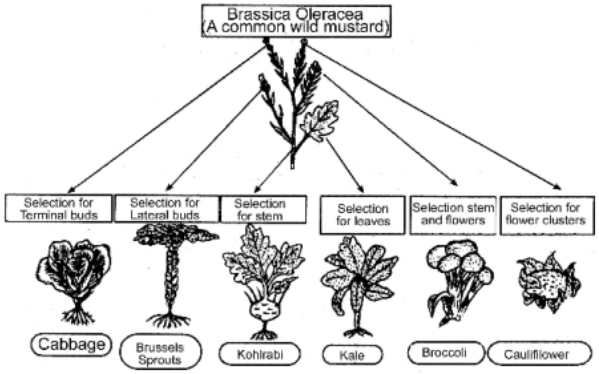
c. According to the finding above, purple stems are subordinate to green stems. Thus, according to the rule of dominance, only the dominant characteristic was present in F_1. Purple stem in F_2 indicates that the alleles for purple stem were inherited but were not expressed in F_1, nevertheless. Only in F_2 under homozygous circumstances did they get expressed.

56. i. Bb will have brown eyes.
    bb will have blue eyes.
    BB will have brown eyes.

    ii. Eye colour in humans is an inherited trait. These are traits that are present in the DNA of an organism and are passed on to their progeny.

57. The result in F1 progeny will be violet flowers because it is dominants over the white flowers.

58. Crop plants produced by selective breeding



59. a. Sperm having X chromosome and sperm having Y chromosome

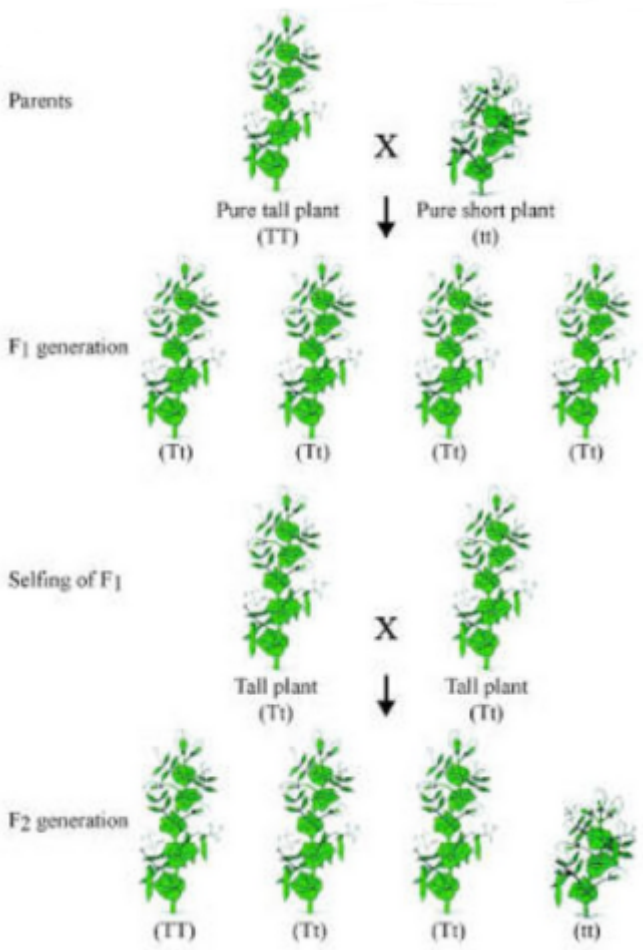
    b. No, As male child gets only Y chromosome from his father and X chromosome from mother to have XY chromosome.

    c. One type/only ovum/egg

60. i. Plant used by Mendal is Garden Pea Plant (Pisum sativum).

ii. F_1 - All tall; F_2 - Tall and short

iii. The ratio in F_2 progeny is 3:1.



Section D

61. i. In given case, genotypic ratio of F_2 progeny will be 1 : 2 : 1 where one is homozygous dominant, two are heterozygous dominant and one is homozygous recessive.

ii. $\frac{1}{4}$ of them have wrinkled seeds and $\frac{3}{4}$ of them have smooth seeds.

iii. Factors representing the alternate or same form of a character are called alleles. In heterozygous individuals or hybrids, a character is represented by two contrasting alleles. Out of the two contrasting alleles, only one is able to express its effect in the individual. It is called the dominant allele. The other allele which does not show its effect in the heterozygous individual is called the recessive allele, e.g., in the case of hybrid tall pea plants (Tt). 'T' is a dominant allele whereas 't' is a recessive allele.

OR

The alternative form of the gene is called Allele. Alleles are a pair of genes that occupy a specific location on a particular chromosome and control the same trait.

62. i. In F_1 generation, all plants were tall / No short plants were observed

No medium height plants / No halfway characteristics were observed / Only dominant parental traits were seen and not the mixture of the two.

ii.

Dominant trait	Recessive trait
Single copy of dominant trait is enough to get it expressed/always expressed	Only expressed when present in pair.

iii. Self-pollination / Self-fertilisation / Selfing of F_1 plants

$$\text{Ratio} - \underset{9}{\text{Round Yellow}} : \underset{1}{\text{Wrinkled Green}}$$

Traits are inherited independently.

OR

If pea plants with yellow seeds are crossed with plants of green seeds, it is found that in F_1 generation all the plants have

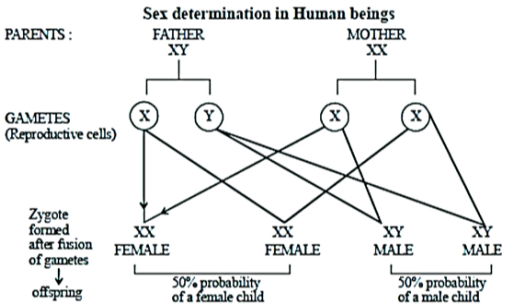
yellow seeds. When F_1 plants are self-pollinated, it is found that in F_2 generation, plants with yellow seeds and plants with green seeds are obtained. This shows that both the traits are inherited but only one trait is visible in F_1 progeny while the other remains unexpressed.

63. i. In terms of type since there are two types XY and XX so XY has two different chromosomes so it is called mismatched pair. Whereas in terms of size X chromosome is normal size whereas Y chromosome is short in size so it is called mismatched pair.

ii. Female has a perfect pair of chromosomes i.e. XX. Yes the gametes produced in the perfect pair will be of same kind.

iii. Crocodile, Bonellia Virdis, turtle,etc are animals whose sex is not determined by genetics.
In these organisms, sex is determined by environmental factors.
For example, in crocodiles, if the egg is incubated at around 30°C, it leads to the development of female whereas if the egg is incubated at around 34°C, it results in the development of the male.
Another example may include Bonellia Viridis in which sex is determined by the location of larvae. If larvae make physical contact with a female, it becomes male. If it is located on the bare sea floor, it becomes female.

OR

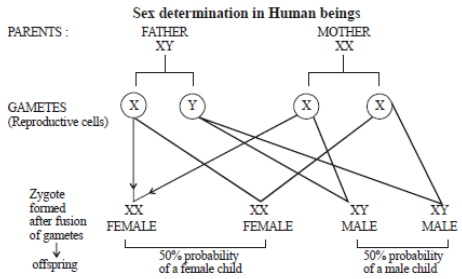


64. i. Gametes have half the number of chromosome. When they fuse, the original number is restored. At the time of fertilization male and female germ cells are fused to form a zygote.

ii. As female have XX chromosomes and male hav XY chromosomes so males have mismatched pair of chromosomes in terms of type. Also in terms of size X is bigger than Y so it is mismatched.

iii. Examples of organisms in which sex is not genetically determined are crocodiles, alligators, turtle, Bonellia Viridis.
For example, in crocodiles, if the egg is incubated at around 30 °C, it leads to the development of female whereas if the egg is incubated at around 34 °C, it results in the development of the male.
Another example may include Bonellia Viridis in which sex is determined by the location of larvae. If larvae make physical contact with a female, it becomes male. If it is located on the bare sea floor, it becomes female.

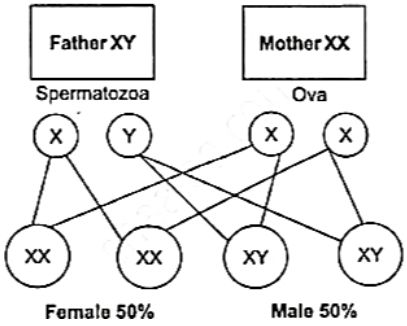
OR



65. i. Haplotype cells make up gametes. Only 23 chromosomes are present in each egg and sperm cell. That is a fraction of a cell's normal number of chromosomes. A diploid cell is created when two haploid cells fuse together. Zygote is a diploid cell, which means it has 46 chromosomes.

ii. Some animals (reptiles) completely rely on environmental signals to determine sex. The temperature at which fertilised eggs are stored determines whether the developing animal in the egg is male or female in some reptiles. Lizard used to be. Individuals in some species, such as the snail, can change sex in response to stress and environmental factors.

iii. The sex of a newborn child is purely and completely a matter of chance and none of the parent i.e. mother and father may be considered answerable for it. The statement in question is justified and can be proved by the process of fertilization:



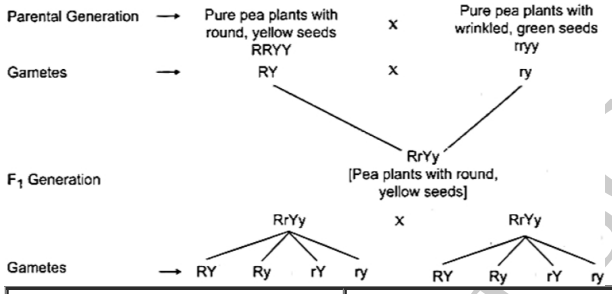
OR

The female human is homomorphic. They have identical copies of both sex chromosomes. Each gamete in meiosis receives one X chromosome at the moment of gamete creation. Thus, the X chromosome is present in all gametes.

Section E

66. Gene controls traits as we know genes are a specific sequence of nucleotides on a chromosome that encodes a particular protein which expresses in form of a particular trait in the body. Each gene has two alternative forms for a particular character. These alternative forms are called alleles, one is a dominant allele and the other is a recessive allele.
For example - The height of a plant, plant height depends on the number of hormones synthesized. The amount of hormones synthesised depends upon the efficiency of the process for making it. If the protein needed for this process is synthesized and works efficiently plant would be tall. On the other hand, if the gene is altered, the protein synthesised will be less efficient and hence hormones produced would be less and plants' height decrease and plants would be dwarfed.

67.



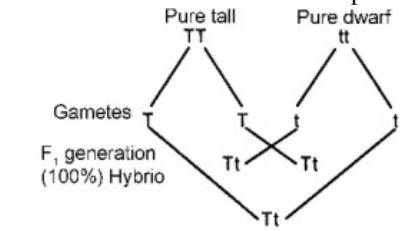
Gametes ↓→	RY	Ry	rY	ry
RY	RRYY	RRYy	RrYY	RrYy
Ry	RRYy	RRyy	RrYy	Rryy
rY	RrYY	ReYy	rrYY	rrYy
ry	Rr?Yy	Rryy	rrYy	rryy

The cross between RRYY× rryy produces the combination of Round-yellow, round-green, wrinkled-yellow, and wrinkled-green in the ratio of 9:3:3:1 in F_2 generations. New characters round-green and wrinkled-yellow are produced because when pure round-yellow pea plants are crossed with pure wrinkled-green pea plants the inheritance of one pair of characters is independent of the other pair i.e., the inheritance of character of round seed is not linked with yellow seed or the inheritance of wrinkled seed is not linked with green seed. The contrasting traits segregate and inherit independently and result in the formation of a new combination of characters.

68. Law of dominance is known as the first law of inheritance. Each character is controlled by distinct units called factors, which occur in pairs. If the pairs are heterozygous, one will always dominate the other.
Law of dominance explains that in a monohybrid cross between a pair of contrasting traits, only one parental character will be expressed in F1 generation and both are expressed in F2 generation in the ratio 3:1. The one which expressed in F1 generation is called dominant trait and the one which is suppressed is called recessive trait. In simple words, the law of dominance states that recessive traits are always dominated or masked by dominant trait.
The law can be well explained by the monohybrid cross by studying the following crosses:

i. Pure tall = TT, Hybrid tall = Tt
Gametes of TT parent = $\frac{1}{2}$T +$\frac{1}{2}$T
Gametes of Tt parent = $\frac{1}{2}$T +$\frac{1}{2}$t
The 50% are pure tall and 50% hybrid tall. Then pure tall plants will produce 100% tall in F_2 generation and hybrid plants will produce in the ratio of 1 : 2 : 1 in the F_2 generation.

ii. When the cross is made between pure tall and pure dwarf, we get results as follows

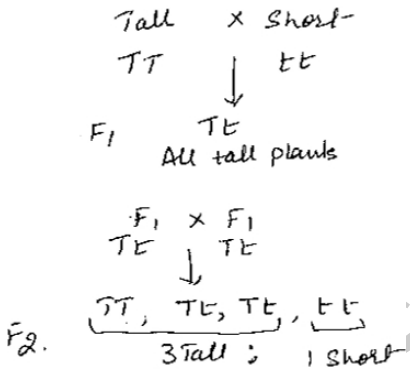


F_2 generation

Pure : Hybrid : Pure
Tall : Tall : Dwarf
1 : 2 : 1

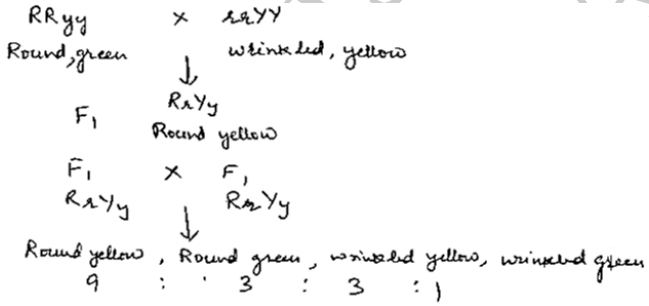
♂ \ ♀	T	t
T	TT	Tt
t	Tt	tt

69. a. i.
- Mendel crossed pure tall pea plants with pure short pea plants.
- All tall plants were produced in the F1 generation.
- When F1 tall plants were self-pollinated, Mendel got both tall and short plants in the ratio of 3 Tall : 1 Short.
- This clearly indicated that tall character is dominant over short character which although present would not be expressed in F1 generation. /



ii. When pea plants with two different characteristics like plants with **round and green seeds** and the plants with wrinkled and yellow seeds; were bred with each other, the F1 generation had plants with round and yellow seeds **(dominant character).**

On self-pollination of F1 generation plants, F2 generation obtained **was a mixture of round yellow, round green, wrinkled yellow and wrinkled green** in the ratio **9:3:3:1**, thus showing that the traits are inherited independently. /



b. Birds and bats are more closely related because they have wings to fly, whereas squirrels and lizards do not. The wings of birds and bats are analogous organs.

70. **Mendel's Experiment:** Gregor Mendel (1822 - 1884) was an Austrian monk. He conducted experiments with garden pea (Pisum sativum). The results thus formulated the laws of inheritance. He studied inheritance of each character separately.

Method of experiment: In breeding experiments (artificial mating) the undeveloped anthers are removed from the flowers of one of the plants to prevent self-pollination. This removal of anther is called as emasculation. On the stigma of this plant are placed the mature pollen of the other selected plant. The artificially pollinated flowers are then covered with bags to prevent access of the other pollen. The seeds produced this way are collected. They are called hybrid seeds.

Now let us follow one of Mendel's breeding experiments. He selected two pure varieties of pea (Pisum sativum) which different in size. One of them was tall and the other dwarf. He cross - pollinated them in the way described above. He placed the pollen of tall one of the stigmas of dwarf and vice versa. The hybrid seeds obtained in both the cases were sown. Which ever way the cross was made, on germination the seeds grew into plants which were all tall. This first hybrid generation, is called the first filial generation and is usually written as F_1. The hybrids of F_1 generation were all similar to the tall parent. The result of this generation surprised Mendel. He expected the hybrids to be intermediate in size. Accordingly the character which appeared in the F_1 generation

(tallness in this case) he called dominant and the other which did not appear he called recessive.

Mendel's next step was to allow the F_1 hybrids to self - pollinate and produce seeds. He collected the seeds, planted them and observed the results. He found that three-fourths of the plant of F_2 generation were tall like the original tall parent and one-fourth dwarf like the original dwarf parent. The result of F_2 generation was all the more surprising to Mendel.

He continued the experiment. He allowed the dwarf plants and tall plants of F_2 generation to self-pollinate. The dwarf plants which formed one-fourth of F_2 generation bred true. They produced dwarf offspring in the F_3 generation. The tall which formed three fourth of F_2 generation did not breed true for tallness in the F_3 generation. One third of them produced tall pea plants in F_3 generation. These bred true like the dwarfs of F_3 generation. The two thirds, again gave the same ratio, 3 tall : 1 dwarf in generation. All these experiments gave result of the same sort. He was greatly surprised by the ratio of two parental types of 3 : 1 in all the seven cases.

71. Conclusion and hereditary principles derived from monohybrid cross.

1**) Principles of paired factors:** Each character is represented in an individual by two determinants / factors / genes. They are same in homozygous which breed true. In hybrid or heterozygous individuals two factors represent alternative forms.

2) Principle of dominance: In a heterozygous individual only one allele is able to express its effect called dominant while the other remains hidden termed recessive.

3) Principle of purity of gametes: A gamete receives only one of the two genes or factors, thus gametes are always pure for a character.

4) The two genes or determinants do not mix up.

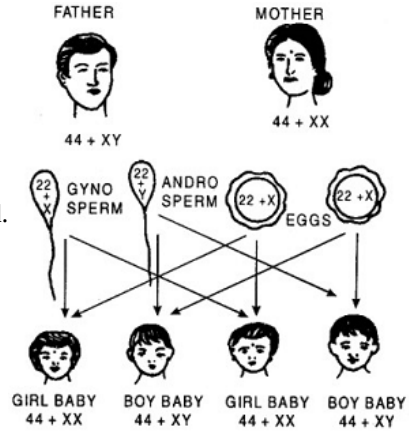
5) Homozygous individuals breed true whereas heterozygous give a phenotypic ratio of 3 : 1.

6) Principle of segregation: The two factors of a character keep their identity in an individual. They segregate (separate) during gamete formation and are passed on to the offspring randomly after fertilization.

72. Determination of the sex of child. Sex chromosomes determine sex in human beings. In males, there are 44 + XY chromosomes, whereas, in female there are 44 + XX chromosomes. Here X and Y chromosomes determine sex in human beings.

Two types of gametes are formed in male, one type is having 50%, X-chromosome, whereas, other type is having Y-chromosome. In female, gametes are of one type and contain X-chromosome.

The females are homogametic. If male gamete having Y-chromosome (endosperm) undergoes fusion with female gamete having X-chromosome the zygote will have X Y chromosomes and this gives rise to male child.



If male gamete having X-chromosome undergoes fusion with female gamete having X-chromosome, the zygote will be having XX-chromosome and this gives rise to female child.

73. **1) Law of unit character:** According to this law, all the characters of body are represented in the gametes by certain units called factors or determiners which always occur in pair. These genes are present on different chromosomes of homologous pairs at the same locus.

2) Law of Dominance: Only one member of the contrasting pair of characters is capable of expressing itself while other remains hidden, is called principle of dominance.

3) Law of Segregation: According to this law, in a hybrid, the two unlike factors of a character do not affect each other but keep their identity. During gamete formation, they are free to segregate or separate from one another and to be redistributed in the next generation. This law is also called the purity of gametes.

4) Law of independent assortment: When two pairs of independent alleles are brought together, they show independent dominant effects. During the formation of gametes, the genes of different characters are independent of one another.

74. i. Law of Dominance state that in a heterozygous (or hybrid) condition, the allele having characters expressed over the other allele is the dominant allele.

For example - for height characters T (tall) and t (dwarf) are two different alleles.

When Tt are present together, T will dominate t and the resulting phenotype will be Tall, not dwarf or mid-sized.

ii. The germ cells of sexually reproducing populations are made in specialized reproductive tissue. Change in non-reproductive tissues, on account of acquired traits, cannot be passed on to the DNA of the germ cells. Therefore, experience gained or traits acquired during the lifetime of an individual not inherited.

75. In human beings, there are two types of sex chromosome X and Y; female have XX chromosome whereas male have XY chromosome. Females produce eggs which carry only X chromosomes but males contain half of the sperms with X chromosomes and other half with Y chromosomes. During fertilisation when X carrying sperms fuse with an egg which contains X chromosome the offspring will be a female (XX). But when Y bearing sperms fuses with an egg (X) the offspring will be male (XY). Thus the sex of a child is determined by the type of sex chromosome X or Y received by the male gamete.