

CHAPTER

9

HEREDITY AND EVOLUTION

Syllabus

Heredity, Mendel's contribution, Laws for inheritance of traits, sex determination – brief introduction, basic concepts of evolution.



STAND ALONE MCQs

(1 Mark each)

Q. 1. 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. U

Ans. Option (D) is correct.

Explanation: Hormone and enzymes are proteins and formation of any particular protein is controlled by a particular gene. Hence, all other options are correct.

AI Q. 2. If a round, green seeded pea plant (RRyy) is crossed with wrinkled, yellow seeded pea plant, (rrYY) the seeds produced in F₁ generation are

- (A) round and yellow.
- (B) round and green.
- (C) wrinkled and green.
- (D) wrinkled and yellow. AE

Ans. Option (A) is correct.

Explanation: As roundness and yellow colour are shown by capital letters in the genotype, so they are dominant traits. In F₁ generation, only dominant traits are expressed.

Q. 3. 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. R

Ans. Option (B) is correct.

Explanation: Y-chromosome in zygote means that the zygote would develop into a male child.

AI Q. 4. 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. U

Ans. Option (B) is correct.

Explanation: A zygote with XX chromosomes in the 23rd pair would develop into a girl child.

Q. 5. 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. U

Ans. Option (C) is correct.

Explanation: Traits in other options are always inheritable traits.

Q. 6. 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. AE

Ans. Option (C) is correct.

Explanation: As it is mentioned in the question that two pink coloured flowers were crossed, thus it is cross fertilization.

Q. 7. 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. U
- (D) height of pea plant is not governed by gene 'T' or 't'.

Ans. Option (A) is correct.

Explanation: This is a case of monohybrid cross, in which all the progenies in the F₁ generation show dominant character. Hence, tallness is the dominant trait.

Q. 8. The number of pair (s) of sex chromosomes in the zygote of humans is

- (A) one. (B) two.
- (C) three. (D) four. R

Ans. Option (A) is correct.

Explanation: The sex chromosomes are in the 23rd pair.

Q. 9. 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.

Ans. Option (B) is correct.

Explanation: An example of homologous organs is our teeth and an elephant's tusks.

Q. 10. In evolutionary terms, we have more in common with

- (A) a Chinese school-boy.
- (B) a chimpanzee.
- (C) a spider.
- (D) a bacterium.

Ans. Option (A) is correct.

Explanation: In evolutionary terms, we have more in common with a Chinese school boy as both are humans and belong to same species.

Q. 11. The theory of evolution of species by natural selection was given by

- (A) Mendel (B) Darwin
- (C) Morgan (D) Lamarck

Ans. Option (B) is correct.

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

Q. 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

Ans. Option (C) is correct.

Explanation: Radish and carrot are modified tap roots. Organs with similar origin are called homologous organs.

Q. 13. The theory of inheritance of acquired characters was given by

- (A) Mendel (B) Darwin
- (C) Morgan (D) Lamarck R

Ans. Option (D) is correct.

Explanation: The theory of inheritance of acquired characters was given by Lamarck.

Q. 14. 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.

Ans. Option (D) is correct.

Explanation: Birds have evolved from reptiles.

AI Q. 15. 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. U

Ans. Option (B) is correct.

Explanation: Newer fossils are deposited in layers above older fossils.

Q. 16. 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.

Ans. Option (B) is correct.

Explanation: Theory of sudden creation has long been disproved by scientists. It is the accumulation of variations over successive generations which results in origin of a new species.



ASSERTION AND REASON BASED MCQs (1 Mark each)

Directions : In the following questions, A statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as.

- (A) Both A and R are true and R is the correct explanation of A.
- (B) Both A and R are true but R is NOT the correct explanation of A.
- (C) A is true but R is false.
- (D) A is false and R is true.

Q. 1. Assertion: A geneticist crossed a pea plant having violet flowers with a pea plant having white flowers, he got all violet flowers in first generation.

Reason: White colour gene is not passed on to next generation. [A] [CBSE SQP, 2021]

Ans. Option (C) is correct.

Explanation: The gene for violet flowers is dominant over the gene for white flowers so that only the violet gene is expressed as violet flowers in the first generation.

Q. 2. Assertion (A): Mendel chose a number of varieties of garden pea as plant material for his experiments.

Reason (R): Garden pea has well defined characters and is bisexual.

Ans. Option (A) is correct.

Explanation: Mendel chose garden pea as plant material for his experiment because garden pea plants were easily available / they grow in one season / fertilization was easy.

Q. 3. Assertion (A): In humans, males play an important role in determining the sex of the child.

Reason (R): Males have two X chromosomes.

Ans. Option (C) is correct.

Explanation: Sex of a child is dependent on the type of the male gamete that fuses with the female gamete. Human beings possess 23 pairs of chromosomes. Out of these, 22 pairs are known as autosomes, while the remaining one pair comprises sex chromosomes (XX in females and XY in males). At the time of fertilisation, the egg cell fuses with the sperm cell, resulting in the formation of the zygote. If the egg cell carrying an X chromosome fuses with the sperm carrying an X chromosome, the resulting child would be a girl. If the egg cell carrying an X chromosome fuses with the sperm carrying a Y chromosome, the resulting child would be a boy.

Q. 4. Assertion (A): Learning a skill such as dance and music is an acquired trait.

Reason (R): Acquired traits develop in the life time of an individual and do not pass to the progeny.

Ans. Option (A) is correct.

Explanation: Traits which develop in the life time of an individual and do not pass to the progeny are called acquired traits. Learning a skill such as dance/music/loss of body parts/weight etc are example of acquired traits.

Q. 5. Assertion (A): Traits like eye colour or height are inherited traits.

Reason (R): Inherited traits are not transferred from parents to young ones.

Ans. Option (C) is correct.

Explanation: Eye colour and height are genetically inherited traits, as these are expressed by genes. Inherited traits are the traits which are transferred from parents to young ones. Acquired traits are the characters that are acquired by the individual during its lifetime. These traits cannot be inherited. For example, if a wrestler develops large muscles due to his training program that does not mean it will be passed on to his offspring.

Q. 6. Assertion (A): Fossils are remains of dead organisms.

Reason (R): It is helpful in study of evolution.

Ans. Option (B) is correct.

Explanation: Fossils are remains of hard parts of the dead organisms in the strata of earth. It help in tracing evolutionary pathways.

Q. 7. Assertion (A): Wings of butterfly and wings of bat are analogous organs.

Reason (R): Analogous organs have different origin and structural plan but same function.

Ans. Option (A) is correct.

Explanation: Wings of butterfly and wings of bat though they perform similar function, they have different origin/basic structure. Hence, they are known as analogous organs.

Q. 8. Assertion (A): Speciation is the process of formation of a new species from a pre-existing one.

Reason (R): Mutation plays a role in speciation.

Ans. Option (A) is correct.

Explanation: Speciation is an evolutionary process by which new species arise. One of the factors that lead to speciation is mutation.

Q. 9. Assertion (A): Natural selection is the phenomenon by which the nature selects those species which possess survival advantage over the other species.

Reason (R): According to theory of natural selection, there is struggle of existence within the species of a population for the environmental resources and their struggle leads to survival of certain organisms and elimination of the less competent species.

Ans. Option (A) is correct.

Explanation: Natural selection is the phenomenon by which the nature selects those species which possess survival advantage over the other species. According to theory of natural selection, there is struggle of existence within the species of a population for the environmental resources and their struggle leads to survival of certain organisms and elimination of the less competent species.



CASE-BASED MCQs

Attempt any 4 sub-parts from each question. Each sub-part carries 1 mark.

I. Read the passage and answer the following questions from Q.1. to Q.5.

In a cross between plants with purple flowers and plants with white flowers, the offspring of F_1 generation all had white flowers. When the F_1 generation was self-crossed, it was observed in the F_2 generation that out of 100, 75 flowers were white. Make a cross and answer the following questions:

Q. 1. The above cross is known as:

- (A) Monohybrid cross (B) Dihybrid cross
(C) Test cross (D) Back cross

Ans. Option (A) is correct.

Explanation: A cross between two plants, which differ in only one pair of contrasting characters is called monohybrid cross. In this cross, F_2 phenotypic ratio is 3 : 1 and genotypic ratio is 1 : 2 : 1.

White flowers
WW

Purple Flowers
ww

×
Ww

White Flowers

Q. 2. In a monohybrid cross between two heterozygous individuals, percentage of pure homozygous individuals obtained in F_1 generation is ?

- (A) 25% (B) 50%
(C) 75% (D) 100%

Ans. Option (B) is correct.

Explanation: In a monohybrid cross between two heterozygous individuals, percentage of pure homozygous individuals obtained in F_1 generation is 50 %.

Q. 3. Which of these is not the genotype of F_2 progeny?

- (A) WW (B) Ww
(C) ww (D) Wp

Ans. Option (D) is correct.

Explanation: Genotypes of F_2 progeny are WW, Ww, ww.

Q. 4. The ratio of 'White: Purple' flowers in the F_2 generation is

- (A) 3 : 1 (B) 1 : 2
(C) 1 : 3 (D) 2 : 1

Ans. Option (A) is correct.

Explanation: Ratio between White : Purple flowers are 3 : 1.

II. Study the given cross showing self pollination in F_1 and answer the following questions from Q.1. to Q.4.

RRYY × rryy Parents
(Round Yellow) (Wrinkled Green)
RrYy × _____ F_1 generation
(Round Yellow)

Q. 1. The missing blank in the above cross is:

- (A) RrYy (B) RRYy
(C) RryY (D) rryy

Ans. Option (A) is correct.

Explanation: RrYy (Round Yellow) is the missing blank in the above cross.

Q. 2. The combination of characters in the F_2 progeny are:

- (A) Round Yellow: Round Green: Wrinkled Yellow: Wrinkled Green
(B) Round Green : Round Yellow : Wrinkled yellow : Wrinkled Green
(C) Round Yellow : Round Green : Wrinkled Green: Wrinkled yellow
(D) Round Green : Round Yellow : Wrinkled yellow : Wrinkled Green

Ans. Option (A) is correct.

Explanation: In F_2 generation, the combination of characters is Round Yellow: Round Green: Wrinkled yellow: Wrinkled Green.

Q. 3. The ratio of the combination of characters in the F_2 progeny is:

- (A) 3 : 1 (B) 1 : 2 : 1
(C) 1 : 1 : 1 (D) 9 : 3 : 3 : 1

Ans. Option (D) is correct.

Explanation: The ratio of the combination of characters in the F_2 progeny is 9: 3: 3: 1.

Q. 4. 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 cod depicted as

- (A) TTWW (B) TTww
(C) TtWW (D) TtWw

Ans. Option (C) is correct.

Explanation: All progeny bore violet flower, 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 this 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.

III. Read the given passage and answer any of the four questions from Q.1. to Q.5. given below:

Seema crossed pure breed pea plants having round-yellow seeds with wrinkled green seeds and found that only A-B type of seeds were produced in the F_1 generation. When F_1 generation pea plants having A-B type of seeds were cross-breed by self pollination, then in addition to the original round yellow and wrinkled green seeds, two new varieties A-D and C-B types of seeds were also obtained.

Q. 1. What are A-B type of seeds?

- (A) Round-yellow (B) Round-green
(C) Wrinkled-yellow (D) Wrinkled-green

Ans. Option (A) is correct.

Explanation: A-B type of seeds are round in shape and yellow in colour.

Q. 2. A and B are _____ traits.

- (A) dominant (B) recessive

Ans. Option (A) is correct.

Explanation: A-B type is dominant traits.

Q. 3. A-D are _____ and C-B are _____ type of seeds.

- (A) Round green and wrinkled yellow respectively
(B) Round yellow and wrinkled green respectively
(C) Wrinkled green and round green respectively
(D) Wrinkled green and round yellow respectively

Ans. Option (A) is correct.

Explanation: A-D is round-green while C-B is wrinkled-yellow.

Q. 4. Which one of these will be produced in minimum and maximum number in the F_2 generation?

- (A) A-B (B) A-D

Ans. Option (A) is correct.

Explanation: A-B is produced in maximum number while A-D will be produced in minimum number.

Q. 5. The above cross is known as

- (A) Monohybrid cross
(B) Dihybrid cross
(C) Test cross
(D) Back cross

Ans. Option (B) is correct.

Explanation: A cross between two plants, which differ in two pairs of contrasting characters are called dihybrid cross.

IV. Read the passage and answer any of the four questions from Q.1. to Q.5. given below:

There were three animals: A, B and C. The animal A can fly but animal B can only run on ground or walls. However, the forelimbs of animal A and B, both have same basic design but they were used for different purposes such as flying and running respectively. The animal C became extinct a long time ago. The study of fossils of animal C tells us that it had some features like those of A and some like those of B. In fact, animal C is said to form a connecting link in the evolutionary chain of A and B.

Q. 1. The animal C is

- (A) Trilobite (B) Archaeopteryx
(C) Peripatus (D) Lamprey

Ans. Option (B) is correct.

Explanation: Animal C is Archaeopteryx.

Q. 2. A belongs to _____ and B belongs to _____ group respectively.

- (A) Birds, Reptile (B) Fish, Amphibian
(C) Birds, Mammals (D) Fish, Reptile

Ans. Option (A) is correct.

Explanation: A belongs to birds group while B belongs to reptile group.

Q. 3. _____ name is given to the forelimbs like those of A and B, which have the same basic design but different functions?

- (A) Analogous organs (B) Homologous organs
(C) Vestigial organs (D) None of these

Ans. Option (B) is correct.

Explanation: Homologous organs are similar in origin (or are embryologically similar) but perform different functions.

Q. 4. Which is the correct evolutionary chain involving A, B and C.

- (A) $C \rightarrow A \rightarrow B$ (B) $B \rightarrow C \rightarrow A$

Ans. Option (B) is correct.

Explanation: The correct evolutionary chain is : $B \rightarrow C \rightarrow A$

Q. 5. 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

Ans. Option (D) is correct.

Explanation: Wings of birds and wings of bat are homologous, since, they have same basic design however their origin is different.

V. Read the passage and answer any of the four questions from Q.1. to Q.5.

Fossils are formed layer by layer in a sequence. It is a slow process that is totally dependent on where the organism dies. In the ocean, fossils are settled at the bottom in the soil or sand. In the course of time, these layers changed into rocks due to the presence of the water above and also due to chemical reactions. The distribution pattern of fossils shows that the ancient fossils present in the bottom rocks are simple, while the most recent fossils found in the upper strata are highly evolved. It means fossils form and become more and more complex as we proceed from earliest to recent rocks.

- Q. 1.** 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

Ans. Option (B) is correct.

Explanation: Fossils refer to the petrified remains of organisms that lived in the past and get preserved in rocks. The fossil position in the layer of earth relates to the time of extinction of organisms. If the fossil of an organism is found in the deeper layers of earth, then it is predicted that extinction of organism has occurred thousands of years ago. Whereas the fossils found closer to the surface are more recent

- Q. 2.** Which of these statements is correct about the importance of fossils in the study of organic evolution?
 (A) It provides missing link between the species.
 (B) They tell us about the prehistoric organisms.
 (C) It help in establishing the time period in which organisms lived.
 (D) All of these

Ans. Option (D) is correct.

Explanation: Fossil provides missing link between the species/who has evolved from whom. They tell us about prehistoric organisms. Also, it help in establishing the time period in which organisms lived.

- Q. 3.** Which of these organisms is fossilized?

- (A) Trilobite (B) Crab
 (C) Lamprey (D) Shark

Ans. Option (A) is correct.

Explanation: Trilobite is a fossilised organism that is extinct marine arthropods belongs to class Trilobita.

- Q. 4.** 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

Ans. Option (D) is correct.

Explanation: In the context of evolution, the use of feathers by birds for flying means that birds have evolved from reptiles. 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.

- Q. 5.** Which of the following constitutes a fossil?
 (A) A mineralized burrow of an extinct animal
 (B) An unidentified animal found frozen in a glacier
 (C) An ant found inside a block of amber, dating back to 110 million years
 (D) All of the above

Ans. Option (D) is correct.

Explanation: All the given options constitute a fossil.

VI. Read the below passage and answer any of the four questions from Q.1. to Q.5.

Meena studied forelimbs of three organisms and she found that organism X had long and short bones, covered with muscles, which are used for running. The organism Y had long and short bones, covered with feathers used for flying. The organism Z has a layer of a complex chemical with supporting framework which is not made of bones and which is used for flying.

- Q. 1.** To which class does the organism X, Y and Z belongs to?
 (A) Insects (B) Mammal
 (C) Reptiles (D) Aves

Ans. Option (A) is correct.

Explanation: Organisms X and Y are vertebrates. X is a mammal whereas Y is a bird. Z is an insect (invertebrate).

- Q. 2.** The name given to the forelimbs of organisms X and Y?
 (A) Homologous organs
 (B) Analogous organs

- (C) Vestigial organs
- (D) Fossils

Ans. Option (A) is correct.

Explanation: Forelimbs of vertebrates are homologous organs, *i.e.*, organs having same fundamental structure but perform different functions.

Q. 3. The name is given to the forelimbs of organisms Y and Z is:

- (A) Homologous organs
- (B) Analogous organs
- (C) Vestigial organs
- (D) Fossils

Ans. Option (B) is correct.

Explanation: Wings of insects and wings of birds are analogous organs, *i.e.*, organs having similar functions but different in their structural details and origin.

Q. 4. Which of the following are examples of homologous origin?

- (A) Wings of pigeon and mosquito
- (B) Wings of pigeon and housefly

- (C) Wings of pigeon and arms of man
- (D) Wings of bat, housefly and butterfly

Ans. Option (C) is correct.

Explanation: The wings of a pigeon and the arms of a man are homologous.

Q. 5. Analogous structures are

- (A) Structurally similar
- (B) Functionally similar
- (C) Structurally and functionally similar
- (D) Normally non-functional

Ans. Option (B) is correct.

Explanation: Analogous organs have different origin but perform similar functions. For example, the wings of a bird and a bat are similar in function but this similarity does not mean that these animals are more closely related. If we carefully look at these structures, then we will find that the wings of a bat are just the folds of skin that are stretched between its fingers whereas the wings of birds are present all along the arm. Therefore, these organs are analogous organs.

