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Chapter 7: Evolution

NCERT Exemplar · Class 12 · Biology

Multiple Choice Questions

Question 1

Which of the following is used as an atmospheric pollution indicator?

A.

Lepidoptera

B.

Lichens

C.

Lycopersicon

D.

Lycopodium

Answer

Correct option: B

Solution

Ans: (b) Lichens

Question 2

The theory of spontaneous generation stated that:

A.

life arose from living forms only

B.

life can arise from both living and nonliving

C.

life can arise from non-living things only.

D.

life arises spontaneously, neither from living nor from the non-living.

Answer

Correct option: C

Solution

Ans: (c) life can arise from non-living things only.

Question 3

Animal husbandry and plant breeding programmes are examples of:

A.

reverse evolution

B.

artificial selection

C.

mutation

D.

natural selection

Answer

Correct option: B

Solution

Ans: (b) artificial selection

Question 4

Palaeontological evidences for evolution refer to the:

A.

development of embryo

B.

homologous organs

C.

fossils

D.

analogous organs

Answer

Correct option: C

Solution

Ans: (c) fossils

Question 5

The bones of forelimbs of whale, bat, cheetah, and man are similar in structure, because:

A.

one organism has given rise to another

B.

they share a common ancestor

C.

they perform the same function

D.

they have biochemical similarities

Answer

Correct option: B

Solution

Ans: (b) they share a common ancestor

Question 6

Analogous organs arise due to:

A.

divergent evolution

B.

artificial selection

C.

genetic drift

D.

convergent evolution

Answer

Correct option: D

Solution

Ans: (d) convergent evolution

Question 7

$(p+q)^2 = p^2 + 2pq + q^2 = 1$ represents an equation used in:

A.

population genetics

B.

mendelian genetics

C.

biometrics

D.

molecular genetics

Answer

Correct option: A

Solution

Ans: (a) population genetics

Question 8

Appearance of antibiotic-resistant bacteria is an example of:

A.

adaptive radiation

B.

transduction

C.

pre-existing variation in the population

D.

divergent evolution

Answer

Correct option: C

Solution

Ans: (c) pre-existing variation in the population

Question 9

Evolution of life shows that life forms had a trend of moving from:

A.

land to water

B.

dryland to wetland

C.

freshwater to seawater

D.

water to land

Answer

Correct option: D

Solution

Ans: (d) water to land

Question 10

Viviparity is considered to be more evolved because:

looked after they are born leading to more chances of survival

A.

the young ones are left on their own

B.

the young ones are protected by a thick shell

C.

the young ones are protected inside the mother's body and are

D.

the embryo takes a long time to develop

Answer

Correct option: C

Solution

Ans: (c) the young ones are protected inside the mother's body and are looked after they are born leading to more chances of survival

Explanation: In viviparity, the young ones are protected inside the mother's body and are looked after after they are born leading to more chances of survival.

Question 11

Fossils are generally found in:

A.

Sedimentary rocks

B.

Igneous rocks

C.

Metamorphic rocks

D.

Any type of rock

Answer

Correct option: A

Solution

Ans: (a) Sedimentary rocks

Explanation: Sedimentary rocks are formed over time and have less pressure and heat than metamorphic and igneous rocks enabling the preservation of fossils.

Question 12

For the MN-blood group system, the frequencies of M and N alleles are 0.7 and 0.3, respectively. The expected frequency of MN-blood group bearing organisms is likely to be

A.

42%

B.

49%

C.

9%

D.

58%

Answer

Correct option: A

Solution

Ans: (a) 42%

Explanation: Hardy Weinberg's Principle states, the allele frequency in a population remains constant and it is shown through a binomial expansion of $(p+q)^2$.

$$\text{i.e. } (p+q)^2 = p^2 + q^2 + 2pq = 1$$

$$M=0.7 = p, \quad N=0.3 = q$$

$$(M+N)^2 = (0.7)^2 + (0.3)^2 + 2 \cdot 0.7 \times 0.3 + (0.3)^2$$

$$= 0.49 + 0.09 + 0.42$$

$$\text{Frequency of MN} = 2pq = 2 \cdot MN = 0.42 = 42\%$$

Therefore, the expected frequency of MN blood group is 42%.

Question 13

Which type of selection explains industrial melanism observed in moth, *Biston betularia*:

A.

Stabilising

B.

Directional

C.

Disruptive

D.

Artificial

Answer

Correct option: B

Solution

Ans: (b) Directional

Explanation: In directional selection size of the population changes, the population changes towards one specific direction.

Question 14

The most accepted line of descent in human evolution is:

A.

Australopithecus - Ramapithecus - Homo sapiens - Homo habilis

B.

Homo erectus - Homo habilis - Homo sapiens

C.

Ramapithecus - Homo habilis - Homo erectus - Homo sapiens

D.

Australopithecus - Ramapithecus - Homo erectus - Homo habilis - Homo sapiens.

Answer

Correct option: C

Solution

Ans: (c) Ramapithecus - Homo habilis - Homo erectus - Homo sapiens

Explanation: Human evolution started from Ramapithecus about 14-15 million years ago. Then about 2 million years ago Homo habilis appeared. Then the Homo erectus and around 10,000 years ago modern man appeared.

Question 15

Which of the following is an example for link species?

A.

Lobe fish

B.

Dodo bird

C.

Seaweed

D.

Chimpanzee

Answer

Correct option: A

Solution

Ans: (a) Lobe fish

Explanation: Lobe fish belongs to bony fishes, and show characters from other two groups of animals, therefore they are considered link species.

Question 16

Match the scientists listed under column 'I' with ideas listed in column 'II'.

Column A		Column B	
A.	Darwin	i.	Abiogenesis
B.	Oparin	ii.	Use and disuse of organs
C.	Lamarck	iii.	Continental drift theory
D.	Wagner	iv.	Evolution by natural selection

A.

A-i; B-iv; C-ii; D-iii

B.

A-iv; B-i; C-ii; D-iii

C.

A-ii; B-iv; C-iii; D-i

D.

A-iv; B-iii; C-ii; D-i

Answer

Correct option: B

Solution

Ans: (b) A-iv; B-i; C-ii; D-iii

Column A	Column B
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A.	Darwin	iv.	Evolution by natural selection
B.	Oparin	i.	Abiogenesis
C.	Lamarck	ii.	Use and disuse of organs
D.	Wagner	iii.	Continental drift theory

Question 17

In 1953 S. L. Miller created primitive earth conditions in the laboratory and gave experimental evidence for the origin of the first form of life from preexisting non-living organic molecules. The primitive earth conditions created include:

containing CH₄, NH₃ et(c)

A.

low temperature, volcanic storms, an atmosphere rich in oxygen

B.

low temperature, volcanic storms, reducing atmosphere

C.

high temperature, volcanic storms, non-reducing atmosphere

D.

high temperature, volcanic storms, reducing atmosphere

Answer

Correct option: D

Solution

Ans: (d) high temperature, volcanic storms, reducing atmosphere

containing CH₄, NH₃ et(c)

Question 18

Variations during mutations of meiotic recombination are:

A.

random and directionless

B.

random and directional

C.

small and directional

D.

random, small, and directional

Answer

Correct option: A

Solution

Ans: (a) random and directionless

Explanation: Mutation is a sudden inheritable change in the DNA. It appears in all directions.

Very Short Answer Questions**Question 1**

What were the characteristics of life forms that had been fossilized?

Solution

Ans: Life forms had some hard parts such as Bones, teeth, etc. which could be fossilized.

Question 2

Did aquatic life forms get fossilized? If, yes where do we come across such fossils?

Solution

Ans: Yes, aquatic life forms get fossilized. Many of these fossils have been discovered in oil wells. Many more have been discovered in sedimentary rocks as a result of sedimentation filling up many water bodies.

Question 3

What are we referring to? When we say 'simple organisms' or 'complex organisms'.

Solution

Ans: When we say 'simple organisms' or 'complex organisms' we refer to the complexity of the division of labor, metabolism, and the level of organization in the organisms.

Question 4

How do we compute the age of a living tree?

Solution

Ans: We can compute the age of a tree by counting the number of annual rings or with the help of carbon dating.

Question 5

Give an example for convergent evolution and identify the features towards which they are converging.

Solution

Ans: Flippers of dolphins and penguins are examples of convergent evolution. In both of the organisms, flippers have different origins but perform similar functions.

Question 6

How do we compute the age of a fossil?

Solution

Ans: Age of fossil is computed by using carbon dating. The presence of radioactive carbon is calculated to compute the age of a rock.

Question 7

What is the most important precondition for adaptive radiation?

Solution

Ans: The most important precondition for radiation is common ancestry.

Question 8

How do we compute the age of a rock?

Solution

Ans: The age of the rock is computed by using radiocarbon dating. The presence of radioactive carbon is calculated to compute the age of a rock.

Question 9

When we talk of functional macromolecules (e.g. proteins as enzymes, hormones, receptors, antibodies, etc), what are they evolving?

Solution

Ans: Functional macromolecules are evolving towards living forms.

Question 10

In a certain population, the frequency of three genotypes is as follows:

Genotypes	BB	Bb	Bb
Frequency	22%	62%	16%

What is the likely frequency of B and b alleles?

Solution

Ans: Frequency of B alleles = BB +

$$\frac{1}{2}$$

Bb

$$= 22\% + 31\%$$

$$= 53\%$$

Frequency of b alleles = bb +

$$\frac{1}{2}$$

Bb

$$= 16\% + 31\%$$

$$= 47\%$$

Question 11

Among the five factors that are known to affect Hardy-Weinberg equilibrium, three factors are gene flow, genetic drift, and genetic recombination. What are the other two factors?

Solution

Ans: The two factors are: Natural selection and Mutation

Question 12

What is founder effect?

Solution

Ans: There is the loss of genetic variation when a small group of individuals becomes isolated from a larger population.

Question 13

Who among the Dryopithecus and Ramapithecus was more man-like?

Solution

Ans: Ramapithecus

Question 14

By what Latin name the first hominid was known?

Solution

Ans: Homo habilis

Question 15

Among Ramapithecus, Australopithecines and Homo habilis - who probably did not eat meat?

Solution

Ans: Homo habilis

Short Answer Questions

Question 1

Louis Pasteur's experiments, if you recall, proved that life can arise from only pre-existing life. Can we correct this as life evolves from pre-existent life or otherwise we will never answer the question as to how the first forms of life arose? Comment.

Solution

Ans: Louis Pasteur used a sterile flask and another one that was open to the air. New yeast organisms were developed in a flask that was open to air, but in the sterilized flask yeast did not produce new organisms. This experiment contributed to the rejection of the spontaneous generation theory. Miller's later experiment, on the other hand, demonstrated that organic molecules may evolve from inorganic molecules, leading to the origin of life. Therefore, we can correct the statement that the first form of life could have arisen from pre-existing non-living organic molecules.

Question 2

Scientists believe that evolution is gradual. But extinction, part of the evolutionary story, is 'sudden' and 'abrupt' and also group-specific. Comment whether a natural disaster can be the cause for extinction of species.

Solution

Ans: Natural disasters such as earthquakes can result in the extinction of species. A majority of scientists believe that a meteor struck the earth, causing widespread destruction and the extinction of dinosaurs.

Question 3

Why is nascent oxygen supported to be toxic to aerobic life forms?

Solution

Ans: Nascent oxygen is highly reactive. It can react easily and cause a reaction with a variety of compounds, including DNA and proteins found in cells of aerobic life forms. This may result in Mutations and unfavorable metabolic changes.

Question 4

While the creation and presence of variation is directionless, natural selection is directional as it is in the context of adaptation. Comment.

Solution

Ans: Variation continues to appear in each generation. However, because nature may not support such variations, most of them are not retained by the organism. When a new recombinant passes the test of natural selection, then only it is inherited in species through generation to generation. As a result, creation and the presence of variation can be considered to be directionless, but natural selection and adaptation are directional.

Question 5

The evolutionary story of moths in England during industrialization reveals, that 'evolution is apparently reversible'. Clarify this statement.

Solution

Ans: In England before industrialization, the white-winged moths were able to thrive because whitish lichens and moss flourished on tree trunks. White-winged moths blended very well and therefore had better chances of survival against the whitish background. But when the industrial revolution started the tree trunks turned dark, Lichens and mosses did not survive. As a result, the population of white-winged moths decreased and the population of dark-winged moths increased. Thus, the evolution of white-winged moth reversed due to industrialization.

Question 6

Comment on the statement that "evolution and natural selections are end result or consequence of some other processes but themselves are not processed".

Solution

Ans: It is controversial whether evolution and natural selection are processes in and of themselves, or if they are the end result or consequence of other processes. When we talk about the success of life on Earth, we consider evolution and natural selection to be processes. However, when discussing how life arose from primitive beginnings, evolution and natural selection appear to be the outcomes of other processes. This is still a debatable topic in the scientific community.

Question 7

State and explain any three factors affecting allele frequency in populations.

Solution

Ans: The allele frequency in population can be affected by the following factors:

1. Mutation: Mutation is a sudden inheritable change in the DNA, it leads to the formation of new species and therefore changes in allelic frequency.
2. Natural Selection: Natural selection theory states that Nature only selects the fittest organisms which survive in changed environmental conditions.

3. Genetic Recombination: The new organism or traits produced that differ from parents is called genetic recombination.
-

Question 8

Gene flow occurs through generations. Gene flow can occur across language barriers in humans. If we have a technique of measuring specific allele frequencies in different populations of the world, can we not predict human migratory patterns in pre-history and history? Do you agree or disagree? Provide an explanation of your answer.

Solution

Ans: Yes, I agree. Gene flow occurs across generations. The project known as Human Genome Project has used specific genes/chromosomes and mitochondrial DNA to trace the evolutionary history and migratory patterns of humans. Therefore with the help of HGP by studying specific allele frequencies, we can predict the human migratory patterns in prehistory and history.

Question 9

How do you express the meaning of words like race, breed, cultivars, or variety?

Solution

Ans: Race: Race is a group of people that share similar and distinct physical characteristics. Members of different races of the same species can interbreed.

Breed: Breed is a group of animals that are similar in physical appearance.

Cultivars: Cultivar is a selected group of plants that can be propagated through vegetative parts.

Variety: Variety is a taxonomic category that ranks below species level in the plant kingdom.

Question 10

When we say "survival of the fittest", does it mean that (a) those who are fit only survive, or (b) those that survive are called fit? Comment.

Solution

Ans: The “survival of the fittest” means the organisms with suitable and useful adaptations survive and reproduce in the varied environmental conditions that are known to be fit.

Question 11

Enumerate the three most characteristic criteria for designating a Mendelian population.

Solution

Ans: The three most important criteria for the mendelian population :

1. The population must be sufficiently large
 2. The population must have potentialities for the free flow of genetic material among individuals.
 3. Migration should be nil or negligible in the population.
-

Question 12

"Migration may enhance or blur the effects of selection". Comment.

Solution

Ans: Migration can enhance the natural selection process by bringing in alleles and traits within the population. And it can blur the effect of selection by removing the useful traits and genes from the population.

Long Answer Questions

Question 1

Name the law that states that the sum of allelic frequencies in a population remains constant. What are the five factors that influence these values?

Solution

Ans: Hardy Weinberg Principle, also known as Hardy Weinberg Law.

The law states that the sum of allelic frequencies in a population remains constant from generation to generation in the absence of disturbing factors.

Hardy Weinberg Equation: $(p+q)^2 = p^2+2pq+q^2=1$

Where p is the frequency of dominant allele

q is the frequency of recessive allele

p^2 is the frequency of homozygous dominant allele

$2pq$ is the frequency of individuals with heterozygous genotype

q^2 is the frequency of individuals with the homozygous recessive allele

The extent of evolutionary change can be evaluated by measuring the difference between the values.

The factors that influence these values are as follows :

- (a) Gene migration or gene flow
- (b) Genetic drift
- (c) Genetic recombination
- (d) Mutation
- (e) Natural selection

Question 2

Explain divergent evolution in detail. What is the driving force behind it?

Solution

Ans: Divergent evolution is when there are two organisms or species having common ancestors but different characteristics due to adaptation. These organisms are in different habitats and share similar anatomical structures but perform different functions. This is known as Divergent evolution. For

example, the forelimbs of Whales, bats, Human and Cheetah are similar in structure but they perform different functions.

Divergent evolution occurs due to the changed environmental conditions. The driving force behind this evolution is an adaptation to a new habitat and altering environmental conditions.

Question 3

You have studied the story of Pepper moths in England. Had the industries been removed, what impact could it have on the moth population? Discuss.

Solution

Ans: In England, Two varieties of Pepper moths were present in the population. But before industrialization, the number of White-winged Pepper moths was much higher than the black-winged moths. Colored wings help in camouflage. Therefore they were not spotted by the predators due to their camouflage they blended very well in the moss and lichens-covered trees.

After the industrial revolution, tree trunks became dark, lichens did not survive. As a result, the black-winged moth population started increasing because the dark tree trunk helped them to camouflage. And now the white ones were easily spotted and killed by the predators. Again if the industries are removed the population of Black-winged moths will decrease and the population of white-winged moths will increase.

Question 4

What are the key concepts in the evolution theory of Darwin?

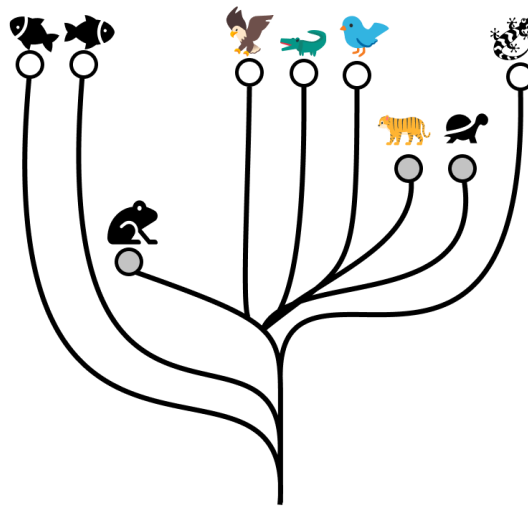
Solution

Ans: Darwin's theory of evolution was based on two key concepts:

Branching descent and natural selection.

- **Branching descent:** This is usually referred to as the "Tree of life". Every organism originated from a single common ancestor. Every new species is developed by adaptation to new environmental

conditions. Ex. Darwin's finches arose from grain eaters, Australian marsupials evolved from common marsupials.



- As the following diagram shows that the various life forms we see today have evolved from one common ancestor. One branch evolved into fishes, another one evolved into amphibians. The third branch has given rise to various terrestrial animals: reptiles, aves, and mammals.
- Natural Selection: According to Darwin's theory, only the fittest organisms can survive the changing environmental conditions. Every living trying to cope with the changed environmental conditions by developing certain adaptations. Only those organisms with suitable adaptation are capable of surviving. Therefore, natural selection is an important phenomenon in evolution.

Question 5

Two organisms occupying a particular geographical area (say desert) show similar adaptive strategies. Take examples, describe the phenomenon.

Solution

Ans: Two organisms occupying a particular geographical area may show similar adaptive strategies, this phenomenon is known as convergent evolution. This is because both organisms are reacting to the same environmental conditions.

For Example, *Cereus peruvianus* and *euphorbia virosa*, are desert plants and not related to one another. Both of the species show similar adaptations:

- Stem modification: Fleshy stem, green succulent parts store water and perform the function of photosynthesis.
- Leaf modification: Leaves are modified into spines to reduce water loss.
- Root modification: Roots penetrate deep into the ground to access groundwater.

Analogous organs that are indications of convergent evolution are depicted in these examples.

Question 6

We are told that evolution is a continuing phenomenon for all living things. Are humans also evolving? Justify your answer.

Solution

Ans: Evolution is a continuous process. Microevolution goes on continuously and there are inheritable gradual changes in the organism and its population.

The evolution process is continuous in human beings also as it takes place in all living beings. All the modern-day organisms are descended from their ancestors. Modern man *Homo sapiens* arose from the ancestors that are *Ramapithecus*, *Australopithecus*, *Homo habilis*, *Homo erectus*, Neanderthal man, Cro-Magnon man, etc.

- The average human life expectancy has increased, it is almost double the of primitive times.
- All the other animals develop lactose intolerance in adulthood. Other mammals do not have the facility to consume other mammals' milk. But human beings can consume milk throughout life and rarely develop lactose intolerance.
- Humans have developed resistance to many infectious diseases.

These are the signs of evolution. Although evolution can take place through geographical isolation and genetic drift.

Question 7

Had Darwin been aware of Mendel's work, would he have been able to explain the origin of variations. Discuss.

Solution

Ans: Gregor Mendel and Charles Darwin were born in the same era. Darwin was apparently aware of Mendel's work but could not explain the origins of Variation. Mendel proposed his theories and principles of genetics. His work was extensively limited to particular species and he put forward laws about the inheritance and variations among the organisms. The parent's genotype is responsible for offspring's character has been proved by Mendel through his Pigeon Pea plant experiments. And at the time Darwin seems to ignore the fact that the variation among the population of the organism is due to their genes or alleles. There are many other factors that may change the allele frequency, for example, Mutation, Genetic recombination, genetic drift, etc. So, after many generations, there would be a change in the gene pool, organism's characteristics, and therefore new forms appear to arise in the population.