Heredity and Evolution

Question 1:

Select the proper choice from the given multiple choices :

Question 1.1:

The occurrence of differences among the individuals of the same species is due to :

Solution :

B. Variations

Variations are differences among the individuals of the same species which arise due to mutation or sexual reproduction.

Question 1.2:

The continuity of features from one generation to another is known as :

Solution :

C. Heredity

Heredity is the transmission of characters from the parent to the offsprings to maintain the same structure of characters from generation to generation.

Question 1.3:

On which of the following plant species Mendel has worked:

Solution :

B. Pisum sativum

Mendel used Pisum sativum, commonly known as the pea plant as his experimental material to study the inheritance of characters.

Question 1.4:

When Mendel crossed Tall plant with Dwarf plant what was the ratio of dwarf plants in F_2 generation ?

Solution :

B. 25%

Dwarfism is a recessive character in pea plants. When Mendel selfed heterozygous plants of the F1 generation, he obtained a phenotypic ratio of 3:1 for tall:dwarf plants in the F2 generation.

Question 1.5:

In human being sex is determined by ;

Solution :

C. Genes

The genes present on the chromosomes of humans determine the sex of an individual. The 23rd pair of chromosome in males is XY and in females is XX. The remaining 22 chromosomes are the same in males and females.

Question 1.6:

The Human Species have genetic roots in:

Solution :

C. Africa

Research has traced the genetic foot prints of human beings to Africa. Migration of our ancestors from Africa led to their spread over the planet.

Question 1.7:

The organs which perform different functions but have the same basic structure are known as:

Solution :

A. Homologous organs

The basic structure of the forelimb of a frog, a bird and humans is the same. However, the functions of the forelimb in these organisms are different. These are homologous organs.

Question 1.8:

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

1. the extinction of organism has occurred recently
2. the extinction of organism has occurred thousands of years ago
3. the fossil position in the layers of earth is not related to its time of extinction
4. time of extinction cannot be determined.

Solution :

ii. The extinction of an organism has occurred thousands of years ago.

Fossils are the impressions of dead organisms that lived in the past. The deeper the impression in the soil, the older the fossils.

Question 1.9:

New species may be formed if :

1. DNA undergoes significant changes in germ cells
2. there is no change in the genetic material
3. mating does not take place

Solution :

B. (i) and (iii)

DNA in the germ cells is hereditary material. Significant changes made in the DNA of the germ cells and passed to the subsequent generation during reproduction, can result in the formation of a new species of the organism.

Also, when individuals of the same species separated due to geographical barriers cannot mate, it results in the formation of a new species in their own respective environments.

Question 1.10:

The presence of which of the following types of organs in two animals indicates that they are not derived from a common ancestor?

Solution :

C. Analogous organs

Analogous organs are the ones which have similar functions but different basic structures. Analogous organs are indicative of divergent evolution.

Question 1.11:

Which one of the following is not homologous ?

Solution :

C. Wings in butterfly and bat

Wings in butterfly and bat are analogous structures; they have similar functions but their basic structures are different.

Question 2:

Answer the following questions in brief :

Question 2.1:

Define sex determination

Solution :

Sex determination methods or mechanisms help to determine whether the individual organism is a male or a female.

Question 2.2:

What are the mechanisms or methods of sex determination in different organisms?

Solution :

Mechanisms or methods of sex determination in different organisms are as follows:

- In some animals, the temperature at which the egg is fertilised determines the sex of the individual.
- In snails, individuals can change sex.
- In humans, sex of an individual is genetically determined.

Question 2.3:

Name the ancestor of the following:

Broccoli, Kohlrabi, Kale

Solution :

Wild cabbage is the ancestor of Broccoli, Kohlrabi and Kale.

Question 2.4:

Name two organisms which are now extinct and are studied from their fossils.

Solution :

Ammonite, Trilobite and Dinosaur are extinct organisms studied from their fossils.

Question 2.5:

Name five verities of vegetables which have been produced from ‘wild cabbage’ by the process of artificial selection

Solution :

Varieties of vegetables produced from wild cabbage are

- Cabbage

- Cauliflower
- Broccoli
- Kohlrabi
- Kale

Question 2.6:

Choose the one term from the following which includes the other three : broccoli, wild cabbage, cauliflower, cabbage

Solution :

Wild cabbage is the term which includes the other three i.e. broccoli, cauliflower and cabbage because it is the ancestor of these three vegetables.

Question 3:

Write answers to the following questions :

Question 3.1:

What are fossils ?

Solution :

Fossils are the impressions or remains of dead organisms which lived in the past. When organisms die, sometimes due to environmental conditions, some body parts do not decompose and get covered within the soil forming a cast and thereby, becoming a fossil.

Question 3.2:

In what way homologous organs give evidence for evolution?

Solution :

Homologous organs have similar structural design. However, to adapt to their environment, the organisms modify their structures for different functions. The basic structural design of homologous organs despite different functions indicates evolution.

Question 3.3:

Will geographical isolation be a major factor in the speciation of an organism that reproduces asexually? Give reason for your answer.

Solution :

Yes, geographical isolation is a major factor in the speciation of an organism which reproduces asexually.

In organisms that reproduce asexually, variations arise due to mutation and natural selection. Organisms modify and adapt themselves to survive in the given environment. Thus, two groups of organisms of the same species living in different environmental conditions will form two different new species after many generations and lead to speciation.

Question 3.4:

Does geographical isolation of individuals of a species lead to the formation of a new species? Provide a suitable explanation for your answer.

Solution :

Yes, geographical isolation of individuals of a species leads to the formation of a new species.

Due to geographical isolation of individuals of a species, gene flow is restricted and does not take place between the separated individuals. Each group of isolated individual develops and inherits variations to survive in the given environment. Inheritance of these variations over generations, results in the formation of a new species.

Question 3.5:

How characters are inherited ?

Solution :

Characters are inherited from one generation to another through the genes present on the chromosomes of the organisms.

Question 3.6:

Write a note on heredity.

Solution :

Heredity is continuity of basic characters from one generation to another.
It is transmission of characters from the parent to the offsprings to maintain the same structure of characters for generation after generation.

Question 4:

Answer the following questions in detail :

Question 4.1:

(A) Explain the terms ‘analogous organs’ and ‘homologous organs’ with examples.
(B) In what way analogous organs give evidence for evolution ?

Solution :

A. Analogous organs are organs of organisms which perform the same functions in their respective organisms but have a different structural design. Example – Wings of insects and birds have different structures but perform the same functions. They are analogous organs.

Homologous organs are organs of organisms which perform different functions in their respective organisms but have the same structural design. Example – Forelimbs of humans, frog and birds perform different functions but have the same structure. They are homologous organs.

B. Analogous organs of different organisms help to prove that those organisms have not evolved from common ancestors.

Question 4.2:

(A) Define ‘speciation’. Explain how speciation occurs.
(B) Will geographical isolation be a major factor in the speciation of a self-pollinating plant species? Give reason for your answer.

Solution :

A. Speciation is the process of formation of a new species from the existing ones. When a population of species splits into groups and gets separated due to geographical barriers, speciation occurs. There is a lack of gene flow between the separated species. This leads to reproductive isolation. Variations occur in isolated species to adapt to their surroundings, which are inherited over generations. After many generations, these species show great variations and develop into a completely new species which cannot reproduce with each other.
B. Yes, geographical isolation is a major factor in the speciation of self-pollinating plant species.
In plants that reproduce by self pollination, variations arise due to mutation and natural selection. They modify and adapt themselves to survive in the given environment. Thus, two groups of plants of the same species living in different environmental conditions will form two new and different species after many generations and lead to speciation.

Question 4.3:

Explain Mendel’s contribution.

Solution :

Mendel performed experiments on a garden pea plant which shows 7 pairs of contrasting characters, to study the inheritance of characters. He performed monohybrid cross and dihybrid cross to study the inheritance of some pairs of contrasting characters.

Monohybrid Cross:

A cross between a pure tall plant (TT) and a pure dwarf (tt) plant which involves only one trait is called the monohybrid cross.

The parents with the genotype TT and tt at first form gametes T and t respectively.

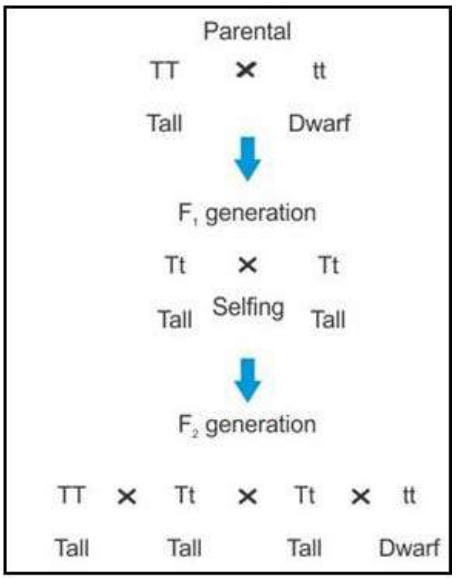
These gametes fuse and result in the formation of the F1 generation.

The genotype of F1 generation is Tt and the phenotype is tall plants. These tall plants have both the characters and thus, the plants are called heterozygous.

On selfing F1 generation, we get F2 generation.

The F1 plant being heterozygous forms two types of gametes, with T and t.

The union of these gametes can take place in all four possibilities. Thus, the F2 generation forms plants in genotypic ration of 1:2:1 for TT:Tt:tt and a phenotypic ration of 3:1 for tall:dwarf plants.



Dihybrid Cross:

A cross between a pure round yellow (YYRR) and a pure green wrinkled (yyrr) plant which involves two traits is called a dihybrid cross.

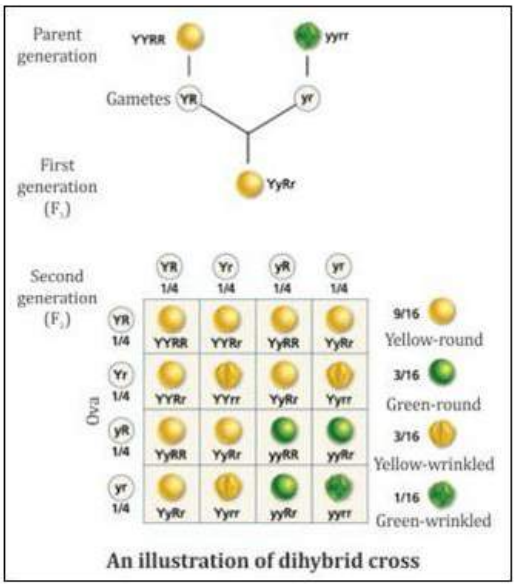
In dihybrid cross, parents homozygous for given traits produced a hybrid in F1 generation.

On selfing F1 generation, offspring having characters of yellow (YY), Round (RR), green (yy) and wrinkled (rr) were produced.

In the following checker board, we can see that different combinations of characters resulted in the F2 generation from a dihybrid cross.

Out of the 16 combinations in the following checker board, 9 have yellow round seeds, 3 have yellow wrinkled seeds, 3 have green round seeds and 1 has green wrinkled seeds.

Thus, phenotypic ratio is 9:3:3:1



These crosses helped Mendel to deduce the laws of inheritance.

Question 4.4:

Describe the sex determination in human beings

Solution :

Humans have 23 pairs of chromosomes. Out of 23, 22 are autosomes and 1 pair is of sex chromosome. The 22 autosomes are same in males and females. Males have XY as sex chromosomes and females have XX as sex chromosomes. During gamete formation, only one of the two in a pair of chromosomes enters the gamete. Thus, females form only one type of gamete with the ova carrying only X chromosomes with 22 autosomes. However, males form two types of sperms. 50% of the sperms will carry X chromosome and 50% of the sperm will carry Y chromosome.

Now, if the sperm carrying X chromosome fertilises the ovum, the resulting zygote will have XX chromosomes and result in a baby girl. On the other hand, if the sperm carrying Y chromosome fertilises the ovum, the resulting zygote will have XY chromosomes and result in a baby boy.