

Heredity And Evolution

Multiple Choice Questions

Question 1.

Exchange of genetic material takes place in

- A. vegetative reproduction
- B. asexual reproduction
- C. sexual reproduction
- D. budding

Answer:

Exchange of genetic material takes place during sexual reproduction. During sexual reproduction male and female gametes exchange their genetic material to form zygote.

Question 2.

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

- A. double fertilization
- B. self-pollination
- C. cross fertilization
- D. no fertilization

Answer:

Two pink colored flowers on crossing resulted in 1 red, 2 pink and 1 white flower progeny. The nature of the cross will be cross fertilization. Cross fertilization is transfer of pollen grains from one plant to the stigma of flower borne of different plant of same species.

Question 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'

Answer:

According to the law of dominance, character that is expressed in F1 generation, is called dominant trait whereas character that is not expressed in F1 generation is known as recessive trait. Thus, tallness is the dominant trait.

Question 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

Answer:

Hormone and enzymes are made up of proteins and formation of any particular protein is controlled by a particular gene. But, fat biosynthesis occurs through metabolic reaction.

Question 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

Answer:

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 round and yellow with genotype (RrYy).

Question 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)

Answer:

In human beings, there are 23 pair of chromosome, out of which one pair is sex chromosome. In males, there are two types of sex chromosomes-X and Y. In males, all chromosomes are paired except sex chromosomes. Hence, normal sized X chromosome and small sized Y chromosome are unpaired.

Question 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

Answer:

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

Question 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

Answer:

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

Question 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

Answer:

Reduction in weight of the organism due to starvation is external environmentally determined factor. It is not genetically controlled because it will not change the DNA of germ cells. Hence, option 'b' shows incorrect statement.

Question 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)

Answer:

New species may be formed if DNA undergoes significant changes in germ cells and chromosome number changes in the gamete. This leads to new variations.

Question 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)

Answer:

The new combination in F₂ progeny will be round, yellow and wrinkled green. The phenotypic ratio 9:3:3:1 is obtained. This can be shown by following Punnett square:

		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

Question 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

Answer:

Radish and carrot represent the homologous structure because both have similar design or structure though both are different species.

Question 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

Answer:

Homologous organs are those organs that have same basic structural design but have different appearance and functions. Tendril of a pea plant and phylloclade of opuntia are homologous organs because they are modified stems but serve different functions in different plants.

Question 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

Answer:

Fossils are the preserved remains or impressions of living organisms that lived in the past. Fossils tell the process of evolution. They help to trace the racial history of organisms. Fossils that found closer to the surface are more recent than the fossils found in the deepest layers.

Question 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.

Variation is minimum in asexual reproduction

Answer:

Variation means certain changes which occur in sexually reproducing organisms because of errors in DNA copying. Variations are beneficial for species because they increase the adaptability of an organism to its changing environmental conditions. The variations produced in organisms during successive generations

gets accumulated in the organism. The significance of variations shows up only if it continues to be inherited by the offspring for several generation.

Question 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

Answer:

A trait in an organism is influenced by both maternal and paternal. This trait transfers one generation to other generation through genes located on the chromosomes.

Question 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
- two genera of two families

Answer:

Two individual of a species share maximum number of common characters. A species is a group of organisms consisting similar individual which can breed together and produce fertile offspring. It is the lowest taxon.

Question 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

movement of individuals from one habitat to another

Answer:

The process by which a new species develops from the already existing species by accumulation of variations, natural selection, gene flow, genetic drift, etc. is known as speciation.

Question 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

nature of hair

Answer:

Acquired traits are traits which are acquired by an organism during its lifetime and it cannot be passed from one generation to the next and it does not result in evolution. Example- size of body.

Question 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

Answer:

The two versions of a trait which are brought in by the male and female gametes are situated on copies of the same chromosome. Each parent contributes one copy of the gene for a particular trait.

Question 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. and (iv)
- D. and (iv)

Answer:

Genes are units of hereditary and are responsible for inheritance. Genes controls the expression of a trait or a character in an organism. Genes are located on the chromosomes inside the nucleus of the cell.

Question 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

Answer:

When pure bred tall plant with phenotype (TT) crossed with short plant with phenotype (tt), the possible progeny in F₂ generation: TT (1), tt(1) and Tt (2). Thus the ratio of pure tall (TT) to pure short (tt) is 1:1.

Question 23.

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

- A. One
- B. Two
- C. Three
- D. Four

Answer:

Zygote has 23 pairs of chromosomes i.e., 46. Out of them, one pair is sex chromosome.

Question 24.

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

- A. Mendel
- B. Darwin
- C. Morgan
- D. Lamarck

Answer:

Charles Darwin put forth the theory of natural selection. Natural selection is the process by which nature selects the individual which can survive in a particular environment with desirable trait.

Natural selection gives a survival advantage and thus alters frequency of inherited trait.

Question 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

Answer:

Some dinosaurs had feathers although they could not fly using the feathers. Birds also have feathers to flight. Since, dinosaurs were reptiles, this means that birds are evolved from reptiles.

Short Answer Questions

Question 1.

How is the sex of a newborn determined in humans?

Answer:

The two chromosomes that determine the sex of the unborn baby are called sex chromosomes named X chromosomes and Y chromosomes. A female has two X chromosomes, while a male has one X and one Y chromosome. The gametes (egg and sperm) have only one set of chromosomes. Thus, in females all the egg cells contain X chromosomes while in males, half sperm have X chromosomes and half sperms have Y chromosomes.

When a sperm containing X chromosome fertilizes the egg, the zygote would have XX chromosomes and develop into a female child. If the sperm contributes a Y chromosome to the egg (ovum) at fertilization, the zygote would develop into a male child.

Thus, father is responsible for the sex of the baby which is born.

Question 2.

Does genetic combination of mothers play a significant role in determining the sex of a new born?

Answer:

No, the genetic combination of mothers has no role in determining the sex of a new born baby. father is responsible for the sex of the baby which is born because only male has two types of sex chromosome names X and Y which will determine the sex of the foetus.

Question 3.

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

Answer:

Fossils are the preserved remains or impressions of living organisms that lived in the past.

Fossils helps:

- (i) To trace the racial history of organisms.
- (ii) To analyze the past climatic conditions.
- (iii) To measure the geological time.

Question 4.

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

Answer:

In human females, there are 23 pairs of chromosomes. Out of which 22 is autosome chromosomes and one pair is sex chromosome i.e., two X chromosomes. During gametogenesis, each gamete formed by females contain only the X chromosome (22 A + X). Hence, all female gametes in humans have X chromosome.

Question 5.

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

Answer:

Human beings have 23 pairs of chromosomes. The 22 pairs are called autosomes are similar in males and females. The two chromosomes (23rd pair) that determine the sex of the unborn baby are called sex chromosomes named X chromosomes and Y chromosomes.

A female has two X chromosomes (22+XX), while a male has one X and one Y chromosome (22+XY). The gametes (egg and sperm) have only one set of chromosomes. Thus, all the gametes produced by females have only the X chromosome (22+ X) while male produced two types of gametes, half gametes have X chromosomes (22+X) and half gametes have Y chromosomes (22+Y).

Therefore, the possibility of fertilization of egg (22 + X) with the sperm having (22 + X) chromosome to have girl child is 50%. Likewise, there is 50% possibility that egg is fertilized with sperm carrying (22 +Y) chromosome to have male child.

Question 6.

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

Answer:

A small population of a species faces a greater threat of extinction than a larger population. This is because small population has small number of individuals in a species. Fewer number of individual in a species impose extensive inbreeding among them. Thus, less number of individuals imparts lesser changes in production of genetic variation. Lack of genetic diversity, makes small population of a species more prone to extinction under any environmental changes.

Question 7.

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

Answer:

Homologous organs are those organs that have same basic structural design but have different appearance and functions. Example, forelimb of amphibians, bird and reptiles.

Yes, homologous structures always have a common ancestor. In the given example, the basic structure of forelimb of amphibians, birds and reptiles is similar but they are modified to perform different functions in various vertebrates. Thus, this shows that they have evolved from a common ancestor.

Question 8.

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

Answer:

The occurrence of diversity of animals on earth does not suggest their diverse ancestry. There are number of types of animals on this earth. On the basis of certain common characters, these animals are grouped into different group and subgroups. For example- On the basis of presence or absence of notochord, all animals are grouped into two groups- Chordata (with notochord) and Non-Chordata (without notochord).

Because of common characters, we draw a conclusion about common ancestry.

Question 9.

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.

Answer:

	Contrasting Traits	
Characters	Dominant	Recessive
(i) Seed color	Yellow	Green
(ii) Seed shape	Round	Wrinkled

Question 10.

Why did Mendel choose pea plant for his experiments?

Answer:

Mendel chose pea plant for his experiments due to following reasons:

- a. Pea plant was easy to cultivate and had short life span.
- b. Presence of contrasting variants of features.
- c. Carrying out cross pollination is quite easy in a pea plant.

Question 11.

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

Answer:

The two chromosomes that determine the sex of the unborn baby are called sex chromosomes named X chromosomes and Y chromosomes. A female has two X chromosomes, while a male has one X and one Y chromosome. The gametes (egg and sperm) have only one set of chromosomes. Thus, in females all the egg cells contain X chromosomes while in males, half sperm have X chromosomes and half sperms have Y chromosomes.

When a sperm containing X chromosome fertilizes the egg, the zygote would have XX chromosomes and develop into a female child. If the sperm contributes a Y chromosome to the egg (ovum) at fertilization, the zygote would develop into a male child.

Only daughters indicate the fusion of egg with sperms carrying 22+X chromosomes every time.

Long Answer Questions

Question 1.

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 lead to formation of a new species.

It can be understood from the example of turtle of the Galapagos Islands. Turtles of different islands were geographically isolated. The individuals of one island could not meet with the individuals of other islands. Hence, exchange of genetic material could not take place between them. Over generations, genetic drift accumulated different changes in each sub-population. Natural selection also made them differently. After many years, the individuals of isolated groups would become so different that they would be incapable of reproducing with each other (if they meet again) and new species would evolve.

Question 2.

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 simply the generation of diversity and the shaping of the diversity by environmental selection. The only progressive trend in evolution seems to be that more and more complex body designs have emerged over time. If evolution is viewed in terms of the complexity of body design then human beings are more evolved as they have most complex body designs. However, if evolution is viewed as the ability to survive in extreme conditions then bacteria is more evolved compared to human beings as bacteria can survive under the most extreme conditions. Many bacteria live in Sulphur springs and in craters of volcanoes.

Question 3.

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:

All human beings have evolved from a common ancestor as they have maximum number of common characters. Moreover, all human beings can interbreed with each other which shows that all of them belong to same species. Some of the common characters of all human beings are –

- a. Body hairs.
- b. Similar body design.
- c. Similar brain size.
- d. Ability to handle tools.
- e. Ability to communicate.
- f. Bipedal locomotion.
- g. Highly complex social behaviour.

Question 4.

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

Answer:

Differences between inherited and acquired characters are:

Inherited characters	Acquired characters
Inherited traits are traits in an organism due to changes in the genetic composition.	Acquired traits are traits which are acquired by an organism during its lifetime.
it can be passed from one generation to the next.	it cannot be passed from one generation to the next.
it results in evolution.	it does not result in evolution.
Example- Eye color, hair color, etc.	Example- Large muscle size.

Question 5.

Give reasons why acquired characters are not inherited.

Answer:

Acquired characters are developed by an individual over a period of time in response to external stimuli. For example – a wrestler develops good physique and

body as a result of continuous exercise and proper diet. Given proper exposure and opportunities, the wrestler may be able to excel in his chosen field. However, this is not necessary that the son of a wrestler would become a wrestler and do equally well. He may choose to be a cricketer or an actor.

As the name suggests, acquired characters appear in an individual because of his/her response to the external stimuli. These traits develop because of constant exposure to a certain stimulus and the resultant response by the individual. Let us take the example of a wrestler. The wrestler develops good physique because of continuous exercise and suitable diet. Given proper exposure and opportunities, the wrestler may be able to excel in his chosen field. But this does not mean that the son of the wrestler would do equally well in wrestling. He may end up being a cricketer or a film star.

Question 6.

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

Answer:

Molecular structure is the smallest component with which an organism is made up of while the morphological structure is the external structure of an organism which can be seen by us. The diversity, in organisms, that we see around is because of diversity in morphological structure. When we look at the molecular level all the organisms are made up of same biomolecules. DNA, protein, lipid, carbohydrates, etc. The DNA structure is same in all organisms but the count of DNA may vary. Irrespective of the type of organism, a DNA molecule or a protein molecule would have the same structure. Hence, it can be said that molecular structures show great stability.

Question 7.

Give the basic features of the mechanism of inheritance.

Answer:

Transmission of genetic characteristic from one generation to next is termed as inheritance. The basic features of the mechanism of inheritance are-

- Each genetic character is controlled by a gene.
- Genes are units of hereditary and are responsible for inheritance. Genes controls the expression of a trait or a character in an organism. Genes are located on the chromosomes inside the nucleus of the cell.

- Each gene has two or more alternating forms called as alleles. One of the allele is dominant while other is recessive.
- Each parent possesses a pair of genes for each characteristic on a chromosome.
- Each cell has two copies of each chromosome, one each from the male and female parents.
- Every germ-cell will take one chromosome from each pair and these may be of either
 - maternal or paternal origin.
- When two germ cells combine, they will restore the normal number of chromosomes in the progeny, ensuring the stability of the DNA of the species

Question 8.

In the following crosses write the characteristics of the progeny

- RRYY x RRYT (round yellow x round yellow)
- RrYy x RrYy (round yellow x round yellow)
- rryy x rryy (wrinkled green x wrinkled green)
- RRYY x rryy (round yellow x wrinkled green)

Answer:

- A cross between two pure breeding dominant parents gives pure breeding dominant progeny in F1 generation. All produced progeny will exhibit round and yellow with phenotype (RRYY).
- A cross between two dihybrid dominant recessive parents, gives phenotypic ratio 9:3:3:1 in progeny. All progeny in this cross will exhibit round yellow (RRYY), Round yellow (RrYy), Round green (RRyy), Round green (Rryy), wrinkled yellow (rrYY), wrinkled yellow (rrYy), wrinkled green (rryy).
- A cross between two pure breeding recessive parents gives pure breeding recessive progeny in F1 generation. All produced progeny will exhibit wrinkled green with phenotype (rryy).
- A cross between pure breeding dominant and pure recessive parents, gives

heterozygous dominant progeny. All progeny in the cross will have genotype RrYy and exhibit Round yellow.

Question 9.

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

Parents	RRYY Round, yellow	x	rryy wrinkled, green
F ₁ —	Rr Yy Round, yellow	x	?

Answer:

A dihybrid cross shows inheritance of two different traits simultaneously. In the given question, when pure breeding dominant parent plant (RRYY) crossed with pure breeding recessive parent plant (rryy), it give heterozygous dominant progeny in F₁ generation. All progeny in this cross will have genotype RrYy and exhibit round yellow. Self-cross of F₁ progeny will give F₂ generation.

















Question 10.

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

Answer:

A dihybrid cross shows inheritance of two different traits simultaneously. A cross between two dihybrid dominant recessive parents, gives phenotypic ratio 9:3:3:1 in progeny. All progeny in this cross will exhibit round yellow (RRYY), Round yellow (RrYy), Round green (RRyy), Round green (Rryy), wrinkled yellow (rrYY), wrinkled yellow (rrYy), wrinkled green (rryy).

This can be shown by following Punette Square:

		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

Question 11.

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

Answer:

In dihybrid cross, when pea plants with round and green seeds (RRyy) are crossed with plants with wrinkled and yellow seeds (rrYY), round and yellow colour (RrYy) seeds are produced in F1 generation. In F1 generation, the dominant alleles suppress the recessive ones. So, as a result only dominant allele are expressed. Thus, all the progenies in F1 generation, showed dominant traits only. However, genes for recessive traits were present in all the plants.

When F1 generation are crossed, they give rise to new combination in the F2 generation with round yellow, round green, wrinkled yellow and wrinkled green in the ratio 9:3:3:1.