

Chapter – 9 Heredity and Evolution

Multiple Choice Question

Q1. Exchange of genetic material takes place in

- a) Vegetative reproduction
- b) Asexual reproduction
- c) Sexual reproduction
- d) Budding

Answer: Option c)

Exchange of genetic material takes place in sexual reproduction in which the genes of two parents are involved.

Q2. Two pink coloured flowers on crossing resulted in 1 red, 2 pink and 1 white flower progeny. The nature of the cross will be

- a) Double fertilisation
- b) Self-pollination
- c) Cross pollination
- d) No fertilisation

Answer: Option c)

Fertilising a plant using pollen from another plant of the same species is cross-fertilisation.

Q3. A cross between a tall plant (TT) and short pea plant (tt) resulted in progeny that were all tall plants because

- a) Tallness is the dominant trait
- b) Shortness is the dominant trait
- c) Tallness is the recessive trait
- d) Height of pea plant is not governed by gene 'T' or 't'

Answer: Option a)

In F_1 generation, the cross between TT and tt will result into all tall plant, hence, tallness is the dominant trait. When two traits of a character are crossed the F_1 plant show only one of the traits, which is dominant trait and other trait that does not express itself in F_1 generation is recessive trait.

Q4. Which of the following statement is incorrect?

- a) For every hormone there is a gene
- b) For every protein there is a gene
- c) For production of every enzyme there is a gene
- d) For every molecule of fat there is a gene

Answer: Option d)

The fat molecules are not related to genes. The genes contain information for making proteins in a cell. The proteins synthesised may be enzymes that catalyse biochemical reactions. The enzymes control the process of making hormones.

Q5. If a round, green seeded pea plant (RR yy) is crossed with wrinkled, yellow seeded pea plant, (rr YY) the seeds production in F_1 generation are

- a) Round and yellow
- b) Round and green
- c) Wrinkled and green
- d) Wrinkled and yellow

Answer: Option a)

The cross between $RRyy$ and $rrYY$ seeds will produce $RrYy$ (round and yellow) seeds in F_1 generation because round and yellow are dominant traits.

Q6. In human males all the chromosomes are paired perfectly except one. This/these unpaired chromosomes is/are

- i) Large chromosome
- ii) Small chromosome
- iii) Y-chromosome
- iv) X-chromosome

- a) i) and ii)
- b) iii) only
- c) iii) and iv)
- d) ii) and iv)

Answer: Option c)

In human males, one pair called sex chromosomes are unpaired. One is normal sized X-chromosome while other is short Y-chromosome. Women have a perfect pair of sex chromosomes, called X.

Q7. The maleness of a child is determined by

- a) the X-chromosome in the zygote
- b) the Y-chromosome in zygote
- c) the cytoplasm of germ cell which determines the sex
- d) sex is determined by chance

Answer: Option b)

The maleness of a child is by the Y-chromosome in zygote inherited from the father. If X-chromosome is from the father, the zygote develops into girl.

Q8. A zygote which has an X-chromosome inherited from the father will develop into a

- a) boy
- b) girl
- c) X-chromosome does not determine the sex of a child
- d) Either boy a girl

Answer: Option b)

A zygote that has an X-chromosome inherited from father develop into a girl. All children whether boy or girl inherit an X-chromosome from their mother. Hence, sex is determined by what they inherit from their father. A child who inherits X-chromosome from her father will be a girl, and one who inherits Y-chromosome from him will be a boy.

Q9. Select the incorrect statement

- a) Frequency of certain genes in a population change over several generations resulting in evolution.
- b) Reduction in weight of the organism due to starvation is genetically controlled.
- c) Low weight parents can have weight progeny.
- d) Traits which are not inherited over generations do not cause evolution.

Answer: Option b)

The loss in weight due to starvation do not change the DNA of the germ cells, because low weight is not a trait, genetically controlled or inherited. Hence, low weight parents have heavy weight progeny.

Q10. New species may be found if

- i) DNA undergoes significant changes in germ cells.
- ii) Chromosome number changes in the gamete.
- iii) There is no change in the genetic material.

- iv) Mating does not take place.
- a) i) and ii)
 - b) i) and iii)
 - c) ii), iii) and iv)
 - d) i), ii) and iii)

Answer: Option a)

New species may be formed if the DNA changes are severe enough, such as a change in the number of chromosomes. This leads to new variations.

Q11. Two pea plants one with round seeds ($RRyy$) and another with wrinkled yellow ($rrYY$) seeds produce F_1 progeny that have round, yellow ($RrYy$) seeds. When F_1 plants are selfed, the F_2 progeny will have new combination of characters. Choose the new combination from the following.

- i) Round, yellow
- ii) Round, green
- iii) Wrinkled, yellow
- iv) Wrinkled, green

- a) i) and ii)
- b) i) and iv)
- c) ii) and iii)
- d) i) and iii)

Answer: Option b)

The new combination in F_2 progeny will be round yellow and wrinkled green.

The phenotypic ratio of 9:3:3:1 is obtained.

Round Yellow: Round green: Wrinkled yellow: Wrinkled green = 9:3:3:1

Q12. A basket of vegetables contains carrot, potato, radish and tomato. Which of them represent the correct homologous structures?

- a) Carrot and potato
- b) Carrot and tomato
- c) Radish and carrot
- d) Radish and potato

Answer: Option c)

Radish and carrot present homologous structures because they have the same structure through, they are different species.

Q13. Select the correct statement

- a) Tendril of a pea plant and phylloclade of Opuntia are homologous
- b) Tendril of a pea plant and phylloclade of Opuntia are analogous
- c) Wings of birds and limbs of lizards are analogous
- d) Wings of bird and wings of bat are homologous

Answer: Option d)

Wings of birds and wings of bat are homologous, since they have the same basic design but the origin is different.

Q14. If the fossil of an organism is found in the deeper layers of earth, then we can predict that

- a) The extinction of organism has occurred recently
- b) The extinction of organism has occurred thousands of years ago
- c) The fossil position in the layer of earth is not related to its time of extinction
- d) Time of extinction cannot be determined

Answer: Option b)

Fossils are remains of organisms, lived in the past and preserved in the rocks. When fossil of an organism is found in the deeper layers of earth it shows extinction of organism thousands of years ago.

Q15. Which of the following statements is not true with respect to variation?

- a) All variation in a species have equal chance of survival
- b) Change in genetic composition results in variation
- c) Selection of variants by environmental factors forms the basis of evolutionary processes
- d) Variation is minimum in asexual reproduction

Answer: Option a)

All the variations in a species do not have equal chances of survival. The variations are selected by environmental factors, which leads to evolution and speciation.

Q16. A trait in an organism is influenced by

- a) Paternal DNA only

- b) Maternal DNA only
- c) Both maternal and paternal DNA
- d) Neither by paternal nor by maternal DNA

Answer: Option c)

A trait of an organism is influenced by maternal and paternal DNA. It is passed from one generation to other through genes found on the chromosomes.

Q17. Select the group which shares maximum number of common characters

- a) Two individuals of a species
- b) Two species of a genus
- c) Two genera of a family
- d) Two genera of two families

Answer: Option a)

Two individuals of a species share common characters. A species is a population of organisms of same individuals which breed and produce fertile offspring.

Q18. According to the evolutionary theory, formation of a new species is generally due to

- a) Sudden creation by nature
- b) Accumulation of variations over several generations
- c) Clones formed during asexual reproduction
- d) Movement of individuals from one habitat to another

Answer: Option b)

Accumulation of variations in several generations forms new species. Genetic drift accumulates changes in sub-populations of a species.

Q19. From the list given below, select the character which can be acquired but not inherited

- a) Colour of eye
- b) Colour of skin
- c) Size of body
- d) Nature of hair

Answer: Option c)

The size of the body is a trait because change on the availability of less or more food.

Q20. The two versions of a trait (character) which are brought in by the male and female gametes are situated on

- a) Copies of the same chromosome
- b) Two different chromosomes
- c) Sex chromosomes
- d) Any chromosome

Answer: Option a)

Two versions of a trait are situated on copies of same chromosome. Each parent contributes one copy of the gene for a particular character. Sex chromosomes carry genes for sexual characters.

Q21. Select the statements that describe characteristics of gene

- i) Genes are specific sequence of bases in a DNA molecule
 - ii) A gene does not code for proteins
 - iii) In individuals of a given species, a specific gene is located on a particular chromosome
 - iv) Each chromosome has only one gene
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- a) i) and ii)
 - b) i) and iii)
 - c) i) and iv)
 - d) iii) and iv)

Answer: Option b)

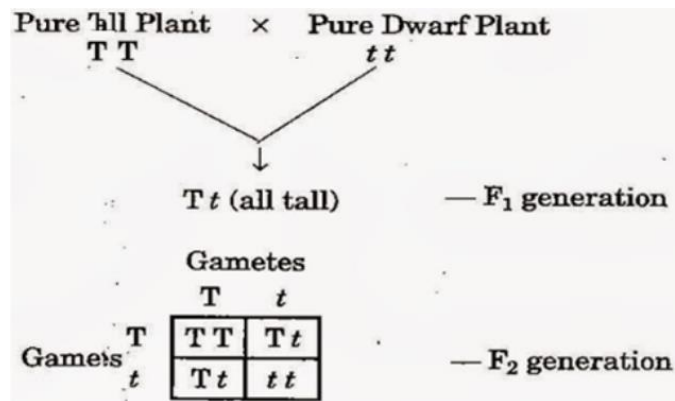
Gene are stretches of DNA found on chromosomes of a cell. A gene consists information for making protein in a cell. A specific gene is on a particular chromosome in individuals of a species.

Q22. In peas, a pure tall plant (TT) is crossed with a short plant (tt). The ratio of pure tall plants to short plants in F_2 is

- a) 1:3
- b) 3:1
- c) 1:1
- d) 2:1

Answer: Option b)

In F_2 generation, the phenotypic ratio is 3:1, in a monohybrid cross.



So, the generation phenotypic ratio = 3:1

Genotypic ratio = 1:2:1

Q23. The number of pair(s) of sex chromosomes in the zygote of humans is

- a) One
- b) Two
- c) Three
- d) Four

Answer: Option a)

The number of sex chromosomes in the zygote of humans is one pair. It is not always a perfect pair. In females, its perfect two X-chromosomes. In males, there is one X-chromosome and one Y-chromosome.

Q24. The theory of evolution of species by natural selection was given by

- a) Mendel
- b) Darwin
- c) Morgan
- d) Lamarck

Answer: Option b)

The theory of evolution of species by natural selection was given by Charles Darwin.

Q25. Some dinosaurs have feathers although they could not fly but birds have feathers that help them to fly. In the context of evolution this means that

- a) Reptiles have evolved from birds
- b) There is no evolutionary connection between reptiles and birds
- c) Feathers are homologous structures in both the organisms
- d) Birds have evolved from reptiles

Answer: Option d)

The use of feathers by birds for flying means they have evolved from reptiles. Dinosaurs had feathers but they could not fly using them. Dinosaurs were reptiles which means that birds have evolved from them.

Short Answer Type Questions

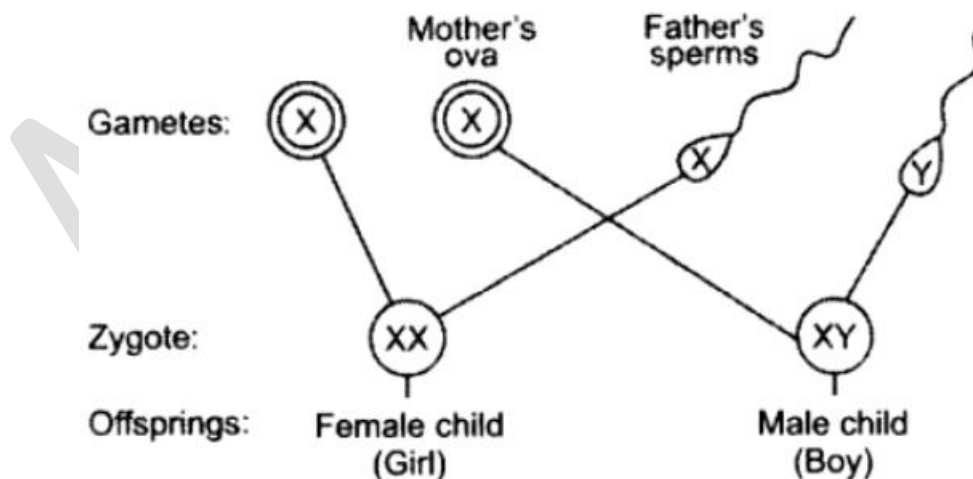
Q26. How is the sex of a new born determined humans?

Answer:

The sex of an individual is genetically determined, that is, the genes inherited from parents decide whether it will be a boy or a girl. Most of the chromosomes have a maternal and a paternal copy, and we have 22 such pairs. One pair is called as sex chromosomes, is odd and not always a perfect pair.

Women have a perfect pair of chromosomes, both called as X, man have mismatched pair in which one a normal-sized X while the other is a short one called Y. Hence, women are XX and men are XY.

The sex of the children is determined by inheritance from their father. A child who inherits an X-chromosome from her father is a girl, one who inherits a Y-chromosome from him is a boy.



Sex determination in Human Beings

Q27. Do genetic combination of mothers play a significant role in determining the sex of a new born?

Answer:

The mothers have a pair of X-chromosomes. Hence, they do not play an important role in determining the sex of a new born. All children will inherit an X-chromosome from their mother regardless whether they are boys or girls. Hence, sex is always determined by the other sex chromosome that they inherit from the father.

Q28. Mention three important features of fossils which help in the study of evolution.

Answer:

Important features of fossils are:

- i) Fossils signifies mode of preservation of ancient species.
- ii) Fossils help in forming evolutionary relationship between organisms and their ancestors.
- iii) Fossils help in forming the time period in which organisms lived.

Q29. Why do all the gametes formed in human females have an X-chromosome?

Answer:

Human females have two X-chromosomes called sex chromosome. During meiosis of gamete formation, one X-chromosome enters each gamete which formed in human females has X-chromosome.

Q30. In human beings, the statistical probability of getting wither a male or female child is 50:50. Give a suitable explanation.

Answer:

The sex is determined by the type of sex chromosome by the male gamete. A male produces 2 types of sperms – one type bears 22 + X composition and the other, 22 + Y.

Hence, a male have 50% sperms with X-chromosome and other 50% with Y-chromosome.

Any of sperms can fertilise the egg. If a Y- sperm fertilise the egg, the zygote is XY (male) and when an X- sperm fertilise the egg, the resulting zygote is XX (female). Since the ratio of X-chromosome and Y-chromosome in male gamete is 50:50. The statistical probability of male or a female infant is 50:50.

Q31. A very small population of a species faces a greater threat of extinction than a large population. Provide a suitable genetic explanation.

Answer:

Few individuals of a species in a population face reproductive isolation and impose extensive inbreeding among them, due to which no exchange of genes take place. So, variations is limited and the species is at disadvantage. If there is any change in environment, the individuals fail to cope up with the environmental changes, and thus face a greater threat of extinction.

Q32. What are homologous structures? Give an example. Is it necessary that homologous structures always have a common ancestor?

Answer:

Structures which have same basic structure but perform different functions are called homologous structures, e.g., forelimbs of reptiles, amphibians, bird and mammals.

Yes, the homologous structures are inherited from a common ancestor. The basic structure of limbs is similar though it has been modified to perform different functions in various vertebrates. Hence, it shows they have evolved from a common ancestor.

Q33. Does the occurrence of diversity of animals on earth suggest their diverse ancestry also? Discuss this point in the light of evolution.

Answer:

Since animals shows a vast diversity in their structures, they have diverse ancestry, as common ancestry greatly limit the extent of diversity, e.g., all birds are closely related, they have common ancestors but birds and reptiles are also related.

A small group of species has recent common ancestors, then super-groups with more distant common ancestors, and so on. Many diverse animals are inhabiting the same habitat, their evolution by geographical isolation and speciation is also not likely to occur. Hence, occurrence of diversity of animals on earth suggest diverse ancestry.

Q34. Give the pair of contrasting traits of the following characters in pea plant and mention which is dominant and recessive

- i) **Yellow seed**
- ii) **Rounds seed**

Answer:

- i) **Yellow: dominant**

- ii) Green: Recessive
Round: Dominant
Wrinkled: Recessive

Q35. Why did Mendel choose pea plant for his experiments?

Answer:

Pea plants are self-pollinating, it means that it enables them to produce next generation of plants easily.

Pea plants were easy to cultivate and had short life span.

They had sharply defined contrasting traits such as height, seed colour etc.

Q36. A woman has only daughters. Analyse the situation genetically and provide a suitable explanation.

Answer:

The sex of a child depends on the type of male gamete as the man produces sperms with either X or Y – chromosome. If a sperm carrying X-chromosome fertilises the ovum, then the child born will be girl, since the child will have XX pair of sex chromosome. A woman has only daughters. This indicates that in every fusion, the sperm carrying X-chromosome fertilised the ovum.

Long Answer Type Questions

Q37. Does geographical isolation of individuals of a species lead to formation of a new species? Provide a suitable explanation.

Answer:

Yes, geographical isolation of individuals of a species helps in formation of a new species. The population of same species splitting into two separate groups and getting isolated from each other geographically by various barriers as sea, mountain etc.

Geographical isolation of the two groups shows reproductive isolation, hence there will be no genes are exchanged between them. But breeding continues within the isolated populations producing more generations.

Over generations, the genetic drift and natural selection is operated in the isolated group and make them more different from other.

After many years, the individuals of isolated groups is so different that they are incapable of reproducing with each other and new species will originate evolved.

Q38. Bacteria have a simpler body plan when compared with human beings. Does it mean that human beings are more evolved than bacteria? Provide a suitable explanation.

Answer:

Evolution is generation of diversity and the shaping of the diversity by environmental selection. New generated species are better than older one. Natural selection and genetic drift led to the formation of a population that cannot reproduce with the original one.

Evolution is more complex body design which have emerged over the time. Human beings are not crest of evolution but simply another species in the abundant spectrum of evolving life.

Q39. All the human races like Africans, Asians, Europeans, Americans and others might have evolved from a common ancestor. Provide a few evidences in support of this view.

Answer:

There is no such biological basis on which we can differentiate the human races. Since, all humans belong to same species, have a common body structure, metabolism, have a contrast chromosome number, that is, 46. Also, their genetics are also similar, 99.9% DNA is also same in humans. The study of the evolution human shows that we all come from Africa. Home sapiens can be traced there.

All these evidences shows that all of us whether Africans, Asian Europeans or Americans etc, have evolved from a common ancestor.

Q40. Differentiate between inherited and acquired characters. Give one example for each type.

Answer:

Inherited characters	Acquired characters
Characters transfered from parents to offspring are inherited characters.	Characters that are not transferred from parents to offspring and develops in response to the environment are acquired characters.
They cause changes in the reproductive cells of an organism.	They do not cause changes in the reproductive cells of an organism.
Example: eye colour, seed colour.	Example: obese body, loss of finger in

	an accident.
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Q41. Give reason why acquired character are not inherited.

Answer:

Acquired characters do not produce change in the genes of germ cells, so cannot be inherited.

Example; it tails of mice are cut in first generation, and then breeding is done, the new mice born will have full tails. The cut of mice is an acquired trait which is never passed on to their progeny, as cutting of mice tails does not change the genes of their reproductive cells.

Q42. Evolution has exhibited a greater stability of molecular structure when compared with morphological structure. Comment on the statement and justify your opinion.

Answer:

Progression of evolution is a more complex in body designs, which is emerged, example; immense diversity and increasing complexity in body size form and structure from non-chordates to chordates.

But at the molecular level, these diverse types of organisms show similarity, like chemical composition of DNA is same in all living organisms except for differences in the order of nitrogenous bases. Other biomolecules like RNA, proteins, etc also show similarity in all organisms.

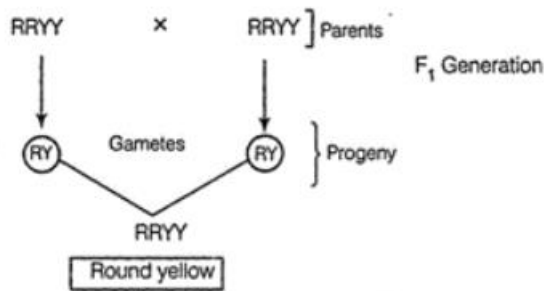
Hence, evolution show greater stability of molecular structure than morphological structures.

Q43. In the following crosses write the characteristics of the progeny

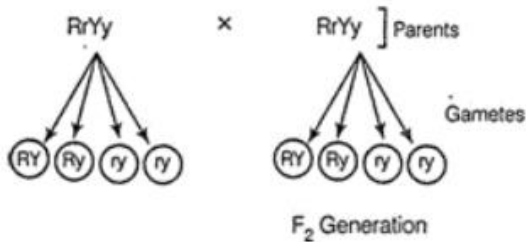
Cross	Progeny
(a) RR YY x RR YY Round, yellow Round, yellow
(b) Rr Yy x Rr Yy Round, yellow Round, yellow
(c) rr yy x rr yy wrinkled, green wrinkled, green
(d) RR YY x rr yy Round, yellow wrinkled green

Answer:

a)



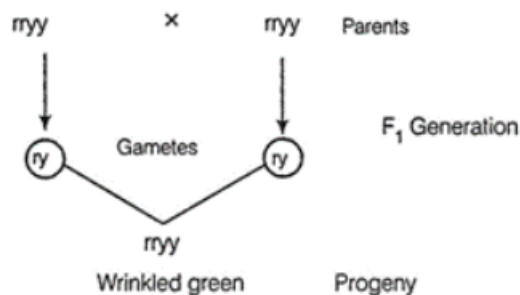
b)



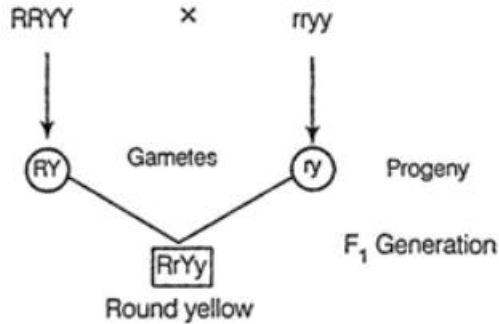
Gametes	Ry	Ry	rY	ry
RY	RRYY Round Yellow	RRYy Round Yellow	RrYY Round Yellow	RrYy Round Yellow
Ry	RRYy Round Yellow	RRyy Round Yellow	RrYy Round Yellow	Rryy Round green
rY	RrYY Round Yellow	RrYy Round Yellow	rrYY wrinkled Yellow	rrYy wrinkled yellow
ry	RryY Round Yellow	Rryy Round green	rrYy wrinkled Yellow	Rryy wrinkled green

Progeny – Round yellow: Round green: Wrinkled yellow: Wrinkled green = 9:3:3:1

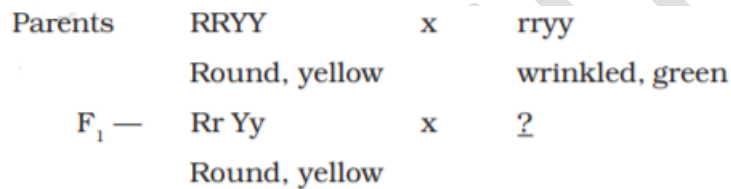
c)



d)



Q44. Study the following cross showing self-pollination in F_1 . Fill in the blank.



Answer:

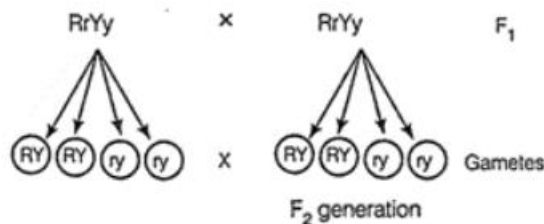
Self-cross in F_1 shows characters in the F_1 generation, that is,



Q45. In Question 44, what are the combination of characters in the F_2 progeny? What are their ratios?

Answer:

When F_1 generation dihybrid parts one crossed with each other the characters segregates to produce now combination the cross can be shown as



Gametes	RY	Ry	rY	Ry
RY	RRYY Round	RRyy Round	RrYY Round	RrYy Round

	Yellow	Yellow	Yellow	Yellow
Ry	RRYy Round Yellow	RRyy Round green	RrYy Round Yellow	Rryy Round green
rY	RrYY Round Yellow	RrYy Round Yellow	rrYY wrinkled Yellow	rrYy wrinkled yellow
ry	RrYy Round Yellow	Rryy Round green	rrYy wrinkled Yellow	Rryy wrinkled green

Combination of characters:

Round yellow: Round green: Wrinkled yellow: Wrinkled green is in the ratio = 9:3:3:1

Q46. Give the basic features of the mechanism of inheritance.

Answer:

Inheritance is the transmission of genetic characteristic from one generation to other. The mechanism of inheritance are:

- i) Characters are controlled by genes called allele one character.
- ii) There are two or more forms of a gene. One form is dominant while other is recessive.
- iii) Genes are present on chromosomes.
- iv) Each parent has a pair of genes for each characteristic on a chromosome.
- v) When a male gamete fuses with the female gamete during fertilisation, they form a new cell called zygote with genes. This zygote carries characteristics of both the parents inherited through the genes.

Q47. Give reasons for the appearance of new combination of characters in the F_2 progeny in question 45.

Answer:

All the F_1 plants had round and yellow seeds. Between the generation they give rise to new combinations in F_2 generation with round-yellow, round-green, wrinkled yellow and wrinkled green in the ratio of 9:3:3:1.

This shows that the chances for the pea seeds to be round or wrinkled do not depend on their chances to be yellow or green. Each pair of alleles is independent of the other pairs. This is the 3rd law of Mendelian gametes – the principle of independent assortment.