Heredity and Evolution - NCERT Questions

Q 1.
A Mendelian experiment consists of breeding tall pea plants bearing violet flowers with short pea plants bearing white flowers. The progeny all bore violet flowers, but almost half of them were short. This suggests that the genetic make-up of the tall parent can be depicted as

A TTWW
B TTww
C TtWW
D TtWw
SOLUTION:
Ans.:(c) All progeny bore violet flowers, so they all must have gene for violet flower. As violet colour appears in hybrids thus it must be the dominant character. So, white flowered plant should have ww genes to show recessive white character. It indicates that all progenies got allele W (violet colour) from tall-violet flowered plant, thus its all gametes should have W allele. To serve the purpose plant must have WW genes. But, tallness was found in 50% progenies thus half of its gametes contained T gene and other half contained t gene. Inclusively, the tall plant had TtWW genotype.

Q 2.
An example of homologous organs is

A our arm and a dog's fore-leg
B our teeth and an elephant's tusks
C potato and runners of grass
D all of the above.
SOLUTION:
Ans.: (d) Homologous organs have same origin and same basis structure but different functions like each of the above pair of organs.

Q 3.
In evolutionary terms, we are more in common with

A a Chinese school-boy
B a chimpanzee
C a spider
D a bacterium.
SOLUTION:
Ans.: (a) Chinese school boy is a member of same species that we are of *i.e., Homo sapiens*. It is the environment that has caused some morphological variations.

Q 4.

A study found that children with light–coloured eyes are likely to have parents with light coloured eyes. On this basis, can we say anything about whether the light eye colour trait is dominant or recessive? Why or why not?

SOLUTION:
Ans.: No. From the given statement, we cannot say with certainty whether light eye colour is dominant or recessive. However, since both children and their parents have light eye colour, the possibility is that light eye colour is a recessive trait. Had the light eye colour been a dominant trait, the homozygous light eyed parents would have only light eyed children but heterozygous light eyed parents might had some recessive dark eyed children (3 : 1 ratio).

Q 5.
How are the areas of study–evolution and classification – interlinked?

SOLUTION:
Ans.: Modern classification system is based on the phylogenetic resemblances and evolutionary relationships between the species. Systematics deals with the classification of living beings on the basis of evolution. Thus, evolution of organisms gives a hint about their position in classification system and *vice versa*. Hence, we can say that 'evolution' and classification are two interlinked areas of study.

Q 6.
Explain the terms analogous and homologous organs with examples.

SOLUTION:
Ans.: Organs with common origin but different functions are called homologous organs *e.g.*, fins of whale and legs of horse are structurally similar but perform different functions. On the contrary, organs with similar functions but different structures are called analogous organs *e.g.*, wings of birds (made of feathers) and wings of insects (made up of chitin).

Q 7.
Outline a project which aims to find the dominant coat colour in dogs.

SOLUTION:
Ans.: (i) Select two varieties of dogs one with white coat colour, the other with black coat colour.
(ii) Crossbreed them taking male dog from one variety and bitch (female dog) from the other variety.
(iii) Observe the colour of offsprings of F_1 generation.
(iv) Now, bring about breeding among the organisms of F_1 generation.
(v) Observe the coat colour of organisms (pups) of F_2 generation and note the variations in coat colour.
(vi) Draw conclusions on the basis of your study. One of the probable inheritance pattern may be as given below.
Phenotypic ratio = 3 : 1, Black coat colour (3) : White coat colour (1)

Q 8.
Explain the importance of fossils in deciding evolutionary relationships.

SOLUTION:
Ans.: Fossils play an important role in deciding evolutionary relationships as follows:
(i) The fossils present in the bottom rocks are simple while the most recent fossils found in the upper strata are highly complex. This geographical succession completely agrees with the concept of evolution.
(ii) Some fossils provide a direct connecting link between two groups, *e.g.*, study of fossil bird *Archaeopteryx* indicates that birds have evolved from reptile-like ancestors.
(iii) Fossil records of certain mammals (horse, elephant, camel, man, etc.) if arranged according to geological time scale it would present a complete series indicating about their evolution.
(iv) Fossils of the dinosaur bodies with feathers have been found in the rocks which were not used for flying by dinosaur but they were meant for giving warmth to the body. These must have evolved into wings later meant for flying as seen in birds. This shows a close relationship between birds and reptiles.

Q 9.
What evidences do we have for the origin of life from inanimate matter?

SOLUTION:
Ans.: Experimental evidence provided by Miller and Urey proves the origin of life from inanimate matter. They designed an apparatus with glass tubes and flask. In the apparatus, they circulated a mixture of methane, ammonia, hydrogen in the ratio of 2 : 2 : 1 and water vapour. These gases were believed to be present in the ancient atmosphere. Energy was provided by electric spark in the gas flask. The mixture was maintained at a temperature just below 100°C. The experiment was kept working continuously for 18 days and then the condensed material was chemically analysed. A large number of organic substances including amino acids (glycine, alanine and aspartic acid), urea, lactic acid, simple sugar, purine, pyrimidine, etc. were found in the condensed mixture which proved the abiotic synthesis of organic molecules during the process of origin of life.

Q 10.
Explain how sexual reproduction gives rise to more viable variations than asexual reproduction. How does this affect the evolution of those organisms that reproduce sexually?

SOLUTION:
Ans.: During sexual reproduction, at the time of gamete formation, meiotic cell division takes place. During meiosis, crossing over between fragments of homologous chromosomes occurs which brings about new gene combinations to be transferred to new generation. Crossing over is the fundamental cause of origin of variations in sexually reproducing organisms. Asexual reproduction does not involve meiosis and crossing over because of one parent lineage. Hence, only minute variations may occur in them due to mutation.
The variations caused by crossing over in sexually reproducing organisms are subjected to the selection process. Natural selection selects those variations which have more adaptive value and guide them towards evolution of new species. In this way, sexual reproduction gives rise to more viable variations for evolution.

Q 11.
How is the equal genetic contribution of male and female parents ensured in the progeny?

SOLUTION:
Ans.: A zygote is formed by the fusion of sperm and ovum. During the formation of gametes as a result of reductional division (meiosis), sperms and eggs receive only half of the genetic material of parent cell and thus become haploid. When fertilization occurs, zygote is formed, which is diploid (2n). In this way, both male and female parents contribute exactly equal amount of genetic material to the offspring.

Q 12.
Only variations that confer an advantage to an individual organism will survive in a population. Do you agree with this statement? Why or why not?

SOLUTION:
Ans.: It is not always true. The variations that confer an advantage to an individual organism are definitely of more survival value because natural selection prefers these variations. But there are several other variations which, though do not provide advantage to the organism in the present condition, survive and are inherited to the next generations. Such non-advantageous variations may become advantageous in future when the environmental conditions change.