CLASS 10TH BIOLOGY WORKSHEET CHAPTER 3– GENETICS -SOME BASIC FUNDAMENTALS

Progress Check 1

Question 1. Mention if the following statements are True or False:

(i) Genetics and heredity are the same thing.

(ii) "Like begets like", this applies only to animals.

(iii) The entire human population shows variations.

Answer

(i) False
Corrected statement — Genetics and heredity are related but not the same thing. (Heredity means the transmission of genetically based characteristics from parents to offspring whereas Genetics is the study of heredity.)

(ii) False
Corrected statement — "Like begets like", this applies to all organisms.

(iii) True

Question 2. Which of the following in humans are established genetic traits ? (Tick-mark the correct ones) in the box provided.

(i) Capacity to be a good cricketer

(ii) Curly hair

(iii) Left-handedness

(iv) Quality of voice

(v) Red-green colour blindness

Answer

Following are the established genetic traits in humans:

- Curly hair
- Left-handedness
- Red-green colour blindness

Progress Check 2

Question 1. Mention the following:

(i) Total number of pairs of chromosomes in each body cell in humans ..... .

(ii) Number of pairs of autosomes in one cell of humans ..... .

Answer

(i) 23

(ii) 22

Question 2. A certain couple got only four daughters in a row and no son. Does it mean that the husband does not produce Y-bearing sperms? Explain.

Answer

No, it does not mean that the husband does not produce Y-bearing sperms. During conception, half of the sperm released are X-bearing and the other half are Y-bearing. In this case, only the X-bearing sperm fertilized the wife's eggs in each instance. This can happen due to random chance, as the probability of having a male or female child is approximately 50% for each pregnancy.

Progress Check 3

Question 1. Write the basic unit of heredity ?

Answer

Gene is the basic unt of heredity.

Question 2. Define the following terms :-

(i) Allele

(ii) Dominant gene

(iii) Genotype

(iv) Phenotype

(v) Recessive gene

Answer

(i) Alternative forms of a gene, occupying the same position on homologous chromosomes and depicting different forms of the same character are called alleles.

(ii) The gene which can super-rule or mask the effect of its allele is called Dominant gene.

(iii) The set of genes present in the cells of an organism is called its genotype.

(iv) The observable characteristics which are genetically controlled are called as phenotype.

(v) The form of allele which remains submissive in presence of dominant form and expresses only in homozygous condition is called recessive gene.

Question 3. Mention the number of paired homozygous chromosomes in

(i) Human female

(ii) Human male

Answer

(i) 23

(ii) 22

Reason — The term used in the above question should be "homologous". All the 23 pairs of chromosomes in female are homologous while in male only 22 pairs are homologous because one pair (sex chromosomes-XY) is different in size and gene sequence.

Question 4. Can there be a heterozygous recessive? Explain.

Answer

No, there can never be a heterozygous recessive. In case of a heterozygous condition, there is one dominant gene and one recessive gene. The character of dominant gene will be expressed as it will mask the expression of recessive gene. Therefore, the recessive gene will always express in homozygous condition and there cannot be a heterozygous recessive.

Question 5. List any four characters along with their traits in humans which you can easily study just by observing and making family charts.

Answer

Eye colour (Brown/Blue), Hand (Left/Right Handedness), Earlobe (Free/Attached) and Cheeks (Dimpled/Normal).

Progress Check 4

Question 1. Who discovered for the first time the basic principles of genetics?

Answer

Gregor John Mendel

Question 2. Give the common and scientific names of the organism on which Gregor Mendel had worked.

Answer

Common name — Garden pea
Scientific name — *Pisum sativum*

Question 3. Distinguish between the following pairs:

(i) Monohybrid and Dihybrid cross

(ii) Genotype and Phenotype

(iii) Character and Trait

(iv) Dominant and Recessive Allele

(v) Autosomes and Sex chromosomes

Answer

(i) Difference between Monohybrid and Dihybrid cross:

Monohybrid Cross	**Dihybrid cross**
Single feature is taken into consideration	Two features are taken into consideration.
Phenotypic ratio in second generation is 3:1	Phenotypic ratio in second generation is 9:3:3:1
Genotypic ratio is 1:2:1	Genotypic ratio obtained is very complex

(ii) Difference between Genotype and Phenotype:

Genotype	**Phenotype**
Set of genes present in any organism is known as its genotype.	Characters expressed or physical appearance of characters is called phenotype.
Can be determined by genotyping method.	Can be determined by observation.
It is formed by expressed and unexpressed genes.	It consists of only expressed genes.

(iii) Difference between Character and Trait:

Character	**Trait**
Any inheritable feature of an organism is a character.	The alternative forms of a character are called traits.

Character	Trait
For example, flower colour is a character.	For example, within the character of flower colour, specific traits will be red, blue, or white flower colour.

(iv) Difference between Dominant and Recessive Allele:

Dominant Allele	Recessive Allele
The gene that expresses itself phenotypically.	The gene that remains unexpressed in presence of dominant allele.
Expresses in homozygous as well as heterozygous condition.	Expresses only in homozygous condition.
Represented by capital letters.	Represented by small letters.

(v) Difference between Autosomes and Sex chromosomes:

Autosomes	Sex chromosomes
Autosomes are chromosomes that determine the general body features.	Sex chromosomes determine the sex of an organism.
Humans have 22 pairs of autosomes.	Humans have 1 pair sex chromosomes.

Question 4. Write two characters of pea pod with their alternative traits.

Answer

Two characters of pea pod with their alternative traits are :

S. No.	Character	Alternative trait
1.	Pod colour	Green and Yellow
2.	Pod shape	Inflated and Constricted

Multiple Choice Type

Question 1. Which one of the following is the phenotypic monohybrid ratio in F_2 generation?

1. 3 : 1
2. 1 : 2 : 1
3. 2 : 2
4. 1 : 3

Answer

3 : 1

Reason — The phenotypic monohybrid ratio in F_2 generation is 3:1 because 3 of the offsprings have dominant allele and one is homozygous recessive.

Question 2. If a pure tall plant is crossed with a pure dwarf plant, then offspring will be

1. all tall
2. all dwarf
3. 3 tall 1 dwarf
4. 50% tall 50% dwarf

Answer

all tall

Reason — Tallness is a dominant character which will be expressed in heterozygous condition.

Question 3. The 9 : 3 : 3 : 1 dihybrid ratio is due to

1. segregation
2. crossing over
3. independent assortment
4. homologous pairing

Answer

independent assortment

Reason — The 9 : 3 : 3 : 1 dihybrid ratio is due to independent assortment as the allele of one character is independent of other.

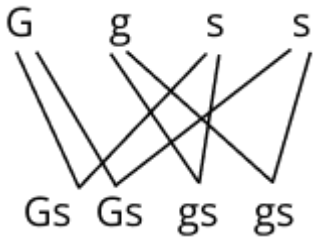
Question 4. A plant with green pods and smooth seeds with genotype Ggss will give rise to the following gametes:

1. Gg and Ss
2. Gs and ss
3. Gs and gs
4. Gg and gs

Answer

Gs and gs

Reason — Only two types of gametes are possible i.e. Gs and gs, as gene 's' is in homozygous condition. This is in accordance to the law of independent assortment.



Question 5. The disease colour blindness is a :

1. Recessive X-linked disease
2. Dominant Y-linked disease
3. Recessive Y-linked disease
4. Dominant X-linked disease

Answer

Recessive X-linked disease

Reason — The disease colour blindness is due to recessive gene that occurs on the X-chromosome.

Question 6. The physical expression of a character is called :

1. Genotype
2. Alleles
3. Phenotype
4. Traits

Answer

Phenotype

Reason — Phenotype are the observable characteristics that are genetically controlled.

Question 7. Purity of gametes is linked to :

1. Law of dominance
2. Law of independent assortment
3. Law of segregation
4. Law of limiting factor

Answer

Law of segregation

Reason — Two alleles of a character are independent and separate during formation of gametes. They do not mix with each other or lose their identity.

Question 8. The phenotypic dihybrid ratio of F_2 generation is

1. 9:3:1:1
2. 9:1:3:1
3. 9:1:3:3
4. 9:3:3:1

Answer

9:3:3:1

Reason — The phenotypic dihybrid ratio of F_2 generation is 9:3:3:1 due to the law of independent assortment.

Question 9. In the human male, a sperm contains autosomes and :

1. X and Y chromosomes
2. Only X chromosome
3. X or Y chromosome
4. Only Y chromosome

Answer

X or Y chromosome

Reason — In the human male, a sperm contains autosomes and either an X chromosome or a Y chromosome.

Question 10. If the mother is normal and the father is haemophilic, then their two daughters will be :

1. Normal
2. Haemophilic
3. Carrier
4. None

Answer

Carrier

Reason — Since mother is normal, one of the X chromosome in daughters will be normal. Hence they will be carrier due to X chromosome received from father.

Question 11. Susheel, a colourblind man, is married to Susheela, a woman with normal vision. Which of the following combinations would be possible in their children?

1. Colourblind daughters and colourblind sons
2. Normal daughters and normal sons
3. Carrier daughters and normal sons
4. Carrier daughters and colourblind sons

Answer

Carrier daughters and normal sons

Reason — Since the mother is normal so the daughters will be carrier due to the X chromosome received from father but sons will be normal.

	Colour-blind father (X°Y)	
	X°	**Y**
Normal Mother (XX)	XX° Carrier daughter	XY Normal son

	XX° Carrier daughter	XY Normal son

Assertion Reason type

Question 12

Assertion. Heredity is the basic fundamental unit of Genetics.

Reason. Genes carry hereditary information from the offsprings to their parents.

1. Both A and R are True.
2. Both A and R are False.
3. A is True and R is False.
4. A is False and R is True.

Answer

A is True and R is False.

Explanation
Genes do not carry hereditary information from offspring to parents. Instead, genes are the carriers of hereditary information from parents to offspring.

Question 13

Assertion. Karyotype is the division of nucleus during cell-division.

Reason. Karyon means nucleus and type explains the number, shape and size of the chromosome.

1. Both A and R are True.
2. Both A and R are False.
3. A is True and R is False.
4. A is False and R is True.

Answer

A is False and R is True.

Explanation
Karyokinesis is the division of nucleus during cell-division. Karyotype is a picture showing all chromosome pairs arranged according to their size and shape.

Question 14

Assertion. Dominant alleles can express themselves only in homozygous condition.

Reason. Dominant alleles support recessive alleles and allow them to express, even in heterozygous condition.

1. Both A and R are True.
2. Both A and R are False.
3. A is True and R is False.
4. A is False and R is True.

Answer

Both A and R are False.

Explanation
Dominant alleles can express themselves in homozygous as well as in heterozygous condition. Dominant alleles suppress recessive alleles and do not allow them to express in heterozygous condition.

Question 15

Assertion. Genotype is the genetic make up of a cell.

Reason. Phenotype is the set of genes present in the cells of an organism that expresses internal characters.

1. Both A and R are True.
2. Both A and R are False.
3. A is True and R is False.
4. A is False and R is True.

Answer

A is True and R is False.

Explanation
The phenotype refers to the observable characteristics or traits of an organism.

Question 16

Assertion. A daughter can resemble only her mother and not her father.

Reason. Sex chromosomes of the daughter (XX) are received from both the parents.

1. Both A and R are True.
2. Both A and R are False.
3. A is True and R is False.
4. A is False and R is True.

Answer

A is False and R is True.

Explanation
A daughter can resemble her mother as well as her father because she receives genes from both the parents.

Very Short Answer Type

Question 1. Match the terms in column I with their the explanations in column II.

Column I (Term)	**Column II (Explanation)**
a. Genetics	(i) Chromosomes similar in size and shape
b. Autosomes	(ii) The alternative forms of a gene
c. Recessive gene	(iii) Study of laws of inheritance of characters
d. Allele	(iv) A gene that can express only when in a similar pair
e. Homologous chromosomes	(v) Chromosomes other than the pair of sex chromosomes

Answer

Column I (Term)	**Column II (Explanation)**
a. Genetics	(iii) Study of laws of inheritance of characters
b. Autosomes	(v) Chromosomes other than the pair of sex chromosomes
c. Recessive gene	(iv) A gene that can express only when in a similar pair
d. Allele	(ii) The alternative forms of a gene
e. Homologous chromosomes	(i) Chromosomes similar in size and shape

Question 2. Name any two genetic diseases in humans.

Answer

Colour blindness and Haemophilia are two genetic diseases in humans.

Question 3. Which one of the following genotypes is homozygous dominant and which one homozygous recessive in regard to tongue rolling:
Rr, rr, RR?

Answer

Homozygous recessive – rr
Homozygous dominant - RR

Short Answer Type

Question 1. Rewrite the correct form of the statement by changing the first or the last word only:

(a) Duplicated chromosomes remain attached at a point termed as centrosome.

(b) The full complement of DNA of an organism is termed as genetics.

(c) The inheritable feature of an organism is termed as heredity.

(d) Terminal flower position is a dominant trait of pea flower.

(e) Alternative forms of a gene are called traits.

Answer

(a) Duplicated chromosomes remain attached at a point termed as ***centromere***.

(b) The full complement of DNA of an organism is termed as ***Genome***.

(c) The inheritable feature of an organism is termed as ***character***.

(d) ***Axillary*** flower position is a dominant trait of pea flower.

(e) Alternative forms of a gene are called ***Allele***.

Question 2. Among lion, tiger and domestic cat, all the three have the same number of 38 chromosomes, yet they have different appearances. How do you account for such differences?

Answer

All species have a fixed number of chromosomes. However, the characteristics of species including physical appearance, body functions, behavior, etc. are not simply the outcome of chromosome number, but these are the result of the units called genes which the chromosomes carry. The lion and the cat have the same number of chromosomes (38). Yet one is distinct from the other in body size, appearance, colour, behavior, etc. All such characteristics of an organism are the result of the genes located on the chromosomes.

Question 3. List any three features of garden pea with their dominant and recessive traits.

Answer

Character	Dominant trait	Recessive trait
Flower Colour	Purple	White
Seed Colour	Yellow	Green
Seed Shape	Round	Wrinkled
Pod Shape	Inflated	Constricted
Flower Position	Axial	Terminal

Question 4

Explain why generally only the male child suffers from colour blindness and not the female?

Answer

Colour blindness is caused due to recessive genes, which occur on the 'x' chromosomes. Males have only one X chromosome. If there is recessive gene present on X chromosome, then the male will suffer from colour-blindness. Females have two X chromosomes. It is highly impossible that both the X chromosomes carry abnormal gene. Hence, if one gene is abnormal and since it is recessive, its expression will be masked by the normal gene present on the other X chromosome. Due to this reason, females are unlikely to suffer from colour-blindness.

Descriptive Type

Question 1

Define the following terms:

(a) Pedigree chart

(b) Variations

(c) Mutation

Answer

(a) **Pedigree chart** — A pedigree chart is a diagram that shows the occurrence and appearance or phenotypes of a particular gene or organism and its ancestors from one generation to the next. In the pedigree chart, males are shown by squares and females by circles.

(b) **Variations** — The small differences among the individuals of the same species are called variations.

(c) **Mutation** — Mutation is a sudden change in one or more genes, or in the number or in the structure of chromosomes. Mutation alters the hereditary material of an organism's cells and results in a change in certain characters or traits for example :

1. Sickle cell anaemia
2. Radioactive radiations

Question 2. State the three Mendel's laws of inheritance.

Answer

Mendel's law of inheritance are as follows —

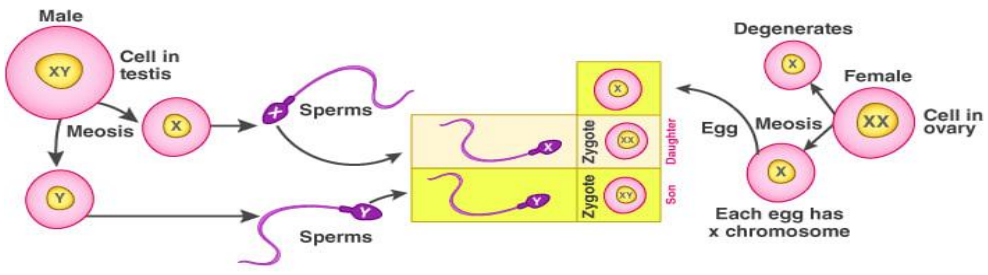
1. **Law of Dominance** — Out of a pair of contrasting characters present together, only one is able to express itself while the other remains suppressed. The one that expresses is the **dominant** character and the one that is unexpressed is the **recessive** one.
2. **Law of Segregation** (also called the law of purity of gametes) — The two members of a pair of factors separate during the formation of gametes. They do not blend but segregate or separate into different gametes. The gametes combine together by random fusion at the time of zygote formation.
3. **Law of Independent Assortment** — When there are two pairs of contrasting characters, the distribution of the members of one pair into the gametes is independent of the distribution of the other pair.

Question 3. Does the sex of the child depend on the father or is it just a matter of chance? Discuss.

Answer

The sex of the child depends upon the kind of sperm that fertilises the egg. The egg contains only one X chromosome, but half of the sperms released into the genital tract of the female during coitus are X-bearing and the remaining half are Y-bearing. It is simply a matter of chance as to which category of sperm fuses with the ovum:

- If the egg (X) is fused by X-bearing sperm, the resulting combination is XX i.e. female constitution and the child produced is a female (Daughter).
- If the egg (X) is fused by Y-bearing sperm, the resulting combination is XY i.e. male constitution and the child produced is a male (Son).



Question 4

Distinguish between the following pairs:

(a) Karyotype and Karyokinesis

(b) Autosomes and Sex chromosomes

(c) Homozygous and Heterozygous chromosomes

Answer

(a) Difference between karyotype and karyokinesis —

Karyotype	**Karyokinesis**
The complete set of chromosomes in the cells of an organism is its karyotype.	The division of the nucleus during mitosis is called karyokinesis.

(b) Difference between autosomes and sex chromosomes

Autosomes	**Sex chromosomes**
They determine the somatic traits.	They determine the sex of an organism.
They are numbered as 1 to 22.	They are recognized by the letters XO, XY, ZO, ZW.
They show Mendelian inheritance.	They do not show Mendelian inheritance.
Human show 22 pairs of autosomes.	Humans show only 1 pair of sex chromosome.

(c) Difference between homozygous and heterozygous chromosomes

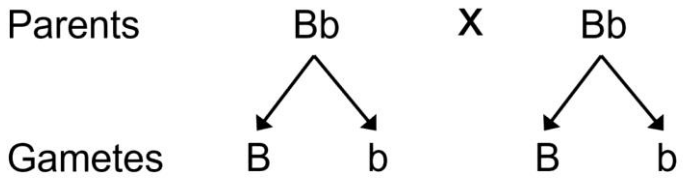
Homozygous chromosomes	**Heterozygous chromosomes**
It has two same copies of the same allele coding for a particular trait.	It contains two different copies of alleles coding for a particular trait.

Structured / Application / Skill Type

Question 1

In a certain species of animals, black fur (B) is dominant over brown fur (b). Predict the genotype and phenotype of the offspring, when both parents are 'Bb' or have heterozygous black fur.

Answer



	B	b
B	BB	Bb
b	Bb	bb

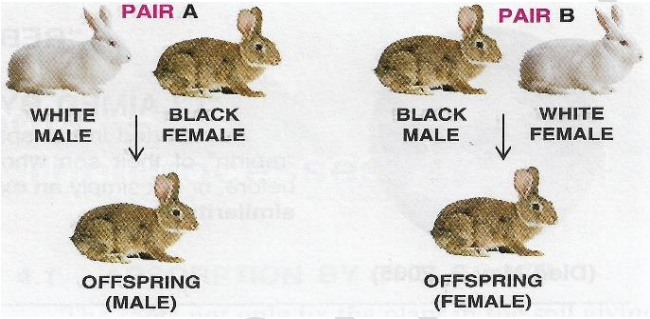
In the question it is given that B refers to black fur and b refers to brown fur. So the genotype and phenotype of the offspring will be:

Genotype — 1 (Homozygous Black Fur) : 2 (Heterozygous Black Fur) : 1 (Homozygous Brown Fur)

Phenotype — 3 (Black Fur): 1 (Brown Fur)

Question 2

Two pairs (A and B) of rabbits were crossed as given below:



(a) Can you tell which coat colour (black or white) is dominant?

(b) Is the coat colour sex-linked?

Answer

(a) Black

(b) No

Question 3

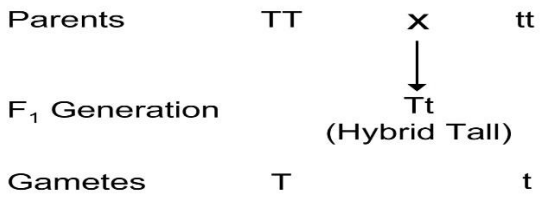
Make a Punnett square and find out the genotypic and phenotypic ratios of F_1 and F_2 generations in the progeny of a genetic cross between:

(a) A pure tall (TT) pea plant with a pure dwarf (tt) pea plant.

(b) Red flower variety of pea (RR) with white flower variety of pea (rr).

Answer

(a) A pure tall (TT) pea plant with a pure dwarf (tt) pea plant:



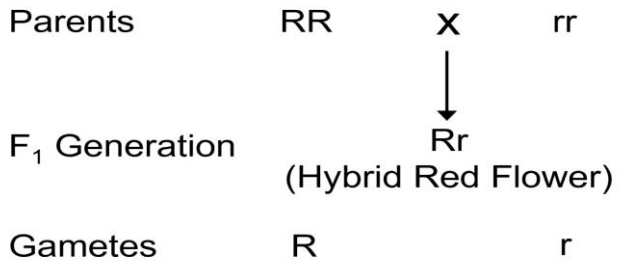
F_2 Generation:

Gametes	**T**	**t**
T	TT	Tt
t	Tt	tt

Genotype - 1 (Homozygous tall) : 2 (Heterozygous tall) : 1 (Homozygous dwarf)

Phenotype - 3 (Tall) : 1 (Dwarf)

(b) Red flower variety of pea (RR) with white flower variety of pea (rr):



F_2 Generation:

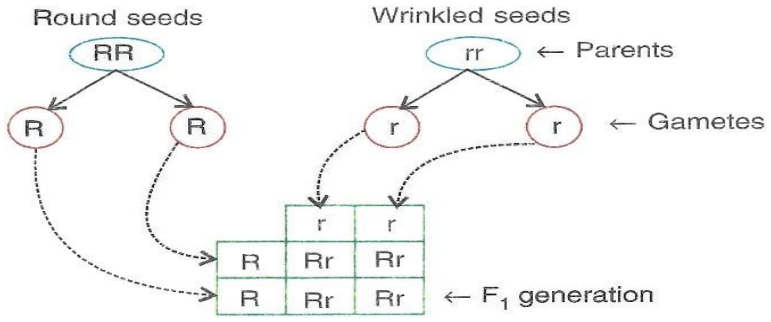
Gametes	**R**	**r**
R	RR	Rr
r	Rr	rr

Genotype — 1 (Homozygous red) : 2 (Heterozygous red) : 1 (Homozygous white)

Phenotype — 3 (Red) : 1 (White)

Question 4

Mendel crossed a homozygous pea plant having round seeds (RR) with a homozygous pea plant having wrinkled seeds (rr). He got different results. On the basis of it, answer the following questions:



(a) Which character of seed is studied in the experiment?

(b) Which of the above two traits is dominant ?

(c) Write the phenotype and genotype of F_1 offspring.

(d) Mention and state the Mendel's law shown in the above cross.

(e) Make a Punnett square for F_2 generation when two plants of F_1 offspring are crossed with each other.

(f) Write the phenotypic ratio of F_2 progeny.

(g) What will be the genotypic ratio of F_2 offsprings ?

(h) What are the two traits of seed colour ? Also mention which is dominant and recessive ?

(i) Write the scientific name of garden pea.

(j) Write two main features of pea plant due to which Mendel had selected it for his hybridisation studies.

Answer

(a) Shape of seed

(b) Round seed shape is dominant.

(c) Phenotype — Round seed
Genotype — Rr

(d) Law of dominance, which states that out of a pair of contrasting characters present together, only one is able to express itself while the other remains suppressed.

(e)

Gamete	R	r
R	RR	Rr
r	Rr	rr

(f) Phenotypic ratio — 3:1

(g) Genotypic ratio — 1:2:1

(h) The two traits of seed colour are:

1. Yellow (dominant)
2. Green (recessive)

(i) *Pisum sativum*

(j) The two main features due to which Mendel selected pea plants are :

1. Many varieties were available in alternative forms of a character.
2. The life span of pea plants is short and many generations can be obtained and studied in less time.

Question 5

A homozygous plant having round (R) and yellow (Y) seed is crossed with another homozygous plant having wrinkled (r) and green (y) seeds. Answer the following questions :

(a) Give the genotype of the F_1 generation.

(b) Mention the phenotype of the F_1 offsprings.

(c) Give the possible combinations of gametes that can be obtained from F_1 hybrids.

(d) Give the dihybrid phenotypic ratio and the phenotype of the offsprings of the F_2 generation when two plants of F_1 generation are crossed.

(e) Name and state the law which explains the dihybrid phenotypic ratio.

Answer

(a) Genotype : RrYy

(b) All Round and yellow seeds

(c) RY, Ry, rY, ry

(d) 9:3:3:1

(e) Law of Independent Assortment, which states that the distribution of the alleles of one character into the gametes is independent of the distribution of the alleles of the other character.