7

Evolution

Multiple Choice Questions (MCQs)

Q. 1 Which of the following is used as an atmospheric pollution indicator?

(a) Lepidoptera (b) Lichens (c) *Lycopersicon* (d) *Lycopodium*

Ans. *(b)* Lichens can be used as an atmospheric pollution indicator. They do not grow in areas that are polluted, as they are sensitive (especially phycobiont) to oxides of nitrogen and sulphur, hence unable to synthesise organic food and do not grow well.

Lepidoptera It is insect order.

Lycopersicon It is scientific name of tomato.

Lycopodium It is an pteridophyte.

Q. 2 The theory of spontaneous generation stated that

(a) life arose from living forms only

(b) life can arise from both living and non-living

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

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

Ans. *(c)* The theory of spontaneous generation stated that life can arise from non-living things only. It is also known as abiogenesis.

Louis Pasteur by careful experimentation disapproved this theory and demonstrated that life arose from living forms (pre-existing life).

Q. 3 Animal husbandry and plant breeding programmes are the examples of

(a) reverse evolution (b) artificial selection

(c) mutation (d) natural selection

Ans. *(b) These are examples of artificial selection*

'Artificial selection' is a process in which the breeder choose to perpetuate only those forms that have certain desirable inheritable characteristics.

The other three options are incorrect as mutation is a sudden change in DNA sequence due to mutagenic agents such as chemicals and radiations.

Natural selection is a gradual process by which biological traits become either more or less common in a population as a function of the effect of the changing environment.

Reverse evolution or **devolution** is a notion that species can change into more primitive forms over time.

Q. 4 Palaeontological evidences for evolution refer to the

(a) development of embryo
(b) homologous organs
(c) fossils
(d) analogous organs

Ans. *(c)* Palaeontological evidences for evolution refer to the evidences from fossils. Fossils are the preserved remains or traces of organisms from the distant past. The study of fossils is called Palaeontology. The other options are not correct because the development patterns of embryo refer to embryological evidences for evolution.

Homologous and analogous organs provide evidences for comparative anatomy and morphology.

Q. 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) the have biochemical similarities

Ans. *(b)* The bones of forelimbs of whale, bat, cheetah and man are similar in structure, because they have a common ancestor.

These are homologous organs which have different functions across diverse forms, but are developed along same pattern. These organs arise due to divergent evolution.

Q. 6 Analogous organs arise due to

(a) divergent evolution
(b) artificial selection
(c) genetic drift
(d) convergent evolution

Ans. *(d)* Analogous organs arise due to convergent evolution. These are the organs which have similar functions, but are different in their structural details and origin, *e.g.,* wings of insect and bird.

The other three options are incorrect, because divergent evolution give rise to homologous organs, genetic drift can contribute to speciation and artificial selection is used to produce improved varieties of animals and plants.

Q. 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

Ans. *(a)* $(p + q)^2 = p^2 + 2pq + q^2 = 1$ represents an equation used in population genetics.

It is a mathematical representation of 'Hardy-Weinberg principle'. This principle says that allele frequencies in a population are stable and is constant from generation to generation, *i.e.,* the gene pool remains a constant.

Q. 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

Ans. *(c)* Appearance of antibiotic-resistant bacteria is an example of pre-existing variation in the population. When a bacterial population encounters a particular antibiotic, those sensitive to it die.

But some bacteria having mutations become resistant to the antibiotic. Soon, the resistance providing genes become widespread and the entire population becomes resistant.

It is not due to adaptive radiation because adaptive radiation is development of different functional structures from a common ancestral form. Which is also known as divergent evolution.

Transduction is a process whereby, foreign DNA is introduced into another cell *via* a viral vector.

Q. 9 Evolution of life shows that life forms had a trend of moving from

(a) land to water
(b) dryland to wet land
(c) freshwater to sea water
(d) water to land

Ans. *(d)* Evolution of life shows that life forms had a trend of moving from water to land. The early vertebrates were fishes (which lived in only water). Some fishes gradually changed into amphibians (can live both on land and in water).

Certain amphibians then transformed into the reptiles (live on land) some of the latter finally evolved into birds (can fly) and than mammals. Thus, showing life forms moved from water to land.

Q. 10 Viviparity is considered to be more evolved because

(a) the young ones are left on their own
(b) the young ones are protected by a thicks shell
(c) the young ones are protected inside the mother's body and are looked after they are born leading to more chances of survival
(d) the embryo takes a long time to develop

Ans. *(c)* Viviparity is considered to be more evolved because the youngs ones are protected inside the mother's body and are looked after once they are born, leading to more chances of survival, *e.g.,* mammals.

However, in oviparity, the female lays fertilised/unfertilised eggs covered by a hard calcareous shell in a safe place in the environment. The chances of survival are less as the young ones are left on their own.

Q. 11 Fossils are generally found in

(a) sedimentary rocks
(b) igneous rocks
(c) metamorphic rocks
(d) any type of rock

Ans. *(a)* Fossils are generally found in sedimentary rocks, which are formed by the gradual deposition of silt, sand or calcium carbonate over millions of years in regions such as lakes or sea during their formation, the dead animals are carried to the sea or large lake, sink down and get burried in the rocks. The animals, thus preserved in the rocks, are converted into fossils.

Q. 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%

Ans. ***(a)*** The expected frequency of MN blood group bearings organisms is likely to be 42%.

According to Hardy-Weinberg equation, $p^2 + 2pq + q^2 = 1$

where, p = Frequency of M alleles,

p^2 = Frequency of homozygous dominant individuals.

q = frequency of N alleles

q^2 = Frequency of homozygous recessive individuals.

$2Pq$ = Frequency of heterozygous individuals.

So, $(0.7)^2 + (0.3)^2 + 2\ pq = 1$

$0.49 + 0.09 + 2\ pq = 1$

$\therefore \quad 2pq = 0.42$ = Frequency of heterozygous individuals.

i.e., 42%

Q. 13 Which type of selection is industrial melanism observed in moth, Biston betularia

(a) Stabilising (b) Directional
(c) Disruptive (d) Artificial

Ans. ***(b)*** **Directional selection** is observed in moth, *Biston betularia* is industrial melanism. Under this, individuals at one end of the frequency distribution do well light and so more individuals of that type will be present in next generation.

The other options are incorrect because in **stabilising selection,** average sized individuals are favoured. *e.g.,* weight of new-born babies and in **disruptive selection** both extremes are favoured, while intermediate varieties are eleminated, *e.g.,* black bellied seed cracker, *Pyrenestes ostrinus.*

In artificial selection, the individuals with desirable characteristics are deliberately selected to produce a progeny with all those characteristics.

Q. 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 sapiens*
(d) *Australopithecus* → *Ramapithecus* → *Homo erectus* → *Homo habilis* → *Homo sapiens*

Ans. *(c)* The most accepted line of descent in human evolution is *Ramapithecus→ Homo habilis→ Homo erectus→ Homo sapiens.*

Human Evolution	Characteristics
Ramapithecus	Survived about 14-15 mya, walked erect on its hind legs, arise fro0m *Dryopithecus.*
Australopithecus	Lived from 4-1-5 mya in caves, had omnivorous diet. Fully bipedal hominid
Homo habilis	First human like being Did not eat meat, brain capacity 650-800 cc
Homo erectus	Lived about 1.5 mya Brain capacity around 900 cc, and ate meat
Homo sapiens	Brain capacity averages 1450 cc. Erect posture and limbs straight.

Q. 15 Which of the following is an example for link, species?

(a) Lobe fish (b) Dodo bird
(c) Sea weed (d) Chimpanzee

Ans. *(a)* Lobe fish is an example for link species.

About 350 mya, fish with stout and strong fins could move on land and go back to water. These were called lobe and they evolved into the first amphibians that lived on both land and water, *e.g.,* coelocanth.

Dodo is an extinct flightless bird. Sea weed is multicellular benthic marine algae chimpanzees are the closest living relatives of humans.

Q.16 Match the scientists listed under column I with ideas listed column II.

Column I		Column II	
A.	Darwin	1.	Abiogenesis
B.	Oparin	2.	Use and disuse of organs
C.	Lamarck	3.	Continental drift theory
D.	Wagner	4,	Evolution by natural selection

Codes

	A	B	C	D		A	B	C	D
(a)	1	4	2	3	(b)	4	1	2	3
(c)	2	4	3	1	(d)	4	3	2	1

Ans. *(b)* **Darwin** is related with evolution by natural selection. According to the theory in the struggle for existence, the individuals which have more favourable variations will survive and reproduce, while others, which have less favourable or unfavourable variations will not puripetuate.

Oparin Put forth abiogenesis theory.

According to abiogenesis Life is originated from the non-living things spontaneously.

Lamarck Use and disuse of organs is one of the important principle of Lamarckism.

Wagner proposed continental drift theory.

It states that part of the Earth's crust slowly drift atop a liquid core forming different continents. As these continents had different environmental conditions, so plants and animals evolved.

Q. 17 In 1953 SL Miller created primitive earth conditions in the laboratory and gave experimental evidence for origin of first form of life from pre-existing non-living organic molecules. The primitive earth conditions created include

(a) low temperature, volcanic storms, 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 containing CH_4, NH_3 etc.

Ans. ***(d)*** The Miller – Urey experiment tested for the occurrence of chemical evolution by stimulating hypothetical conditions present on early earth.

These primitive earth conditions include high temperature, volcanic storms and reducing environment containing methane (CH_4), ammonia (NH_3), hydrogen (H_2) and water (H_2O).

They ultimately found that a large number of simple organic compounds including some amino acids such as alanine, glycine and aspartic acid can be synthesised in into as during chemical origin of life.

Q. 18 Variations during mutations of meiotic recombinations are

(a) random and directionless (b) random and directional

(c) random and small (d) random, small and directional

Ans. ***(a)*** Variations during mutations of meiotic recombinations are random and directionless.

Hugo de Vries based on his work on evening primrose stated that it is mutation which causes sudden appearance of variations that results in speciation.

He stated that mutations are sudden, heritable and persistant in successive generation. He contradicted Darwinian variations that are small and directional.

Very Short Answer Type Questions

Q. 1 What were the characteristics of life forms that had been fossilised?

Thinking Process

Fossils are formed and preserved over times so, all organisms are not equally likely to fossilis. It is based towards organisms with hard parts such as bones of vertebrates or calcareous exoskeleton of invertebrates.

Ans. The organisms with hard parts are likely to be fossilised, than those who do not have such parts. The harder the material, better it would be preserved soft parts fossils occur rarely, *e.g.,* birds and pterosaurs have very light bones, hollowed out and specialised for flight.

So, they have sparser fossil record as compared to mammals, whose bones are partially mineralised during life.

Q. 2 Did aquatic life forms get fossilised? If, yes where do we come across such fossils?

Thinking Process

The geological changes that took place over time transformed many water-bodies into solid rocks and mountains, so fossils of aquatic organism are more likely to be found in mountains.

And. *Yes*, aquatic forms of life do get fossilised, infact, there are more aquatic than terrestrial fossil organisms. Such fossils of sea creatures are found in mountains as opposed to deep sea beds.

This is because the rocks in which the fossils are found used to be at the bottom of oceans. Due to the changes in the crustal plates over time, the ocean sediments were pushed up to form mountains.

Q. 3 What are we referring to when we say 'simple organisms' or 'complex organisms'?

Ans. These terms are used to classify organisms according to their evolutionary history.

Simple organisms refer to those organisms that have simple structural and functional organisation and are considered primitive, whereas **Complex organisms** refer to those organisms that have higher and complex levels of structural and functional organisation.

These are more advanced and said to have arisen from simple organisms.

Q. 4 How do we compute the age of a living tree?

Ans. *To estimate the age of a living tree, following steps are required*

(i) Measure the circumference of the tree trunk (at about 4.5 feet above the ground).

(ii) Calculate the diameter of the trunk. This is done by dividing the circumference by 3.14. Divide this (*i.e.,* diameter) by 2 to get the radius.

(iii) Determine the growth factor. A tree's growth factor is the measurement of the width it gains annually. The trees's growth factor can be seen from the data available or by measuring the rings of a dead tree from the same species.

(iv) Multiply the diameter and the tree species average growth factor and the so done calculating suggest the approximate age of the tree in years.

Q. 5 Give an example for convergent evolution and identify the features towards which they are converging.

Ans. When unrelated animals converging to the same form or structure, that is very adaptive in their common environment. It is called **convergent evolution,** *e.g.,* Australian marsupials and placental mammals.

Such as (placental wolf and Tasmanian wolf). These two sub-classes of mammals have adapted in similar ways to a particular food supply, locomotor skill or climate.

Their resemblances in overall shape, locomotor mode and feeding and foraging are superimposed upon different modes of reproduction, the feature that accurately reflects their distinct evolutionary relationships.

Q. 6 How do we compute the age of a fossil?

Ans. The age of a fossil can be computed by **radioactive dating** (also called radiometric dating). It is a technique based on a comparison between the observed abundance of a naturally occurring radioactive isotope and its decay products, using known decay rates.

Among the best known techniques are radiocarbon dating, potassium-argon dating and uranium lead dating.

Q. 7 What is the most important pre-condition for adaptive radiation?

Ans. **Conditions promoting adaptive radiation** are much of the diversity of life originated through episodes of adaptive radiation during periods when **ecological space** became available for diversification. There are two primary mechanisms through which ecological space can become available.

(i) intrinsic changes in organisms.

(ii) extrinsic effects, including environmental change and colonisation of isolated landmasses.

Q. 8 How do we compute the age of a rock?

Ans. The age of a rock in years is called its absolute age. It is determined by the natural radioactive decay of certain elements, *e.g.,* uranium, when decays turns into lead. The parent atoms of uranium are converted into daughter atoms of lead over a fixed interval of time. This interval is the **decay constant**.

The ratio of parent-daughter atoms changes in a quantity that can be measured.

The **radioactive half-life** (the amount of time required for one half of the parent atoms to beonverted to daughter atoms) is used to calculate the age of the rock.

Q. 9 When we talk of functional macromolecules (*e.g.,* proteins as enzymes, hormones, receptors, antibodies etc), towards what are they evolving?

Ans. Functional macromolecules are evolving towards creation of a complex organism. There are various evidences that are common to simple and complex forms of lite indicate common ancestry, *e.g.,* histones protein tend to be well preserved among all eukaryotes, from amoebas to blue whale or to humans, with only one or two amino acids different.

The genetic code is nearly identical for all known life forms, from bacteria to archaea or animals and plants.

Q. 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?

Thinking Process

According to Hardy-Weinberg equilibrium, $p^2 + 2pq + q^2 = 1$.

Ans. The likely frequency of B = BB + 1/2 Bb

$$= \left[22 + \frac{62}{2}\right]\%$$

$$= 53\%$$

The likely frequency of b = bb + 1/2 Bb

$$= \left[16 + \frac{62}{2}\right]\%$$

$$= 47\%$$

Q. 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?

Ans. The other two factors that affect Hardy-Weinberg equilibrium are **mutation** and **natural selection**.

Mutation is a sudden heritable change in an organism which is generally due to change in the base sequence of the nucleic acid in the organism's genome.

Microbial experiments show that pre-existing advantageous mutations when selected will result in formation of new phenotypes. Over few generations, this would result in speciation. Thus, resulting in changed frequency of genes and alleles.

Natural selection is a phenomenon by which organisms possessing heritable variations enabling their better survival reproduce and leave greater number of progeny than their counterpart.

It can lead to stabilisation (in which more individuals acquire mean character value), directional change (more individuals acquire value other than the mean character value) or disruption (more individuals acquire peripheral character value at both ends of the distribution curve).

Q. 12 What is founder effect?

Ans. Sometimes, a small number of individuals become isolated from a larger population to form a new population at some distance away from their place of origin.

The gene pool of the new population differs from the source population. It is possible that the change in allele frequency is so drastically different in the new sample that they become a different species. The original driftted population becomes **founders** and this effect is called **founder effect**.

Q. 13 Who among the *Dryopithecus* and *Ramapithecus* was more man like?

Ans. *Ramapithecus* was more man-like. It walked erect on its hind legs, ate hard nuts and seeds like modern man and had jaws and teeth similar to humans. It arose from *Dryopithecus*, which was considered to be a common ancestor of man and apes.

Dryopithecus was more ape-like with same length of arms and legs.

Q. 14 By what Latin name, the first Hominid was known?

Ans. The first hominid was known as *Homo habilis*. The brain capacities were between 650-800cc. They probably did not eat meat.

Q. 15 Among *Ramapithecus*, *Australopithecines* and *Homo habilis* who probably did not eat meat?

Ans. *Homo habilis* probably did not eat meat. This creature was the first human like being, with brain capacities between 650-800cc.

Short Answer Type Questions

Q. 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.

Ans. *Yes*, we can correct this as life evolves from pre-existent life. The first life that appeared on earth was apparently the result of chemical evolution, *i.e.,* the life originated from inorganic molecules which formed organic molecules, further forming complex compounds.

This finally resulted into simple cells and then simple organisms, wherein complexity development with time. However, once life originated, abiogenesis could not follow, and hence, life evolved further only through biogenesis, *i.e.,* pre-existent life gave rise to new life.

Q. 2 The scientists believe that evolution is gradual. But extinction, part of evolutionary story, are 'sudden' and 'abrupt' and also group-specific. Comment whether a natural disaster can be the cause for extinction of species.

Ans. *Yes*, a natural disaster can be the cause for extinction of species. As new species evolve to fit ever changing ecological niches, older species fade away. But, the rate of extincition is far from constant.

In last 500 million years, 50 - 90% or more of all species on earth have disappeared in a geological blink of the eye. Many times, these mass extinctions had been the consequence of a natural disaster.

The most studied mass extinction between the Cretaceous and Palaeocene periods about 65 million years ago, killed off the dinosaurs and made room for mammals to rapidly diversify and evolve. The cause is suspected to be volcanic eruptions and impact of large asteroids or comets striking the earth.

Q. 3 Why is nascent oxygen supposed to be toxic to aerobic life forms?

Ans. Nascent oxygen is very reactive and can react with different biomolecules. Nascent oxygen is a permanent oxidising agent. It is highly reactive and can react readily with different kind of molecules including DNA, proteins present in the cells of aerobic life forms.

It is thus, considered toxic if it reacts with DNA, it can lead to mutations and defective proteins, both structural and functional. Similarly if it reacts with proteins and enzymes, they are degraded and many metabolic pathways may hence be impaired.

Q. 4 While creation and presence of variation is directionless, natural selection is directional as it is in the context of adaptation. Comment.

Ans. The creation and presence of variations is directionless in regard that they occur randomly and spontaneously. The variations which are helpful in the adaptations of an organism towards its surroundings would be passed on to next generations.

Natural selection is the most critical evolutionary process, which can be considered directional as it leads to only one path that is selection and perpetuation of better adapted individuals. Natural selection leads to survival of the fittest and disappearance of all those organisms which do not all fit in the preveling environmental conditions.

Q. 5 The evolutionary story of moths in England during industrialisation reveals, that 'evolution is apparently reversible'. Clarify this statement.

Thinking Process

The peppered moths were initially white coloured, then black coloured due to industrialisation. In recent years, the light coloured moths are increasing in population again.

Ans. During the last century in the industrial regions of England, a light coloured peppered moth *Biston betularia* was found on the bark of trees. The tree bark was covered by whitish lichens, so light coloured moths escaped unnoticed from predatory birds.

After industrialisation, barks got covered by smoke, so the white moths were selectively picked up by birds. However, the black coloured moths escaped unnoticed against a dark background and became abundant.

However, in recent years, reduced industrial pollution has led to the growth of lichens again and thus, the population of light coloured moths is again increasing.

This evolutionary story of moths in England, thus reveals, that 'evolution is apparently reversible'

Q. 6 Comment on the statement that 'evolution and natural selection are end result or consequence of some other processes, but themselves are not processes'.

Ans. Evolution helps us to understand the history of life. We can view evolution as a pattern of evolutionary change and as a process as well.

The world we see, all the inanimate and animate, is only the success stories of evolution. When we describe the story of this world, we describe evolution as a process.

On the other hand, when we describe the story of life an earth, we treat evolution as a consequence of a process called natural selection. Natural selection is the outcome of favourable variations among organisms and environmental conditions.

Thus, we are still not very clear whether to regard evolution and natural selection as processes or end result of processes.

Q. 7 State and explain any three factors affecting allele frequency in populations.

Ans. *Factors affecting allele frequency in populations are as described below*

(i) **Mutations** These are sudden heritable changes which are supposed to be the primary source of genetic variation. *They are of following two types*

(a) **Chromosomal Mutations** They arise due to changes in chromosome number and changes in structure.

(b) **Gene Mutations** These are changes in gene structure and expression due to addition, deletion, substitution or inversion of nucleotides.

(ii) **Non-random Mating** Repeated mating between individuals of certain selected traits changes the gene frequency, *e.g.,* selection of more brightly coloured male bird by a female bird may increase the gene frequency of bright colour in the next generation.

(iii) **Gene Flow** (Gene Migration) It is the movement of alleles into and out of a gene pool. Breeding of immigrants with the host population adds new alleles to the gene pool of the host population.

Q. 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 population of the world, can we not predict human migratory patterns in pre-history and history? Do you agree or disagree? Provide explanation to your answer.

Ans. *Yes*, we agree. As the gene flow occurs through geographical barriers over generations, by studying specific allelic frequencies in various populations of the world, we can predict the human migratory patterns in pre-historic and historic era.

There have been projects undertaken such as human genographics project. Which uses data from studies on specific genes/chromosomes/mitochondrial DNA to trace the evolutionary history and migratory patterns of humans.

Q. 9 How do you express the meaning of worlds like race, breed, cultivars or variety?

Ans. *The meaning of the given words are as given below*

Race It is a classification system used to categorise humans into large and distinct populations or groups by anatomical, cultural, linguistic, geographical, historical and for relegious relationship.

Breed It is a specific group of domestic animals or plants having homogenous appearance, homogenous behaviour and other characteristics that distinguish it from other animals or plants of the same species and that were arrived at through selective breeding.

Cultivar It is a plant or grouping of plants selected for desirable characteristics that can be maintained by propogation. 'Cultivar' stands for 'cultivated variety'.

Variety A variety arises naturally in the plant kingdom and plant grown from its seeds will typically come out true to type.

Q. 10 When we say 'survival of the fittest', does it mean that

(a) those which are fit only survive

(b) those that survive are called fit? Comment.

Thinking Process

Those individuals which survice and reproduce in their respective environment are called fit.

Ans. In the struggle for existence, the individuals which have more favourable variations will enjoy a competitive advantage over others which have less favourable or unfavourable variations.

They are considered fit and thus, will survive and reproduce. Such individuals produce more progeny (with more fit individuals) than others who are less adapted in that environment.

Q. 11 Enumerate three most characteristic criteria for designating a Mendelian population.

Ans. *Characteristic criteria for designating a Mendelian population are*

(i) Population must be sufficiently large.

(ii) Population must have potentialities for free flow of genetic material among individuals, through sexual reproduction.

(iii) Migration should either be nil or negligible.

Q. 12 'Migration may enhance or blurr the effects of selection' comment.

Ans. The movement of individuals from one place to another is called **migration**. It can be the movement of individuals to a different populations (*i.e.,* emigration) or movement of individual into a particular population (*i.e.,* cmmigration) Migration may bring in more such alleles, that bestow upon the individuals, such adaptations or traits which are selected by nature. Thus, enhancing the effect of selection.

Similarly, emigration may lead to removal of such alleles that confer better adaptations. Immigration may also bring in those alleles which confer the traits that are not selected by nature, *i.e.,* blurr the effects of selection.

Hence, it is justifiable to say that 'Migration may enhance or blurr the effects of selection.'

Long Answer Type Questions

Q. 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?

Ans. **Hardy-Weinberg Principle** states that the sum of allelic frequencies in a population is stable and is constant from generation to generation, *i.e.,* the gene pool (total genes and their alleles in a population remains constant. This is called genetic equilibrium. *The sum total of all the allelic frequencies is*

Five factors that influence these values are

(i) **Gene Migration or Gene Flow** When migration of a section of population to another place occurs, gene frequencies change in the original as well as in the new population. New genes/alleles are added to the new population and these are lost from the old population. There would be gene flow if this gene migration, happens multiple times.

(ii) **Genetic Drift** It refers to the elimination of the genes of certain traits when a section of population migrates or dies of natural calamity. It is an evolutionary force operating in small populations whereby gene frequency changes by chance leadings to loss of some genes or gain of others irrespective of their selective advantages or disadvantages.

(iii) **Mutation** The sudden heritable change which is directionless in gene is called mutation. It alters the genetic frequency or genetic make up of an individual.

(iv) **Genetic Recombination** This phenomenon occurs during gamete formation when chromosomes pass from parents to offsprings which show new combination of characteristics.

(v) **Natural Selection** It is a phenomenon by which some members of population having traits that enable them to grow and reproduce at higher rater are favoured. Hence, they leave more surviving offspring in the next generation than others.

Q. 2 Explain divergent evolution in detail. What is the driving force behind it?

Ans. **Divergent evolution** is the evolution of a number of different forms of animals or plants froms of a common ancestral form. The driving force behind, it is adaptations to newly involved habitat and the prevailing environmental conditions there. As the original population increases in size, it spreads out from its centre of origin to exploit new habitas and food resources.

In time this results in a number of populations each adapted to its particular habitat, eventually these populations will differ from each other sufficiently to become new species.

A good example of this process is the evolution of the Australian marsupials into species adapted as carnivores, herbivores, burrowers, fliers, etc. Another example is that of peritadactyl limb in mammals.

The flipper of a seal, wing of a bat, forelimb of a male, front legs of horse and the arm of a man perform different functions, but exhibit the same structural plan including same pentadactyl pattern of bones.

Q. 3 You have studied the story of peppered moths in England. Had the industries been removed, what impact could it have on the moth population? Discuss.

Thinking Process

Prior to industrialisation, the light coloured moths were prevalent and well adapted to lichen covered trunks of trees.

Ans. In the population of pepper moth two variants exist the dark and the light coloured. Before industrialisation, the light coloured moths were prevalent because they blended well with the lichen covered bark of the trees.

The predators were unable to spot them and hence, their population were more in number. With industrialisation, the barks got covered with soot. The growth of lichens reduced, the light coloured moths were thus, spotted by the predators and their number decreased.

However, the black variants were camouflased better on soot covered barks and their number increased drastically.

If the industries were removed, the population of black moths would have declined because as stated before, they would not be able to camouflage against a light background (no black soot). Also the growth of lichens would increase. Therefore, the dark variants would be spotted better by predators and be eaten more frequently.

Q. 4 What are the key concepts in the evolution theory of Darwin?

Ans. *Key concepts of Darwin's theory of evolution are as follows*

(i) **Over Production** Living beings have an innate ability of producing own kind for the continuity of race. It has been observed that more individuals of each kind are produced than could possibly survive.

(ii) **Struggle for Existence** Individuals multiply in geometric ratio, whereas space and food remain almost limited.

(iii) **Variations** Members of a population vary is size, form and other characteristics even though they look superficially similar, no two individuals are alike. These variations are gradual and those with adaptive value are passed on to next generation.

(iv) **Survival of the Fittest and Natural Selection** During struggle for existence only those individuals could survive which exhibit beneficial variations and adapt better to changing environment. This is known as natural selection.

(v) **Origin of Species** Natural Selection results in modification of traits within a lineage, which over a period of long time can bring about evolution of original species into new one.

Q. 5 Two organisms occupying a particular geographical area (say desert) show similar adaptive strategies. Taking examples, describe the phenomenon.

Ans. This phenomenon indicated in the question is convergent evolution where by organisms, not closely related, evolve similar traits independently as a result of adaptation to similar environment. *e.g.,*

(i) Streamlined shape of sharks and dolphins. The former is a fish, while dolphin is a mammal, but both of them depend on swift movement through the water, so a streamlined shape is essential. Thus, it is the similar habitat that resulted in selection of similar adaptive features in different groups of organisms, but toward the same function.

(ii) Spines (modified leaves) and thorns (modified stems), both look similar and provide protection to the plant, but the plants to which they belong are distantly related.

Q. 6 We are told that evolution is a continuing phenomenon for all living things. Are humans also evolving? Justify your answer.

Ans. New research suggests that despite modern technology and industrialisation, 'humans continue to evolve'. In the last 10,000 years or so, the pace of our evolution has speeded up 100 times creating more mutations in our genes and hence, greater natural selection.

Some clues that show humans are evolving are

(i) **Lactose Tolerance** Historically the gene that regulated human's ability to digest lactose was shut down as infants are weaned off of their mother's breast milk. However, adult human in regions of Africa and Northern Europe developed the ability to tolerate lactose in their diets as recent as 5,000 or 6,000 years ago due to mutations.

(ii) **Wisdom Teeth** Our ancestors had much bigger jaws than we do to lactose their eating habits. Today our jaws are much smaller and wisdom teeth are often impacted estimates say that they will disappear in the coming population.

Q. 7 Had Darwin been aware of Mendel's work would he been able to explain the origin of variations. Discuss.

Ans. *Yes*, had Darwin been aware of **Mendel's** work, he would have been able to explain the origin of variations. Darwins observation of different forms of an individual in a population could be related to the presence of different forms of alleles of a gene.

The gene express as the most adaptive traits are selected naturally and become more abundant than those that are expressed as less adaptive traits.

Over the time, the accumulation of these traits might change the species to an extent that it develops into a new one and adapted to the specific environment.