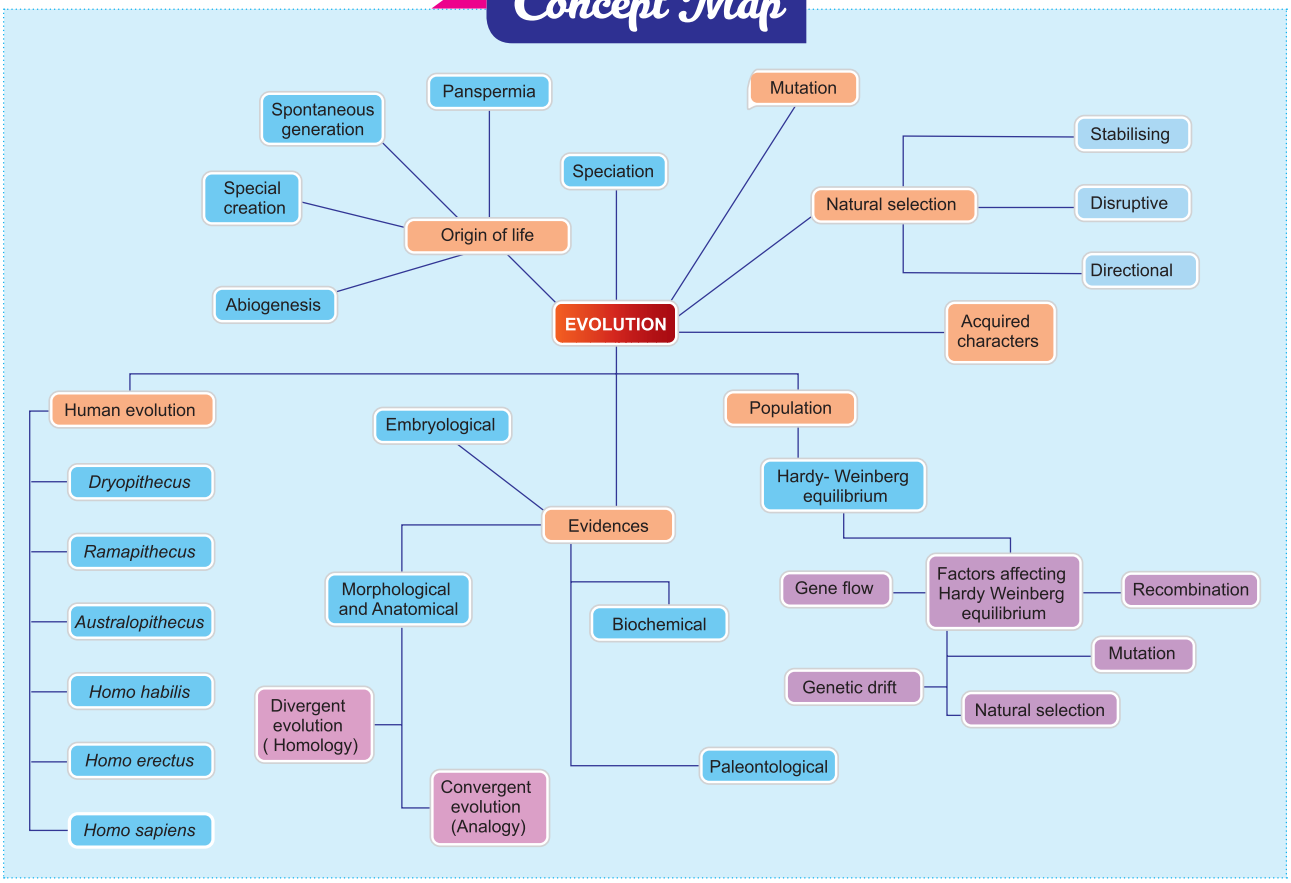
UNIT II

Chapter 6

EVOLUTION

CHAPTER SNAPSHOT

Concept Map



MUST KNOW DEFINITIONS

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Evolution	:	The term evolution is used to describe heritable changes in one or more characteristics of a population of species from one generation to the other.
Abiogenesis	:	Living organisms originated from non living materials.
Biogenesis	:	Life arose from pre existing life.
Coacervates	:	Large colloidal particles or pre-cells which transformed into first living cells.
Geological time scale	:	Duration of the earth's history is divided into eras which are further divided into periods. The periods are spilt into Epochs.
Paleontology	:	Study of prehistoric life through fossils.
Fossilization	:	process by which plant and animal remains are preserved.
Petrification	:	Method of fossilization in which original portion of the dead animal body is replaced molecule for molecule by minerals and original substance is lost through disintegration.
Coprolites	:	Hardened faecal matter of animals of post ages.
Homologous organs	:	Structures which are similar in origin but perform different functions.
Analogous organs	:	Organisms having different structural patterns but similar function.
Vestigial organs	:	Structures which are of no use to the possessor and not needed for existence.
Connecting links	:	Organisms which possess the characters of two different groups.
Atavistic organs	:	Sudden appearance of vestigial organs in highly evolved organisms
Mutations	:	Sudden random changes that occur in organisms.
Darwin's finches	:	14 species of a bird observed by Darwin during his voyage which differed in is body size, beak shape and feeding behavior.
Micro evolution	:	Evolution on a small scale leading to changes in allele frequencies within a population.
Speciation	:	The process by which one species evolves into one or more different species.
Extinction	:	Disappearance of the species from the earth i.e there are no more individuals of that species alive anywhere in the word.

Chapter 6

Evaluation

1. The first life on earth originated
a) in air b) on land
c) in water d) on mountain
[Ans. (c) in water]

2. Who published the book "Origin of species by Natural Selection" in 1859?
a) Charles Darwin b) Lamarck
c) Weismann d) Hugo de Vries
[Ans. (a) Charles Darwin]

3. Which of the following was the contribution of Hugo de Vries?
a) Theory of mutation
b) Theory of natural Selection
c) Theory of inheritance of acquired characters
d) Germplasm theory
[Ans. (a) Theory of mutation]

4. The wings of birds and butterflies is an example of
a) Adaptive radiation
b) convergent evolution
c) divergent evolution
d) variation
[Ans. (b) convergent evolution]

5. The phenomenon of "Industrial Melanism" demonstrates
a) Natural selection
b) induced mutation
c) reproductive isolation
d) geographical isolation
[Ans. (a) Natural selection]

6. Darwin's finches are an excellent example of
a) connecting links
b) seasonal migration
c) adaptive radiation
d) parasitism **[Ans. (c) adaptive radiation]**

7. Who proposed the Germplasm theory?
a) Darwin
b) August Weismann
c) Lamarck
d) Alfred Wallace
[Ans. (b) August Weismann]

8. The age of fossils can be determined by
a) electron microscope b) weighing the fossils
c) carbon dating d) analysis of bones
[Ans. (c) carbon dating]

9. Fossils are generally found in
a) igneous rocks
b) metamorphic rocks
c) volcanic rocks
d) sedimentary rocks
[Ans. (d) sedimentary rocks]

10. Evolutionary history of an organism is called
a) ancestry b) ontogeny
c) phylogeny d) paleontology
[Ans. (c) phylogeny]

11. The golden age of reptiles was
a) Mesozoic era b) Cenozoic era
c) Paleozoic era d) Proterozoic era
[Ans. (a) Mesozoic era]

12. Which period was called "Age of fishes"?
a) Permian b) Triassic
c) Devonian d) Ordovician
[Ans. (c) Devonian]

13. Modern man belongs to which period?
a) Quaternary b) Cretaceous
c) Silurian d) Cambrian
[Ans. (a) Quaternary]

14. The Neanderthal man had the brain capacity of
a) 650 – 800cc b) 1200cc
c) 900cc d) 1400cc
[Ans. (d) 1400cc]

15. List out the major gases seem to be found in the primitive earth.

Ans. (i) The primitive earth had no proper atmosphere, but consisted of ammonia, methane, hydrogen and water vapour. Hydrogen and oxygen were formed by splitting of water molecules by uv rays.

(ii) Ammonia & Methane in the atmosphere combined with oxygen to form carbon dioxide and other gases.

16. Explain the three major categories in which fossilization occur?

Ans. Fossilization is the process by which plant and animal remains are preserved in sedimentary rocks. They fall under three main categories.

(1) Actual remains

(i) The original hard parts such as bones, teeth or shells are preserved as such in the earth's atmosphere.

(ii) This is the most common method of fossilization. When marine animals die, their hard parts such as bones, shells, etc., are covered with sediments and are protected from further deterioration.

(iii) The salinity in ocean prevents decay.

(iv) The sediments become hardened to form definite layers or strata. For example, Woolly Mammoth that lived 22 thousand years ago were preserved in the frozen coast of Siberia.

(2) Petrifaction

(i) When animals die the original portion of their body may be replaced molecule for molecule by minerals and the original substance being lost through disintegration.

(ii) This method of fossilization is called petrifaction.

(iii) The principle minerals involved in this type fossilization are iron pyrites, silica, calcium carbonate and bicarbonates of calcium and magnesium.

(3) Natural moulds and casts

(i) Even after disintegration, the body of an animal might leave indelible impression on the soft mud which later becomes hardened into stones. Such impressions are called moulds.

(ii) The cavities of the moulds may get filled up by hard minerals and get fossilized, which are called casts.

(iii) Hardened faecal matter termed as coprolites occur as tiny pellets.

(iv) Analysis of the coprolites enables us to understand the nature of diet the pre- historic animals thrived on.

17. Differentiate between divergent evolution and convergent evolution with one example for each.

S. No	Divergent evolution	Convergent evolution
1.	Structures which are similar in origin but perform different functions are called homologous structures that brings about divergent evolution.	Organisms having different structural patterns but similar function are termed as analogous structures.
2.	**E.g.** Thorn of *Bougainvillea* and tendril of *Curcurbita* are homologous structures but their functions are different.	**E.g.** the wings of birds and insects are different structurally, but perform the same function of flight that brings about convergent evolution.

18. How does Hardy-Weinberg's expression ($p^2 + 2pq + q^2 = 1$) explain that genetic equilibrium is maintained in a population? List any four factors that can disturb the genetic equilibrium.

Ans. ***(i)*** Hardy of UK and Weinberg of Germany stated that the allele frequencies in a population are stable and are constant from generation to generation in the absence of gene flow, genetic drift, mutation, recombination and natural selection.

(ii) Evolution is a change in the allele frequencies in a population over time. Hence population in Hardy Weinberg is not evolving.

(iii) A large population of beetles, appear in two colours dark grey (black) and light grey, and their colour is determined by 'A' gene. 'AA' and 'Aa' beetles are dark grey and 'aa' beetles are light grey.

(iv) 'A' allele has frequency (p) of 0.3 and 'a' allele has a frequency (q) of 0.7. Then $p + q = 1$.

(v) If a population is in Hardy Weinberg equilibrium, the genotype frequency can be estimated by Hardy Weinberg equation.

$(p + q)^2 = p^2 + 2pq + q^2$

p^2 = frequency of AA

$2pq$ = frequency of Aa

q^2 = frequency of aa

p = 0.3, q = 0.7 then,

$p^2 = (0.3)^2 = 0.09 = 9\ \%$ AA

$2pq = 2(0.3)\ (0.7) = 0.42 = 42\ \%$ Aa

$q^2 = (0.7)^2\ 0.49 = 49\ \%$ aa

Hence the beetle population appears to be in Hardy- Weinberg equilibrium.

(vi) Hardy Weinberg's assumptions include

No mutation – No new alleles are generated by mutation nor the genes get duplicated or deleted.

Random mating – Every organism gets a chance to mate and the mating is random with each other with no preferences for a particular genotype.

No gene flow - Neither individuals nor their gametes enter (immigration) or exit (emigration) the population.

Very large population size - The population should be infinite in size.

No natural selection - All alleles are fit to survive and reproduce.

If any one of these assumptions were not met, the population will not be in Hardy- Weinberg equilibrium.

19. Explain how mutations, natural selection and genetic drift affect Hardy Weinberg equilibrium.

Ans. *(i)* Hardy and Weinberg stated that the allele frequencies in a population are stable and are constant from generation to generation in the absence of gene flow, genetic drift, mutation, recombination and natural selection.

(ii) Hence population in Hardy Weinberg is not evolving.

Hardy weinberg's equilibrium is maintained assuming there is :

(a) No Mutation
(b) Random Mating
(c) No gene flow
(d) Very large population size
(e) No natural selection

(a) Impact of genetic drift on Hardly Weinberg equilibrium

(i) Genetic drift is a mechanism of evolution in which allele frequencies of a population change over generation due to chance (sampling error).

(ii) Genetic drift occurs in all population sizes, but its effects are strong in a small population.

(iii) Genetic drift can have major effects, when the population is reduced in size by natural disaster due to bottle neck effect or when a small group of population splits from the main population to form a new colony due to founder's effect.

(iv) Genetic drift causes gene flow thus Hardy weinberg's equilibrium will be affected by Genetic driff.

(b) Impact of mutation on Hardly Weinberg equilibrium

(i) Although mutation is the original source of all genetic variation, mutation rate for most organisms is low.

(ii) Hence new mutations on an allele frequencies from one generation to the next is usually not large. Thus mutations do not impact much on Hardy Weinberg's equilibrium.

(c) Impact of natural selection on Hardy Weinberg equilibrium

(i) It occurs when one allele (or combination of alleles of differences) makes an organism more or less fit to survive and reproduce in a given environment. If an allele reduces fitness, its frequencies tend to drop from one generation to the next.

(ii) There are mainly three types of natural selection

Thus Hardy Weinberg equilibrium will not hold good it natural selection is operational.

20. How did Darwin explain fitness of organisms?

Ans. Darwin's theory was based on several facts, observations and influences. They are:

1. Over production (or) prodigality of production

All living organisms increase their population in larger number.

2. Struggle for existence

Organisms struggle for food, space and mate. As these become a limiting factor, competition exists among the members of the population.

Darwin denoted struggle for existence in three ways –

(i) Intra specific struggle between the same species for food, space and mate.

(ii) Inter specific struggle with different species for food and space.

(iii) Struggle with the environment to cope with the climatic variations, flood, earthquakes, drought, etc.,

3. Universal occurrence of variations

(i) No two individuals are alike. There are variations even in identical twins.

(ii) The useful variations found in an organism help them to overcome struggle and such variations are passed on to the next generation.

4. Origin of species by Natural Selection

(i) According to Darwin, nature is the most powerful selective force.

(ii) He compared origin of species by natural selection to a small isolated group.

(iii) Darwin believed that the struggle for existence resulted in the survival of the fittest.

(iv) Such organisms become better adapted to the changed environment.

21. Mention the main objections to Darwinism.

Ans. Some objections raised against Darwinism were

(i) Darwin failed to explain the mechanism of variation.

(ii) Darwinism explains the survival of the fittest but not the arrival of the fittest.

(iii) He focused on small fluctuating variations that are mostly non-heritable.

(iv) He did not distinguish between somatic and germinal variations.

(v) He could not explain the occurrence of vestigial organs, over specialization of some organs like large tusks in extinct mammoths, oversized antlers in the extinct Irish deer, etc.,

22. Taking the example of Peppered moth, explain the action of natural selection. What do you call the above phenomenon?

Ans. *(i)* Natural selection can be explained clearly through industrial melanism. Industrial melanism is a classical case of Natural selection exhibited by the peppered moth, *Biston betularia*.

(ii) These were available in two colours, white and black.

(iii) Before industrialization peppered moth both white and black coloured were common in England. Pre-industrialization witnessed white coloured background of the wall of the buildings hence the white coloured moths escaped from their predators.

(iv) Post industrialization, the tree trunks became dark due to smoke and soot let out from the industries. The black moths camouflaged on the dark bark of the trees and the white moths were easily identified by their predators.

(v) Hence the dark coloured moth population was selected and their number increased when compared to the white moths.

(vi) Nature offered positive selection pressure to the black coloured moths. The above proof shows that in a population, organisms that can adapt will survive and produce more progenies resulting in increase in population through natural selection.

23. Darwin's finches and Australian marsupials are suitable examples of adaptive radiation – Justify the statement.

Ans. **Adaptive Radiation**

(i) The evolutionary process which produces new species diverged from a single ancestral form becomes adapted to newly invaded habitats is called adaptive radiation.

(ii) Adaptive radiations are best exemplified in closely related groups that have evolved in relatively short time.

(iii) Darwin's finches and Australian marsupials are best examples for adaptive radiation.

Darwin's finches

(i) Their common ancestor arrived on the Galapagos about 2 million years ago.

(ii) During that time, Darwin's finches have evolved into 14 recognized species differing in body size, beak shape and feeding behavior. This enabled different species to utilize different food resources such as insects, seeds, nectar from cactus flowers and blood from iguanas, all driven by Natural selection.

(iii) Genetic variation by mild mutation in the ALX1 gene in the DNA of Darwin finches is associated with variation in the beak shape.

(iv) Marsupials in Australia and placental mammals in North America are two subclasses of mammals. They have adapted in similar way to a particular food resource, locomotory skill or climate.

(v) They were separated from the common ancestor more than 100 million years ago and each lineage continued to evolve independently.

(vi) Despite temporal and geographical separation, marsupials in Australia and placental mammals in North America have produced varieties of species living in similar habitats with similar ways of life.

(vii) Their overall resemblance in shape, locomotory mode, feeding and foraging are superimposed upon different modes of reproduction.

(viii) This feature reflects their distinctive evolutionary relationships.

(ix) The marsupials have undergone adaptive radiation to occupy the diverse habitats in Australia, just as the placental mammals have radiated across North America.

24. Who disproved Lamarck's Theory of acquired characters? How?

Ans. ***(i)*** **The theory of inheritance of acquired characters** - Characters that are developed during the life time of an organism are called acquired characters and these are then inherited.

Lamarck's "Theory of Acquired characters" was disproved by August Weismann who conducted experiments on mice for twenty generations by cutting their tails and breeding them. All mice born were with tail. Weismann proved that change in the somatoplasm will not be transferred to the next generation but changes in the germplasm will be inherited.

25. How does Mutation theory of De Vries differ from Lamarck and Darwin's view in the origin of new species.

Ans. **Mutation theory**

(i) Hugo de Vries put forth the Mutation theory. Mutations are sudden random changes that occur in an organism that is not heritable. De Vries carried out his experiments in the Evening Primrose plant (*Oenothera lamarckiana*) and observed variations in them due to mutation.

(ii) According to de Vries, sudden and large variations were responsible for the origin of new species

Salient features of Mutation Theory

(i) Mutations or discontinuous variation are transmitted to other generations.

(ii) In naturally breeding populations, mutations occur from time to time.

(iii) There are no intermediate forms, as they are fully fledged.

(iv) They are strictly subjected to natural selection.

(a) Lamarck and Darwin believed in gradual accumulation of all variation as the causative factors in the origin of new species.

(b) Further Lamarck believed that characters developed during the life time of an organism are called acquired characters and these are then inherited.

Darwin did not distinguish between somatic and germinal variation and attributed Natural selection as the force for origin of new species.

26. Explain stabilizing, directional and disruptive selection with examples.

Ans. There are mainly three types of natural selection

1) **Stabilising Selection:**

(i) This type of selection operates in a stable environment. The organisms with average phenotypes survive whereas the extreme individuals from both the ends are eliminated.

(ii) There is no specification but the phenotypic stability is maintained within the population over generation.

(iii) **Eg.** Measurements of sparrows that survived the storm clustered around the mean, and the sparrows that failed to survive the storm clustered around the extremes of the variation showing stabilizing selection.

2) Directional Selection:

(i) The environment which undergoes gradual change is subjected to directional selection.

(ii) This type of selection removes the individuals from one end towards the other end of phenotypic distribution.

(iii) **Eg.** Size differences between male and female sparrows. Both male and female look alike externally but differ in body weight. Females show directional selection in relation to body weight.

3) Disruptive Selection (centrifugal selection):

(i) When homogenous environment changes into heterogenous environment this type of selection is operational.

(ii) The organisms of both the extreme phenotypes are selected whereas individuals with average phenotype are eliminated. This results in splitting of the population into sub population/species.

(iii) This is a rare form of selection but leads to formation of two or more different species. It is also called adaptive radiation.

(iv) **E.g.** Darwin's finches-beak size in relation to seed size inhabiting Galapagos islands.

27. Rearrange the descent in human evolution
Austrolopithecus → Homo erectus → Homo sapiens → Ramapithecus → Homo habilis.

Ans. *Ramapithecus → Austrolopithecus → Homo habilis → Homo erectus →Homo sapiens*

28. Differentiate between the eating habit and brain size of Australopithecus and Ramapithecus.

Ans. (i) The earliest fossils of the prehistoric man like *Ramapithecus* lived some 14mya. They were hairy and walked like gorillas and chimpanzees.

(ii) They had a brain capacity of 1300cc.

(iii) They lived on tough food consisting of seeds and savannah grasses and had well developed grains and heavy molars.

(iv) *Australopithecus* had a brain capacity of 461cc, teeth consisted of small canines and large molars. Good are softer foods consisting of grass, leaves and fruits.

29. How does Neanderthal man differ from the modern man in appearance?

Ans. (i) Neanderthal human was found in Neander Valley, Germany with a brain size of 1400 cc and lived between 34,000 - 1,00,000 years ago.

(ii) They differ from the modern human in having semierect posture, flat cranium, sloping forehead, thin large orbits, heavy brow ridges, protruding jaws and no chin.

(iii) They used animal hides to protect their bodies, knew the use of fire and buried their dead.

(iv) They did not practice agriculture and animal domestication.

30. Mention any three similarities found common in Neanderthal man and Homo sapiens.

Ans. Similarities found in Neanderthal man and Homo sapiens.

(i) They knew to protect their bodies. Neanderthal man used animal hides to protect their bodies.

(ii) They knew the use of fire.

(iii) They buried their dead.

31. According to Darwin, the organic evolution is due to [AIPMT-2013]

a) Intraspecific competition
b) Interspecific competition
c) Competition within closely related species.
d) Reduced feeding efficiency in one species due to the presence of interfering species.

[Ans. (b) Interspecific competition]

32. A population will not exist in Hardy- Weinberg equilibrium if [AIPMT-2015]

a) Individuals mate selectively
b) There are no mutations
c) There is no migration
d) The population is large

[Ans. (a) Individuals mate selectively]

ZOOLOGY LONG VERSION QUESTIONS (FOR PURE SCIENCE GROUP)

Q.No. 1 to 30 Refer Evaluation

31. Define isolating mechanism and explain its types with suitable examples.

Ans. Isolation is the separation of the members of a single population into sub populations so that genetic integrity of the subpopulation can be maintained.

(i) **Ecological isolation or habitat isolation** - the members of the same population may be separated from one another by differences in their habitat. For example *Rana areolata* occupies burrows dug by mammals and tortoises during the day and breeds in grassy shallow ponds whereas *Rana grylio* breeds in deep waters. Due to the difference in their habitat the two species are able to maintain their respective species identities.

(ii) **Seasonal isolation** – In this type of isolation, difference in the breeding seasons prevents interbreeding. E.g. Toad, *Bufo americanus* breeds much early in the spring; whereas *Bufo fowleri* breeds very late in the season. They are able to maintain their species identity because of the differences in the breeding seasons.

(iii) **Sexual or ethological isolation/ Behavioural isolation** – Prevents mating due to the difference in their sexual behavior. The species are not separated from one another either in time or in space. The mating calls of two closely related species of frogs, grey tree frog and pine wood tree frog are different which prevents interbreeding.

(iv) **Morphological isolation or mechanical isolation** – This type of isolation is due to the differences in their external genitalia that is seen in two different species. The size difference between two toad species, prevents their interbreeding.

(v) **Physiological isolation** –Though mating may occur, the gametes are prevented from fertilization due to mechanical or physiological factors. **E.g.** The sperms of *Drosophila virilis* survive only for about a day when introduced into the sperm receptacle of *Drosophila americana* while the sperms of *Drosophila americana* live for a longer time.

(vi) **Cytological isolation** – Fertilization does not take place due to the differences in the chromosome numbers between the two species, the bull frog and gopher frog.

(vii) **Hybrid inviability** – In this type, the sperm enters the egg, fertilization occurs and the embryo develops into the adult but it dies before reaching maturity. In certain fishes, frogs, beetles, even if fertilization takes place between two species, due to genetic in compatibility they do not leave any surviving offspring.

(viii) **Hybrid sterility** – In this type, hybrids are formed due to inter specific crosses but they are sterile due to the failure of the chromosomes to segregate normally during meiosis, **Eg.** Mule (inter specific cross between a horse and a donkey).

(ix) **Hybrid breakdown** – F_1 Hybrids are viable and fertile, but F_2 hybrids may be inviable or sterile.

32. Define speciation according to A. E. Emerson and explain its types giving suitable examples.

Ans. **Speciation:**

(i) The process by which one species evolves into one or more different species is called speciation.

(ii) A. E. Emerson defines species as a 'genetically distinctive, reproductively isolated natural population'.

(iii) Speciation is a fundamental process in evolution.

(iv) Evolution of a new species in a single lineage is called an agenesis / phyletic speciation. If one species diverges to become two or more species it is cladogenesis or divergent evolution.

Sympatric speciation/Reproductive isolation

(i) It is a mode of speciation through which new species form from a single ancestral species while both species continue to inhabit the same geographical region. Two or more species are involved.

(ii) New species formed due to genetic modification in the ancestor that is naturally selected can no longer breed with the parent population. Sexual isolation is strongest.

(iii) Phenotypic plasticity has emerged as potentially important first step in speciation initiated within an isolated population.

Allopatric speciation / Geographical speciation

(i) It is a mode of speciation that occurs when biological populations of similar species become isolated from each other that prevents gene flow.

(ii) One species becomes two species due to geographical barriers hence new species is evolved. **E.g.** Darwin's finches.

(iii) The barriers are land separation, migration or mountain formation. When barriers occur between species, change in ecological conditions and environment leads to adaptations that produce differences.

(iv) If there are no adaptations, they will not survive. Sexual isolation is weakest.

(v) Another example is the adaptation of Apple maggots that feed on apples in North America.

(vi) When the apple trees were imported to North America, Apple maggot flies (*Rhagoletis pomonella*) a parasitic insect that normally laid its eggs in the fruit of wild hawthorns until one subset of population began to lay its eggs in the fruit of domesticated apple trees (*Malus domestica*) that grew in the same area.

(vii) This small group of apple maggot flies selected a different host species from the rest of the population and its offsprings became accustomed to domesticated apples.

33. Give an account on the major causes for the extinction of a particular species on earth.

Ans. Causes for extinction of a species may be natural or due to human Intervention.

Natural causes :

(i) **Environmental events** – Occurrence of Natural disaster such as floods, volcanic eruptions, etc. can wipe out an entire species.

(ii) **Biological events** – Non availability of foods, spread of infectious diseases can wipe out a species at large.

Human Activities :

(i) Man is destroying forests in a large scale. Many species are being reduced homeless.

(ii) Modern technology has a major impact for **Eg.** the sparrow population is said to have reduced due to erection of signal towers built as part of communication. (mobile phones)

(iii) Over exploitation of species for commercial purpose may interfere with food chains and create food deficit for other species. Similarly over may also lead to reduction in population of the species.

(iv) Species do not become extinct suddenly, As the members of particular species appears to be reduce, special initiatives have to be taken to conserve the existing individuals and their young ones, breed them and contribute to increasing their members, Unless such initiatives are taken there is a likelihood of a species moving towards extinction.

34. Explain the three level of impact of extinction of species.

Ans. Extinction was common if not inevitable because species could not always adapt to large or rapid environmental changes. The impact of extinction can be considered at three levels.

(i) **Species extinction** eliminates an entire species, by an environmental event (flood etc.,) or by biological event (disease or non availability of food resource half or more).

(ii) **Mass extinction** eliminates half or more species in a region or ecosystem, as might occur following a volcanic eruption. Five major mass extinction that occurred since the Cambrian period. This mass extinction is often referred to as K-T extinction.

(iii) **Global extinction** eliminates most of the species on a large scale or larger taxonomic groups in the continent or the Earth. Snow ball Earth and extinction following elevation in CO_2 levels are example. Extinction events opens up new habitats and so can facilitate the radiation of organisms that survived the mass extinction.

35. Refer Evaluation Q.No.31

35. Refer Evaluation Q.No.32

Chapter 6

Additional Questions

Choose the Correct Answer 1 Mark

I. Choose the Correct options for the below Questions

1. The solar system is estimated to be _____ years old.
(a) 4.5 billion years (b) 4 billion years
(c) 4.5 trillion years (d) 6.4 billion years
[*Ans.* (a) 4.5 billion years]

2. Carbon dioxide in the primitive earth is said to have been formed from_____
(a) Methane & Oxygen
(b) Methane & Ammonia
(c) Carbon and Oxygen
(d) Carbon & Methane
[*Ans.* (b) Methane & Ammonia]

3. The term biogenesis was coined by
(a) Thomas Huxley (b) Henry Bastian
(c) Haldane (d) Weinberg
[*Ans.* (b) Henry Bastian]

4. _____ was not a part of theory of chemical evolution.
(a) Sea served as chemical laboratory
(b) Oxygen was not present
(c) Physical forces such as uv, lightning contributed to changes.
(d) Solar energy was not available
[*Ans.* (d) Solar energy was not available]

5. Origin of fishes occurred in _____ period
(a) Devonian (b) Silurian
(c) Cambrian (d) Permian
[*Ans.* (b) Silurian]

6. _____is called age of fishes
(a) Silurian (b) Ordovician
(c) Devonian (d) Cambrian
[*Ans.* (c) Devonian]

7. _____ is called age of Invertebrates
(a) Cambrian (b) Devonian
(c) Pennsylvanian (d) Mississippian
[*Ans.* (a) Cambrian]

8. _____ era is called Golden age of reptiles.
(a) Paleozoic (b) Mesozoic
(c) Precambrian (d) Cenozoic
[*Ans.* (b) Mesozoic]

9. Origin of egg laying mammal a occurred in _____ period.
(a) Jurassic (b) Carboniferous
(c) Triassic (d) Cretaceous
[*Ans.* (c) Triassic]

10. Human evolution occured in _____ era
(a) Paleozoic (b) Cenozoic
(c) Mesozoic (d) Precambrian
[*Ans.* (b) Cenozoic]

11. _____ era is called age of mammals
(a) Precambrian (b) Permian
(c) Cenozoic (d) Paleozoic
[*Ans.* (c) Cenozoic]

12. Choose the correct sequence
(a) Ordovician, Triassic, Permian, Cretaceous
(b) Devonian, Permian, Cretaceous, Cambrian
(c) Devonian, Triassic, Cretaceous, Ordovician
(d) Silurian, Devonian, Permian, Triassic
[*Ans.* (d) Silurian, Devonian, Permian, Triassic]

13. Emergence of modern birds occurred in _____ period.
(a) Devonian (b) Silurian
(c) Jurassic (d) Cretaceous
[*Ans.* (d) Cretaceous]

14. Origin of first man like apes occurred in _____ epoch
(a) Oligocene (b) Miocene
(c) Pliocene (d) Paleocene
[*Ans.* (c) Pliocene]

15. _____ are not examples of homologous organs.
(a) Thorn and tendrils
(b) Forelimb of animals and wing of bat
(c) wing of bat and bird
(d) Flippers of penguins and dolphins
[*Ans.* (d) Flippers of penguins and dolphins]

VII. Identify the Odd-man out from the below

1. (a) Finches (b) marsupials (c) placental mammals (d) Oenothera
[Ans. (d) Oenothera]
Reason: It is not linked to adaptive radiation whereas the others show adaptive radiation.

2. (a) Haeckel (b) Mendel (c) Wallace (d) Lamarck
[Ans. (d) Lamarck]
Reason: He proposed use & disuse theory of evolution whereas the others are Neo Darwinists.

3. (a) Over production (b) variation (c) use and disuse (d) origin of species
[Ans. (c) use and disuse]
Reason: It is linked to Lamarckism whereas the others are linked to Darwinism.

4. (a) Archaeopteryx (b) Peripatus (c) presence of tail (d) Marsupials
[Ans. (d) Marsupials]
Reason: It is linked to Darwin's theory of natural selection whereas others are linked to embryological evidence of evolution.

5. (a) Devonian (b) Silurian (c) Jurassic (d) Cambrian
[Ans. (c) Jurassic]
Reason: It is a period in Mesozoic era whereas the others are periods of the Paleozoic era.

Answer in one word*

1. A fossil bird _____ [Ans. Archaeopteryx]
2. Age of mammals _____ [Ans. Cenozoic era]
3. Method used to determine precise age of a fossil _____ [Ans. Absolute dating]
4. Imprints left by fossil animals or plants _____ [Ans. Moulds]
5. Sudden appearance of vestigial organs in highly enlarged organisms _____ [Ans. Atavism]
6. Book published by Lamarck_____ [Ans. Philosophie zoologique]
7. Plant in which De vries caused out his experiments on mutation_____ [Ans. Oenothera lamarckiana]
8. Similarly in Darwin's finches and Australian Marsupials _____ [Ans. Convergent evolution]
9. The human form considered to be ancestors of modern Europeans_____ [Ans. Cro-magnon]
10. Scientific name for modern human_____ [Ans. Homo sapieans]

* Only for quick revision not in pattern

Very Short Answers — 2 Marks

1. What are atavistic organs?
Ans. Sudden appearance of vestigial organs in highly evolved organisms is called atavistic organs. **Eg:** presence of tail in a human baby is an atavistic organ.

2. State the Biogenetic law.
Ans. Ernst Von Haeckel, propounded the "biogenetic law or theory of recapitulation" which states that the life history of an individual (ontogeny) briefly repeats or recapitulates the evolutionary history of the race (phylogeny). In other words "Ontogeny recapitulates Phylogeny".

3. What are molecular clocks?
Ans. A slight change occurs over time in conserved molecules such as DNA, RNA and protein. They are often called as molecular clocks and serve as molecular evidences of evolution.

4. What is the view of Neo lamarckism?
Ans. They argued that external conditions stimulate the somatic cells to produce certain 'secretions' which reach the sex cells through the blood and bring about variations in the offspring.

5. What are coprolites?
Ans. Hardened faecal matter are termed coprolites and occurs as tiny pellets. Analysis of coprolites enables us to understand the nature of diet, on which the prehistoric animals thrived.

6. What is paleontology?
Ans. It is the study of prehistoric life through fossils.

7. What are actual remains?
Ans. The original hard parts such as bones, teeth or shells are preserved as such in the earth's atmosphere. This is the most common method of fossilization.

8. Name the periods of Mesozoic era.

Ans. Mesozoic era is divided into three periods namely Triassic, Jurassic and cretaceous.

9. Name the five basic factors involved is the process of organic evolution according to modern synthetic theory.

Ans. Gene Mutation, Chromosomal mutation, Genetic recombination, Natural selection, Reproductive isolation.

10. Name the types of natural selection.

Ans. Stabilizing selection
Directional selection
Disruptive selection

11. What is founder's effect?

Ans. Genetic drift can have major effects, when the population is reduced in size. When a small group of population splits from the main population to form a new colony. It is called founder's effect.

Short Answers — 3 Marks

1. State the theory of spontaneous generation.

Ans. According to the theory of spontaneous generation or Abiogenesis, living organisms originated from non-living materials and occurred through stepwise chemical and molecular evolution over millions of years. Thomas Huxley coined the term abiogenesis.

2. Define evolution.

Ans. The term evolution is used to describe heritable changes in one or more characteristics of a population of species from one generation to the other.

3. What are Coacervates?

Ans. Coacervates (large colloidal particles that precipitate out in aqueous medium) are the first pre-cells which gradually transformed into living cells, according to theory of chemical evolution.

4. How can we determine the age of fossils?

Ans. The age of fossils can be determined using two methods namely, relative dating and absolute dating. (a) **Relative dating** is used to determine a fossil by comparing it to similar rocks and fossils of known age. (b) **Absolute dating** is used to determine the precise age of a fossil by using radiometric dating to measure the decay of isotopes.

5. Differentiate Sympatric speciation and Allopatric speciation.

Ans.

Sympatric speciation	Allopatric speciation
Mode of speciation through which new species form from a single ancestral species while both species continue to inhabit the same geographical region.	It is a mode of speciation that occurs when biological populations of similar species become isolated from each other that prevents gene flow. one species becomes two species due to geographical barrier.
Sexual isolation is strongest. **Eg:** Plank tons	Sexual isolation is weakest. **Eg:** Darwin's finches

6. Differentiate between mould and cast.

Ans.

Mould	Cast
Even after disintegration, the body of an animal might leave indelible impression on the soft mud which later becomes hardened into stones. Such impressions are called moulds.	The cavities of the moulds may get filled up by hard minerals and get fossilized, which are called casts.

7. What is divergent evolution?

Ans. Structures which are similar in origin but perform different functions are called homologous structures that brings about divergent evolution.

Eg: Thorn of Bougainvillea is used for defence and tendrils of cucurbita are used for climbing but both are homologous structures.

8. What is convergent evolution?

Ans. Organisms having different structural patterns but similar function are termed as analogous structures.

Eg: Wings of birds & Insects are different structurally but perform similar function (flight) which brings about convergent evolution.

22. What is phenotypic plasticity?

Ans. Phenotypic plasicity is the ability of single genotype to produce more than one phenotype. When this plasticity is expressed seasonally in planktons, it is referred to as cyclomorphosis.

23. What is K-T extinction?

Ans. ***(i)*** Mass extinction eliminates half or more species in a region or ecosystem, a volcanic eruption. Five major mass extinction that occurred since the Cambrian period. This mass extinction is often referred to as K-T extinction.

(ii) K-T Extinction refers to the German word Cretaceous and Tertiary periods.

24. What are protobionts?

Ans. ***(i)*** Abiotically produced molecules can spontaneously self assemble into droplets that enclose a watery solution and maintain a chemical environment different from their surroundings. Scientists call these spheres as 'protobionts'.

(ii) This is the basis of biological evolution.

25. What is geological time scale?

Ans. Duration of the earth's history is divided into eras which are further divided into periods. The periods are spilt into Epochs. This is called Geological time scale.

Long Answers — 5 Marks

1. Explain the theory of chemical evolution.

Ans. ***(i)*** According to the theory of chemical evolution primitive organisms in the primordial environment of the earth evolved spontaneously from inorganic substances and physical forces such, as lightning, UV radiations, volcanic activities, etc.

(ii) Oparin (1924) suggested that the organic compounds could have undergone a series of reactions leading to more complex molecules. He proposed that the molecules formed colloidal aggregates or 'coacervates' in an aqueous environment. The coacervates were able to absorb and assimilate organic compounds from the environment.

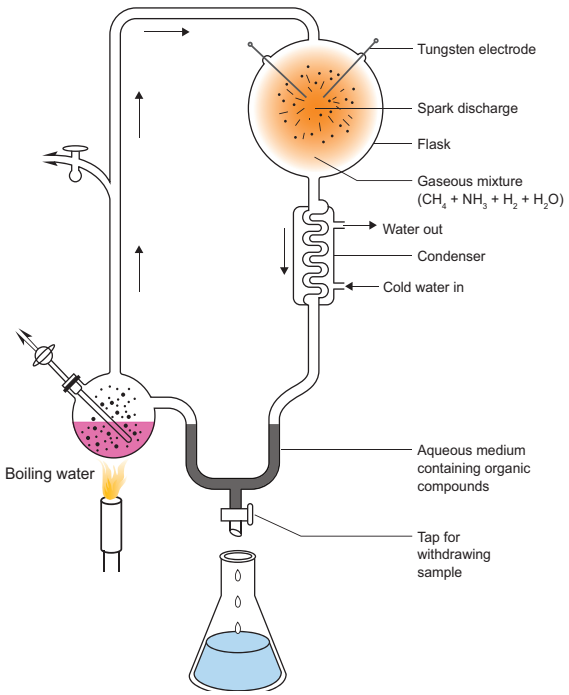
(iii) Haldane (1929) proposed that the primordial sea served as a vast chemical laboratory powered by solar energy. The atmosphere was oxygen free and the combination of CO_2, NH_3 and UV radiations gave rise to organic compounds.

(iv) The sea became a 'hot' dilute soup containing large populations of organic monomers and polymers. They proposed that groups of monomers and polymers acquired lipid membranes and further developed into the first living cell. Haldane coined the term prebiotic soup and this became the powerful symbol of the Oparin-Haldane view on the origin of life (1924-1929).

(v) Oparin and Haldane independently suggested that if the primitive atmosphere was reducing and if there was appropriate supply of energy such as lightning or UV light then a wide range of organic compounds can be synthesized.

2. Explain Urey & Miller's experiment.

Ans. ***(i)*** Urey and Miller (1953), paved way for understanding the possible synthesis of organic compounds that led to the appearance of living organisms.



Urey-Miller's experiment

(ii) In their experiment, a mixture of gases was allowed to circulate over electric discharge from an tungsten electrode.

(iii) A small flask was kept boiling and the steam emanating from it was made to mix with the mixture of gases (ammonia, methane and hydrogen) in the large chamber that was connected to the boiling water. The steam condensed to form water which ran down the 'U' tube.

(iv) Experiment was conducted continuously for a week and the liquid was analysed. Glycine, alanine, beta alanine and aspartic acid were identified. Thus Miller's experiments highlighted the possibility of abiogenetic synthesis of large amount of variety of organic compounds in nature from a mixture of sample gases in which the only source of carbon was methane. Later in similar experiments, formation of all types of amino acids, and nitrogen bases were noticed.

3. Write about the two principles of Lamarck's theory.

Ans. **Lamarck's theory:** Jean Baptiste de Lamarck, was the first to postulate the theory of evolution in his famous book 'Philosophie Zoologique' in the year 1809. The two principles of Lamarckian theory are:

(i) The theory of use and disuse - Organsthat are used often will increase in size and those that are not used will degenerate. Neck in giraffe is an example of use and absence of limbs in snakes is an example for disuse theory.

(ii) The theory of inheritance ofacquired characters - Characters that are developed during the life time of an organism are called acquired characters and these are then inherited.

4. Explain about the objections to Darwinism.

Ans. **Objections to Darwinism:** Some objections raised against Darwinism were –

(i) Darwin failed to explain the mechanism of variation.

(ii) Darwinism explains the survival of the fittest but not the arrival of the fittest.

(iii) He focused on small fluctuating variations that are mostly non-heritable.

(iv) He did not distinguish between somatic and germinal variations.

(v) He could not explain the occurrence of vestigial organs, over specialization of some organs like large tusks in extinct mammoths, oversized antlers in the extinct Irish deer, etc.,