

Chapter - 9

Heredity and Evolution

Multiple Choice Questions

1. Exchange of genetic material takes place in

- (a) vegetative reproduction**
- (b) asexual reproduction**
- (c) sexual reproduction**
- (d) budding**

Soln:

Answer is (c) sexual reproduction

Explanation:

Apart from sexual reproduction other options are type of asexual reproduction where only single parent is involved. Hence exchange of genetic material takes place in sexual mode of reproduction.

2. 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 fertilisation**
- (d) no fertilization**

Soln:

Answer is (c) cross fertilisation

3. 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'**

Soln:

Answer is (a) tallness is the dominant trait

Explanation:

In monohybrid cross only dominant characters are expressed in first progeny.

4. 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

Soln:

Answer is (d) for every molecule of fat there is a gene

Explanation:

Every, protein enzymes and hormones are controlled by specific gene whereas fats are not controlled by gene hence option d is a wrong statement.

5. If a round, green seeded pea plant (RR yy) is crossed with wrinkled, yellow seeded pea plant, (rr YY) the seeds produced in F₁ generation are

- (a) round and yellow
- (b) round and green
- (c) wrinkled and green
- (d) wrinkled and yellow

Soln:

Answer is (a) round and yellow

Explanation:

Round and yellow are the dominant characters hence in f₁ generation all seeds will be round and yellow.

6. In human males all the chromosomes are paired perfectly except one. This/these unpaired chromosome 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)

Soln:

Answer is (c) (iii) and (iv)

Explanation:

These are sex determining chromosomes that are not paired perfectly due to half size of Y chromosome.

7. 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

Soln:

Answer is (b) the Y chromosome in zygote

Explanation:

If sperm with Y chromosome fertilize the egg zygote will develop into male child. If sperm with X chromosome fertilize the egg zygote will develop into female child.

8. 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 or girl

Soln:

Answer is (b) girl

Explanation:

If sperm with Y chromosome fertilize the egg zygote will develop into male child. If sperm with X chromosome fertilize the egg zygote will develop into female child.

9. 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 heavy weight progeny
- (d) Traits which are not inherited over generations do not cause evolution

Soln:

Answer is (b) Reduction in weight of the organism due to starvation is genetically controlled

Explanation:

Option b) is a wrong statement because weight loss and gain are controlled by external factors and they are not controlled genetically.

10. New species may be formed 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)**

Soln:

Answer is (a) (i) and (ii)

Explanation:

Evolution will not take place without change and variation in the genetic material. Hence change in genetic material and variation in chromosome is required for the evolution of new species.

11. Two pea plants one with round green seeds (RRyy) and another with wrinkled yellow (rrYY) seeds produce F1 progeny that have round, yellow (RrYy) seeds. When F1 plants are selfed, the F2 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)**

Soln:

Answer is (c) (ii) and (iii)

Explanation:

		mother (RrYy) 			
		RY	Ry	rY	ry
father (RrYy) 	RY	 RRYY	 RRYy	 RrYY	 RrYy
	Ry	 RRYy	 RRyy	 RrYy	 Rryy
	rY	 RrYY	 RrYy	 rrYY	 rrYy
	ry	 RrYy	 Rryy	 rrYy	 rryy

12. 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

Soln:

Answer is (c) Radish and carrot

Explanation:

They both have similar structure and they both growth beneath the earth(Roots)

13. 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 birds and wings of bat are homologous

Soln:

Answer is (a) Tendril of a pea plant and phylloclade of Opuntia are homologous

Explanation:

Tendril of a pea plant and phylloclade of Opuntia are homologous because they have similar design and origin.

14. 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 layers of earth is not related to its time of extinction**
- (d) time of extinction cannot be determined**

Soln:

Answer is (b) the extinction of organism has occurred thousands of years ago

Explanation:

Older fossils are found deep in the earth. Hence option b) is the right answer.

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

- (a) All variations 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**

Soln:

Answer is (a) All variations in a species have equal chance of survival

Explanation

Statement a) is wrong because only useful variation have chance of survival. Nature choose the fittest variation to survive.

16. 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**

Soln:

Answer is (c) both maternal and paternal DNA

Explanation:

DNA is contributed to an offspring by both the parents hence traits are contributed by both the parents.

17. 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

Soln:

Answer is (a) two individuals of a species

Explanation:

Species is the lowest taxon hence members of same species share maximum number of common characteristics.

18. 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

Soln:

Answer is (b) accumulation of variations over several generations

Explanation:

New species are formed due to variation in the DNA for several generations. Asexual reproduction will not result in variation as there are no gametes involved.) Movement of individuals from one habitat to another will not affect DNA change hence it cannot be right answer.

19. 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

Soln:

Answer is (c) size of body

Explanation:

Person's food habits decide the nature of the body. Regular exercise helps in building muscular body. Body nature is not transferred to offspring hence size of the body is not inherited.

20. 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**

Soln:

Answer is (b) two different chromosomes

Explanation:

This is the reason behind expression of one progenies in one version and other versions in another progeny.

21. Select the statements that describe characteristics of genes

- (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**

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

Soln:

Answer is (b) (i) and (iii)

Explanation:

Statement ii) is wrong because genes code for specific proteins. Statement 4 is wrong because chromosomes have many number of genes.

22. In peas, a pure tall plant (TT) is crossed with a short plant (tt). The ratio of pure tall plants to short plants in F₂ is

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

Soln:

Answer is (b) 3 : 1

Explanation:

A cross between pure tall plant (TT) and short plant (tt) would produce progenies with following genotypes. TT(Pure tall), tt(Pure short) and Tt (Mixed tall). This makes the ratio between tall and short plants is 3:1.

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

- (a) one
- (b) two
- (c) three
- (d) four

Soln:

Answer is (a) one

Explanation:

23rd pair of chromosome determines the sex of the offspring hence it is called as sex chromosome.

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

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

Soln:

Answer is (b) Darwin

Explanation:

Mendel proposed laws of heredity.

Morgan discovered mutation in drosophila.

Lamarck proposed use and disuse theory.

25. Some dinosaurs had 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

Soln:

Answer is (a) reptiles have evolved from birds

Explanation:

Dinosaurs had feathers but could not fly using them. Birds, later adapted the feathers for flight. Since, dinosaurs were reptiles, this means that birds have evolved from them.

Short Answer Questions**26. How is the sex of a newborn determined in humans?****Soln:**

Sex of the individual is determined the genes inherited from the parents. If a newborn acquires X chromosomes from father child will be a female and if newborn receives Y chromosome from father it will be a male.

27. Do genetic combination of mothers play a significant role in determining the sex of a new born?**Soln:**

No Sex of a new born will be determined by the chromosome donated by father. Mothers have XX in their 23rd chromosome pair and they always donate One X. But fathers have X And Y in their 23rd chromosome pair. If father donates X child will be girl and if father donates Y child will be a boy.

28. Mention three important features of fossils which help in the study of evolution.**Soln:**

- Fossils are the preserved ancient species
- Fossils help determine evolutionary differences between organisms and their ancestors.
- Fossils determine the living period of specific species.

29. Why do all the gametes formed in human females have an X chromosome?**Soln:**

Females possess XX in their 23 pair of chromosome. During meiosis one X chromosome enters each gamete hence all females gametes possess X chromosome.

30. In human beings, the statistical probability of getting either a male or female child is 50 : 50. Give a suitable explanation.**Soln:**

Sex of the offspring is determined by the gamete donated by male. Male possess X and Y chromosomes in their 23rd pair. The ration between X and Y is 1:1 Hence the probability of getting either a male or female child is 50: 50.

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

Soln:

A very small population of a species faces a greater threat of extinction than a larger population because of the following reasons

Inbreeding:

Small population promotes inbreeding. Inbreed results in lesser variations.

Genetic drift:

Small population is vulnerable to sudden change in environment. Because of genetic drift chances of species with small population may wipe out.

Inbreeding depression:

This lead to negative population growth which is detrimental for the survival of the species with smaller population.

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

Soln:

Homologous structures are those which has common basic structure and performs different functions. e.g. fore limbs of reptiles, amphibians and mammals. If they don't have common ancestry they are called as analogous structure.

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

Soln:

Inspite of the fact that animals have different variety of structures they don not have common ancestry. This is because common ancestry may greatly limit the extent of diversity. Many of the animals are inhabiting the same habitat, their evolution by geographical isolation and speciation is also not likely. Hence common ancestry for all the animals is not the likely theory.

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

(i) yellow seed (ii) round seed

Soln:

- i) Yellow- dominant
 Green- Recessive

- ii) Round-dominant
 Wrinkled-Recessive

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

Soln:

Mendel choose pea plant for his experiments for the following reasons

- Pea plants are easy to grow
- They have short life span
- They got larger size flower
- Pea plants are self-pollinated

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

Soln:

A woman has only daughter; it means egg always received X chromosome from the sperm. If sperm donates X chromosomes the resultant child will be female and if Sperm donates y chromosome baby will be a male.

Long Answer Questions

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

Soln:

Geographical isolation of individual of a species leads to genetic drift. This limits sexual reproduction of the separated population. This results in separated individuals reproducing among themselves. This leads to formation of new variation. Accumulation and transfer of these variations through generation will lead to the formation of new species.

38. 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.

Soln:

This is an issue of debate. It depends on the way we evaluate evolution. If complexity of the body is a parameter then Human are far superior than bacteria. Bacteria has cellular level of organization and humans have organ level organization.

On the other hand if we consider the ability of survival bacteria have evolved more than human beings. Humans can live in any environment but with artificial protection. Humans cannot live in harsher climate whereas bacteria can be found anywhere on earth. They can survive even harsh climates such as

Hydrothermal vents, sulphur springs.

39. 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.

Soln:

All humans races appear to be different but they have evolved from common ancestry. Following are the evidence to support this view.

- Similar size of brain.
- Bipedal locomotion
- Hair on the body.
- Ability to handle tools.
- Ability to communicate using language.
- Highly complex social behavior.
- Same body design.

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

Soln:

Inherited Characters	Acquired Characters
Characters that are passed on from parents to offspring	Characters appearing in an individual's life time but cannot be transmitted to next generation
Alters Genotype and Phenotype	Alters Phenotype only
Transmitted to further generation	Cannot be transmitted to further generation
Results in genetic recombination	Results in response to environmental changes
Ex: colour of seeds, colour of eyes.	Ex: obese body, loss of a finger in an accident.

41. Give reasons why acquired characters are not inherited.

Soln:

Acquired characters are the results of our body's response to external stimuli such as food, disease, climate change. This results in a development of particular trait where change of phenotype is observed. But for characters to get inherited to generation Genotype of an organism should be changed. In acquired characters there is no change in the DNA of germ cells. Hence acquired characters cannot be inherited.

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

Soln:

Structure which are apparent to our eyes are called morphological structures. Molecular structures are those biomolecules which are the integral components of organisms. We see lot of diversity all around us. This diversity is possible because of diversity in morphological structures. This shows that morphological structures are least stable. Life which began as simple forms on the earth is now composed of many complex forms.

Life has evolved for millions of years but the structure of basic biomolecules such as DNA remains same. A DNA is same in a human and in a mouse. A protein has same structure in a bird and in a fungi. So, the molecular basis of life has not changed through all these years. This proves that evolution has exhibited a greater stability of molecular structure when compared with morphological structure.

43. 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	

Soln:

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

44. Study the following cross and showing self pollination in F1, fill in the blank and answer the question that follows

Parents **RRYY** **x** **rryy**
 Round, yellow **wrinkled green**

F1 — **Rr Yy** **x** **?**
 Round, yellow

Soln:

RrYy- Round yellow

rryy
↓

	ry	ry	ry	ry
RY	RrYy	RrYy	RrYy	RrYy
RY	RrYy	RrYy	RrYy	RrYy
RY	RrYy	RrYy	RrYy	RrYy
RY	RrYy	RrYy	RrYy	RrYy

↗ RRYY

45. In question 44, what are the combinations of character in the F₂ progeny? What are their ratios?

Soln:

	rryy ↓			
	ry	ry	ry	ry
RY	RrYy	RrYy	RrYy	RrYy
RY	RrYy	RrYy	RrYy	RrYy
RY	RrYy	RrYy	RrYy	RrYy
RY	RrYy	RrYy	RrYy	RrYy

RRYY ↗

- (i) Round yellow — 9
 - (ii) Round green — 3
 - (iii) Wrinkled yellow — 3
 - (iv) Wrinkled green — 1
- 9 : 3 : 3 : 1

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

Soln:

Basic features of the mechanism of inheritance are as follows

- Genes control the characters
- Genes are present in two or more forms
- One form of gene may be dominant over other
- Genes are present on chromosomes
- Individual genes exist in two forms may be similar or dissimilar
- Two forms of the gene separate at the time of gamete formation
- Two forms of genes are brought together in zygote

47. Give reasons for the appearance of new combinations of characters in the F₂ progeny.

F₁ plants have round and yellow seeds. Cross between generations can give rise to new combinations in F₂ 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 seed to be round or wrinkled do not depend on their chances to be yellow or green. Hence each pair of alleles is independent of the other pair. This is called as independent assortment.