

UNIT - VII ORGANIC EVOLUTION

Evolutionary Concepts & Origin of life

- The word organic evolution was coined by - **Herbert Spencer**
- The word evolution means - **‘unfolding’ or ‘roll out’ over a period of time**
- According to Darwin, evolution means descent with modification
- Who uttered that nothing in biology makes sense except in the light of evolution
- **Theodosius Dhobzhansky**
- The living organisms on the earth were created by Divine power according to - **theory of special creation**
- Father Suarez believed that - **universe was created in 6 days**
- Theory of special creation is purely
- **a mythological belief**
- The concept of cosmozoic theory or pans permia was - **life is distributed all over cosmos in the form of resistant spores**
- Resistant spores of living organisms are called - **cosmozoa-as explained by Arrhenius**
- ‘Life originated from non-living substances’ was explained by the theory of - **spontaneous generation (or) abiogenesis**
According to abiogenesis,
Worms are generated from - **manure**
Insects are generated from - **dew, rotten slime, dry wood, sweat & meat**
Frogs & Salamanders from - **coagulated slime**
Toads, Snakes & Mice from - **mud of river Nile**
- Aristotle, Thales, Plato & Von Helmont believed - **theory of abiogenesis until 17th century**
- Francesco Redi, Spallanzani & Louis Pasteur - **experimentally disproved abiogenesis theory**
- Louis Pasteur disproved the theory of abiogenesis by his - **swan-neck flask experiment**
- Biogenesis theory explain that - **living organisms originated from the pre existing organisms**
- Cuvier and Orbinge advocated that the earth was subjected to periodic catastrophes & these catastrophes destroyed the life from time to time & created new & special form of life after each destruction was explained in - **theory of catastrophism**
- The hypothesis of chemical origin of life was strongly supported by - **Haldane, A.I. Oparin, Hurey and Stanley Miller**

- A.I.Oparin described the origin of life in his book **-‘The origin of life on the earth’**
- According to Haldane & Oparin the first phase of origin of life was **-the spontaneous generation of early molecules**
- Origin of life is a phenomenon of **-abiogenesis**
- Diversity of organisms is a phenomenon of **-biogenesis**

Origin of earth and atmosphere

- Origin of Earth occurred
-4.5 to 5 billion years ago
- The sequence of events in the origin of earth are A. Fragmentation of an interstellar cloud.
 B. Contraction and flattening of solar nebula
 C. Condensation of nebular material into meteorites and protoplanetary bodies
 D. Solidification of planets.
- The temperature of the early atmosphere was about 5000°C to 6000°C
- The earth was cooled down in millions of years into inner core surrounded by mantle and crust.
- The light elements like helium, hydrogen, nitrogen and carbon flowed to the surface and formed the earth's atmosphere.
- Atmosphere of primitive earth was a reducing atmosphere with abundant hydrogen and absence of free O_2 and Ozone.
- The elements combined due to cooling of atmosphere and formed molecules like water vapour, metal carbides, metal nitrides, metal oxides, ammonia, methane and cyanamide.
- Steam condensed into water resulting in rain and rivers, streams and oceans, were formed.
- Ammonia, methane were washed down to oceans along with rain water.
- Highly reactive radicals CH and CH_2 are condensed to form variety of hydrocarbons like acetylene, ethylene etc. with cooling of atmosphere and water.
- The molecules of ammonia, hydrocarbons and water underwent condensation, oxidation, reduction and polymerisation to produce complex molecules like sugars, amino acids, fatty acids.
- Purines & pyrimidines were synthesized from Hydrogen cyanide and cyanamides by same reactions.
- All these reactions occurred in the sea which had been described as - **hot dilute soup or prebiotic soup by Haldane**
- The complex organic molecules like nucleic acids

& proteins combined together to form giant molecules like **nucleoproteins**.

Biological Evolution

- For the origin of life, 3 conditions were needed. They are
 - a) **self-reproducing molecules called free genes or replicators**
 - b) **Errors during the copying of replicators, Mutations.**
 - c) **Continuous supply of free energy & partial isolation of molecules from environment**
- Oparin observed the formation of coacervates. When oppositely charged colloids were mixed in water.
- Sydney Fox observed the formation of microspheres with **the mixing of organic molecules in cool water**
- Microspheres were the membrane bound molecules & self multiplied by **-budding**

Formation of living organisms

- The free genes evolved into **anaerobic heterotrophs 3-4 billion years ago**
- They obtained their energy by fermentation of some of the organic molecules.
- The earliest living organisms had clumps of nucleoproteins with 1 or 2 DNA molecules, which were similar to Monerans.
- During the course of evolution, early prokaryotes acquired the carbohydrate synthesis catalysing enzymes. Thus chemoautotrophic organisms (Ex: iron & sulphur bacteria) were evolved, which thrived well at high temperatures.
- Meanwhile some bacteria synthesised bacterial chlorophyll from metalloporphyrin of ocean waters. Thus anoxygenic photoautotrophic organisms like purple and green sulphur bacteria were formed.
- Later, oxygenic photoautotrophic organisms like blue green algae were evolved, due to the evolution of bacterial chlorophyll into true chlorophyll.
- O_2 is released into atmosphere due to the evolution of chlorophyll and photosynthetic activity.
- Release of O_2 transformed the reducing atmosphere into modern oxidising atmosphere.
- The free O_2 began to accumulate in the atmosphere about 2 billion years ago.
- The modern atmosphere mostly contains N_2 , O_2 , CO_2 and water vapour.
- With the availability of free O_2 , aerobic mode of respiration is evolved.

- Eukaryotes were evolved by 2 processes
 - 1) Infolding of plasma membrane of ancestral prokaryotes results in formation of endomembrane system of eukaryotes including nuclear membrane.
 - 2) Prokaryotes lived symbiotically in ancestral eukaryotes and evolved into organelles like mitochondria and plastids.

Experimental verification of chemical origin of life

- Stanley Miller & Harold Urey experimentally supported the chemical origin of life which was explained by **-Haldane & Oparin**
- In Miller's experiment he used a mixture of **-water vapour, methane, ammonia & hydrogen in the spark chamber**
- The Amino acids produced in Miller & Urey's experiment were **-glycine, alanine, aspartic acid**
- Adenine & other nitrogen bases were produced by using **-hydrogen cyanide**

EXERCISE

Evolutionary Concepts & Origin of life

LEVEL-1

1. Who believed that the universe was created in 6 days
 - 1) Dobzhansky
 - 2) Father Suarez
 - 3) Haldane
 - 4) A.I. Oparin
2. The chemical origin of life was proposed by
 - 1) Haeckel
 - 2) Huxley
 - 3) Oparin
 - 4) Von Helmont
3. "The origin of life on the earth" book was written by
 - 1) A.I. Oparin
 - 2) Haldane
 - 3) Spencer
 - 4) Miller
4. The condition needed for origin of life is
 - 1) Replicators
 - 2) Mutations
 - 3) Free genes
 - 4) 1, 2 & 3
5. Who said that the formation of microspheres in the prebiotic soup with the mixture of organic molecules and cooling water
 - 1) Sydney Fox
 - 2) Spallanzani
 - 3) Von Helmont
 - 4) Haldane
6. Chemical origin of life was experimentally supported by
 - 1) Stanley Miller & Haldane
 - 2) Harold Urey & Oparin
 - 3) Stanley Miller & Harold Urey
 - 4) Haldane & Oparin

7. On the earth surface reducing atmosphere change into oxidising atmosphere with the release of free oxygen take place in this moment
 - 1) with the evolution of oxygenic photoautotrophs
 - 2) with the evolution of anoxygenic photoautotrophs
 - 3) with the evolution of chemophotoautotrophs
 - 4) with the evolution of anaerobic heterotrophs
8. At the time of the origin of life, the following is correct about atmosphere
 - 1) The freely available oxygen was abundant
 - 2) Enzymatic reactions were present
 - 3) Reducing atmosphere was found
 - 4) Pre-existing life already present
9. Which of the following theory explains, resistant spores of living organisms might have reached the Earth accidentally from other planets of Universe
 - 1) Theory of pangenesis
 - 2) Theory of panspermia
 - 3) Theory of mutations
 - 4) Theory of recapitulation.
10. In the experimental verification of chemical origin of life by using hydrogen cyanide, which one of these is produced
 - 1) Glycine 2) Alanine
 - 3) Adenine 4) Aspartic acid
11. The water of primitive ocean, during the time of origin of life, has been called “hot dilute soup” or “prebiotic soup” by
 - 1) Haldane 2) Miller
 - 3) Oparin 4) Harold Urey
12. Development of bacterial chlorophyll in some bacteria leads to the evolution of
 1. Oxygenic photoautotrophs
 2. Anaerobic heterotrophs
 3. Anoxygenic photoautotrophs
 4. Chemoautotrophs
13. Oxygenic photoautotrophs were evolved by the development of
 1. True chlorophyll 2. Bacterial chlorophyll
 3. Carbohydrate synthesis catalysing enzyme
 4. Free genes
14. Which of the following are produced by chemical reactions of cyanamide and hydrogen cyanide
 1. Amino acids and fatty acids
 2. Sugars and amino acids
 3. Purines and pyrimidines
 4. Nucleosides & nucleotides
15. Membrane bounded protobionts which multiplied by budding are
 1. Chemo autotrophs
 2. Microspheres
 3. Coacervates
 4. Anaerobic heterotrophs
16. Coacervates are
 1. resistant spores of animals came from other planets
 2. primitive organisms formed as a result of biogenesis
 3. the suspended colloidal systems in the hot dilute soup.
 4. etavistic organs
17. The first anaerobic heterotrophs on the Earth
 1. synthesized the food by their own
 2. obtained energy from the Sun
 3. obtained energy by the fermentation of organic molecules
 4. synthesized the food by using metallo porphyrin
18. Coacervates maintained their entity with the help of
 - 1) Lipid membrane 2) Protein membrane
 - 3) Lipoprotein membrane 4) Glycoprotein membrane
19. Arrange the following in proper sequence of their formation.

A) Photo autotrophs	B) Anaerobic heterotrophs
C) Free genes	D) Chemo autotrophs
1) C – D – B – A	2) C – B – D – A
3) C – B – A – D	4) A – D – B – C

LEVEL-II

12. Development of bacterial chlorophyll in some bacteria leads to the evolution of
 1. Oxygenic photoautotrophs
 2. Anaerobic heterotrophs
 3. Anoxygenic photoautotrophs
 4. Chemoautotrophs
13. Oxygenic photoautotrophs were evolved by the development of
 1. True chlorophyll 2. Bacterial chlorophyll
 3. Carbohydrate synthesis catalysing enzyme
 4. Free genes
14. Which of the following are produced by chemical reactions of cyanamide and hydrogen cyanide
 1. Amino acids and fatty acids
 2. Sugars and amino acids
 3. Purines and pyrimidines
 4. Nucleosides & nucleotides

Theories of Evolution

Lamarckism or

inheritance of acquired characters

- French biologist is well known for his concept
-Jean Baptiste de Lamarck
- Book written by Lamarck is
-Philosophie Zoologique
- Salient features of Lamarck
 - a) species progressively develops
 - b) species change under changing external influences
 - c) Fundamental unity underlying the diversity of sps
- Use-Disuse organs results in **-variations**
- Lamarck cited Giraffe as an
-example for Use of organ
- Lamarck cited snake as a **-“Disuse of organ”**
- Lamarck first assumption is

-Living organisms increases in size in evolution.

- Lamarck's second assumption is
-Acquired characters
- Lamarck's third assumption is
-Use and Disuse organ
- Lamarck's fourth assumption is inheritance of acquired characters.

GERMPLASM THEORY

- The scientist who proposed Germplasm theory
-August weismann
- Weismann performed experiments
-Decaudalisation on mice
- Weismann disproved
-Lamarckism, pangenesis theory
- Weismann differentiated protoplasm into
- Somatoplasm, Germplasm
- The protoplasm plays role in heredity is **-Germplasm**

NEOLAMARCKISM

- First scientific assumption of evolution is
- Lamarckism
- Lamarckism is **-Adaptation to environment** is the primary product of evolution
- Neolamarckians are
- Cope, Osborn, Packard, Spencer.
- **Kammarer** observed his expts in **-Proteus anguinus**

DARWINISM OR NATURAL SELECTION

- Charles Robert Darwin was born on 12-2-1809
-in Shrewsbury England.
- Darwin joined as a naturalist on world survey ship
- HMS beagle
- Darwin while visiting island and places influenced by idea during journey is
- Evolution of new sps by natural selection
- Darwin was much influenced by **- T.R.Malthus**
- Malthus titled his publications as **on the principle of populations**
- Malthus states that population increases geometrically, food sources increases arithmetically
- Book published by Charles lyell is
- principles of geology
- Principles of geology explained the
- gradualism and uniformitarianism
- Alfred Russel Wallace paper titled **- on the tendency of varieties to depart from original types**
- Darwin published a book
-Origin of sps by natural selection
- Darwin presented summary of his theory in a joint paper to **- Linnaean society**
- Origin of sps also called **- preservation of favoured races in the struggle for life**

(a) Over production:

Ex: Paramecium, salmon, starfish, Elephants, Human beings

(b) Constancy in population

- Population of each sps remains more or less con

(c) Struggle for existence :

- Over population leads to - struggle for existence
- Most severe check on rate of reproduction is
- intraspecific struggle

- Best ex: for struggle against environment is - **Gigantic Reptiles Dinosaurs** struggled very much in **- cretaceous period**

(d) Variations are of - useful and Harmful

(e) Natural selection:

- Natural selection stresses **- small fluctuating variations**
- Survival of the fittest proposed by **- Herbert spencer**
- Concept of differential reproductive success of variant is **- more accurate**
- Fitness can be assessed after its **- Reproductive success**
- What fails to reproduce cannot be represented in **- Future.**
- **(f) Origin of sps:**
- Struggle for existence leads to **-survival of the fittest**
- As per natural selection new sps evolved due to the cumulative effect of **- Fluctuating variations.**
- Reproductive ability + Environmental resistance led to **- Struggle for existence**
- Struggle for existence + Heritable variations led to **- Natural selection.**
- Natural selection + Environmental changes led to **- Evolution**

Objections

1. Darwin did not distinguish somatic & germinal variations. Heritable / Non Heritable
2. Causes of variations were not-known
3. Variations occur in different directions at random.
4. Pangenesis theory was not supported by evidences
5. No explanation for the inheritance of unfavourable traits
6. No explanation about arrival of fittest, but explained survival of fittest.
7. Darwin did not explain over specialization and degeneration
Ex. : Antlers of Irish deer (extinct), large tusks of Jefferson mammoths.
8. Darwin could not explain the occurrence of vestigial organs because they have no selection value
9. Does not explain the organs formed by coadaptation like electric organs in electric rays.
- 10 Effectiveness of these organs depends upon

- Perfection
 - 11. Perfection depends upon - Coadaptation
 - 12. Darwin considered macroevolution as - Sports of nature
 - 13. Darwin did not explain - Transitional forms
- Experimental Verification of Natural Selection**
- Industrial Melanism:**
- Peppered grey moth is - *Biston betularia*
 - These moths shows two phenotypes
 - Grey and Black
 - Natural selection favoured - **melanic moths in industrial period**
 - Natural selection of darker forms in response to pollution is called - **Industrial melanism**
 - Industrial melanism tested experimentally by - **BERNARD KETTLEWELL**
 - The polluted area is - **Birmingham**
 - The non polluted area is - **Dorset**
 - Kettlewell in Dorset area recaptured more - **Grey forms**
 - In Birmingham are recaptured more - **Black forms**
 - Darwin considered three types of selections these are - **Natural selection, Artificial selection and Sexual selection**
 - Man made selection is - **Artificial selection for production of better races in domestic animals**
- Sexual Selection:**
- Secondary sexual character cannot be explained by - **natural selection**
 - because these characters are not useful in the struggle
 - Non adaptive secondary sexual characters are - Brilliant colours, Ornaments in males
- Artificial selection:-**
- It is a man made selection
 - It focuses on **one trait** rather than over all fitness of the animal.
- Mutation theory :-**
- Sudden, random, discontinuous change heritable change independent of environment
 - Term mutation coined by **Hugo de Vries. Dutch botanist**
 - Darwin called such variations as - **sports or saltations**
 - Bateson called mutation as - **Discontinuous variations**
 - Hugo devries worked his expts on
 - *Oenothera lamarckiana* (Evening prime rose)
 - Short style prime rose in - *O. brevistylis*
 - Smooth leaves seen in - *O. levifolia*
 - Giant form is - *O. gigas*
 - Dwarf form is - *O. nanella*

- Mutation theory proposed by - Hugo de vries
- New full fledged sps originate at once as a result of - Large discontinuous variations which appear suddenly

Salient features:

- Mutations arises from time to time in
- Naturally breeding population
- Mutants markedly different from -parents
- Mutations are heritable
- Mutations are large, sudden and differ from -Fluctuating variation of Darwin
- Mutations are -random occur in any direction
- Mutations are subjected to -Natural selection
- Mutations are - discontinuous variations
- Mutations are
- full fledged so there are no intermediate stages in the evolution of new sps
- devries stressed on the - randomness of variation
- Darwin stressed on the - adaptiveness of variations
- Devries stated that new sps originated because of sudden jump called mutations
- Darwin stated new sps originated because of -Cumulation of gradual fluctuating variations in series of generations
- Scientist confirmed mutation theory by observing - mutations in *Drosophila* is - T.H.Morgan

Theories of Evolution

LEVEL-I

20. Devries did his experiments on the plants
 1. *Biston betularia*
 2. *Mirabilis jalapa/peaplant*
 3. *Pisum sativum*
 4. *Oenothera lamarckiana*
21. Bernard kettlewell related to
 1. Industrial melanism
 2. Sexual selection
 3. Artificial selection
 4. Sexual/Artificial/Natural Selection
22. The idea, not related to the Darwinism
 - 1) Inheritance of acquired characters
 - 2) Survival of fittest
 - 3) Struggle for existence
 - 4) Origin of species by natural selection
23. Identify the wrongly set pair
 - 1) Haeckel - Theory of mutations.
 - 2) Lamarck - use and disuse of organs
 - 3) Weismann - germplasm theory
 - 4) Louis pasteur - Biogenesis

24. Whose theory of evolution believes that the development of organs and their use are proportional to the activities of the organs
 1) Darwinism 2) Lamarckism
 3) Hugo de Vries mutation theory
 4) Weismann's germplasm theor
25. One of the following is not explained by Natural selection
 1) Survival of the fittest
 2) Struggle for existence
 3) Over specialization
 4) Adaptive radiation
26. According to which scientist "The permanent racial change is the product of fluctuating variations"
 1) Hugo devries 2) Charles Darwin
 3) Kammerer 4) R.A. Fisher
27. Darwinism explained only
 1. Importance of macro variations
 2. Universal occurrence of variations
 3. Significance of vestigial organs
 4. Overspecialisation of some organs
28. Darwin stressed on
 1) The adaptiveness of variation in evolution
 2) The randomness of variation in evolution
 3) The inheritance of acquired variation in evolution
 4) The selection of discontinuous variation in evolution
29. New full-fledged species originate at once as a result of large, discontinuous variations which appear suddenly, according to
 1) Inheritance of acquired characters
 2) Natural selection theory
 3) Mutation theory
 4) Modern synthetic theory of evolution
30. According to Bateson the sudden, random and heritable changes are.
 1) Saltations 2) Discontinuous variations
 3) Continuous adaptations
 4) Continuous variations
- LEVEL-II**
31. Struggle for existence due to the combination of
 1. Over production + constancy in population + Atmosphere limits
 2. Over production+constancy in population+ Heredity
 3. Over production + Heredity+Atmosphere limits
 4. Over production + Heredity + Natural selection
32. Which of the following aspects leads to natural selection
 1. Over production & environmental resistance
 2. Over production & struggle for existence
 3. Struggle for existence & heritable variations
 4. Struggle for existence & environmental resistance
33. According to weismann, the changes occurring in, which cells are not inherited to the next generation
 1) Reproductive Cells
 2) Germinal Cells
 3) Non-Reproductive Cells
 4) Gametic Cells
34. Mutation theory was confirmed by experimenting on *Drosophila melanogaster* by
 1) Darwin 2) Devries 3) Morgan 4) Lamarck
35. The year in which Lamarck published his book Philosophie Zoologique and the Father of Evolution was born in England
 1) 1829 2) 1809 3) 1831 4) 1836
36. Darwinism did not explain the
 1) Survival of fittest, Electric organs in electric ray
 2) Survival of fittest, Vestigial organs.
 3) Arrival of fittest, Over specialisation of antlers in Irish deer.
 4) Origin of species
37. One of the following is correct with reference to mutations-
 1) They are continuous and get cumulated over generations
 2) They are small, non random and non-heritable
 3) They are subjected to natural selection
 4) They occur in one direction only
38. The primary product of evolution according to Lamarckism is-
 1) Adaptation to environment
 2) Mutation
 3) Natural selection
 4) Sexual selection
39. Evolutionary theory that explains the Origin of Variations is
 1) Darwin theory of Natural selection
 2) August Weismann germplasm theory
 3) Use and disuse theory of Lamarck
 4) Hugo de Vries Theory of mutation
40. The most severe type of struggle for existence is
 1. Interspecific struggle
 2. Intraspecific struggle
 3. Environmental struggle
 4. Extra specific struggle
41. Kammerer conducted experiments with cave dweller, *proteus anguinus* to explain
 1) The inheritance of acquired characters
 2) The inheritance of discontinuous variations
 3) The inheritance of fluctuating variations

4) The inheritance of germinal variations
lutionary secretes

NEO DARWINISM or SYNTHETIC THEORY OF EVOLUTION

- Weismann's continuity of germplasm, Mendel's postulates of inheritance helped in
 - Understanding the inheritance of variations
- Guiding force for evolution is -Adaptation
- Neo Darwinists are
 - T.H. Huxley, E. Weismann, E. Haeckel and G.G. Simpson
- Neo Darwinists supported -Natural selection
- Modern synthetic theory given by
 - J.B.S. Haldane, R.A. Fisher, Sewall Wright, H.J. Muller, Ernst Mayr
- Sum of all genes present in the sexual reproducing population during a given generation or a period is called -GENEPOOL
- Frequency of any allele in the total alleles of that population is -Allelic frequency
- Frequency of any genotype in the total genotype of that population is -Genotypic frequency

HARDY-WEINBERG EQUILIBRIUM

Basic principles

1. Equilibrium of allelic frequency:

- In a population frequency of alleles at an autosomal locus will not change from
 - generation to generation
- Ratio of dominant and recessive allelic frequency
- will remain constant

2) Genotypic frequencies:

- In a population genotypic frequencies determined by
 - allelic frequencies in a predictable way

3) Equilibrium is neutral:

- If Equilibrium is disturbed it will be reestablished within one generation of random mating at the new frequencies
- Godfrey H. Hardy & Wilhelm Weinberg proposed that the frequencies of alleles and even the ratios of genotypes tend to remain constant from generation to generation under the following conditions.
 1. A very large population.
 2. No change in mutation rates or no change in allelic frequency due to mutations or large scale migration.
 3. Complete randomness in mating so that success is same for all allelic combinations.
 4. No large scale migrations into or out of the mating pool.
 5. Generations do not overlap.
 6. All genotypes are equally fertile.

- * In such population gene frequencies follow laws of probability

- * If the allele 'A' has frequency 'P' in a population and allele 'a' has a frequency 'q' and there are no other alleles for them $p + q = 1$

The probability that allele 'A' occurs is also its frequency (P) dominant allelic frequency

The probability that allele 'a' occurs is also its q-recessive allelic frequency

Thus the probability of occurrence of homozygous "AA" or its frequency is $P \times P = P^2$. (Homozygous dominant frequency). The probability of occurrence of homozygous 'aa' is $q \times q = q^2$

(Homozygous recessive frequency)

Since there are two ways of forming heterozygous 'Aa' (in A allele from mother and B from father or vice versa)

The frequency of Aa in the population is $2pq$

- Heterozygous dominant genotypic frequency

Sum of all these frequencies of $p^2 + 2pq + q^2 = 1$
 $(p+q)^2 = 1$

A population in Hardy Weinberg equilibrium for a gene with two alleles, the gene frequency of allele A is 0.4 then we can calculate frequency of a = $1 - P = 1 - 0.4 = 0.6$

The frequency of various genotypes

$$AA = p^2 = 0.4 \times 0.4 = 0.16$$

$$Aa = 2pq = 2 \times 0.4 \times 0.6 = 0.48$$

$$aa = q^2 = 0.6 \times 0.6 = 0.36$$

$$P^2 + 2pq + q^2 = 0.16 + 0.48 + 0.36 = 1$$

The selection pressures on the population are exposed by the deviations from the Hardy Weinberg gene and genotype frequencies.

Example : 1

Assume in a population of 200 homozygous dominant are 114, heterozygous dominants (Aa) are 76 and recessive (aa) are 10 individuals.

Dominant allelic frequency = p (of A) =

$$\frac{2(\text{no. of dominant homozygous}) + \text{no. of heterozygous}}{2(\text{no. of individuals in the population})}$$

$$= \frac{2(114) + 76}{2(200)} = \frac{304}{400} = 0.76$$

Recessive allelic frequency = q (of a) =

$$\frac{2(\text{no. of dominant homozygous}) + \text{no. of heterozygous}}{2(\text{no. of individuals in the population})}$$

$$= \frac{2(10) + 76}{2(200)} = \frac{96}{400} = 0.24$$

Example : 2

Assume in the population of 1600, 256 individuals are recessive.

The recessive genotypic frequency = $q^2 =$

$$\frac{\text{no. of recessive individuals}}{\text{total no. of individuals in the population}} = \frac{256}{1000} = 0.16$$

Therefore $q = \sqrt{q^2} = \sqrt{0.16} = 0.4$

Then $p = (1 - q) = (1 - 0.4) = 0.6$

The heterozygous genotypic frequency =

$$2pq = 2 \times 0.6 \times 0.4 = 0.48$$

Then heterozygous individuals in the population = $0.48 \times 1600 = 768$.

The homozygous dominant genotypic frequency = $p^2 = 0.6 \times 0.6 = 0.36$

Then homozygous dominant individuals in the population = $0.36 \times 1600 = 576$

EVOLUTIONARY FORCES

(A) Forces responsible for changes in allelic frequencies and genotypic frequencies

- **Natural selection, Geneflow, genetic load, Genetic drift, and Change in mutation rate**

i) Natural selection:

- Selection is a process by which the organisms that are physically, physiologically, behaviorally better adapted to environment, survive and -Reproduce
- Selection is an - operative process
- A measure of the Reproductive success is - Fitness or adaptive value of a genotype
- A genotype that leaves more fertile offspring has - higher fitness

Selection is of three types:

- a) Stabilising selection: (centripetal selection)
- Selective elimination of phenotypically extreme individuals from two ends of phenotypic distribution and preserving those that are in the mean of the phenotypic distribution called – **stabilising selection**
 - Stabilising selection removes deleterious genotypes from the population whose fitness is -zero
 - Stabilising selection does not promote - evolutionary change
 - Stabilising selection maintains - Phenotypic stability

b) Directional selection:

- The selection that operates in response to gradual changes in environment is - **Directional selection**
- The selection that works by constantly removing individuals from one end of the phenotypic distribu-

tion is - **Directional selection**

- In the directional selection the mean value of fitness shifting towards -other end of the phenotypic distribution
- Ex: for Directional selection, stabilizing selection is -Long necked Giraffe

(c) Disruptive selection (centrifugal selection)

- Rarest form of selection is - **Disruptive selection**
- The selection very important to bring about a evolutionary change is - **Disruptive selection**
- Fluctuating conditions within environment (Heterogeneous environment) increases - **Competition**
- The phenotypes of a population pushed away from population mean to the end of the population is due to
- Competition and selection pressure
- Disruptive selection splits the population into two or more subpopulations called - species population
- If the gene flow between the populations is prevented each population may give rise to -New sps (it is also called adaptive radiation)
- Selection in a population at or near carrying capacity of a habitat is k - selection
- The selection in a population subject to rapidly changing environments with highly fluctuating food sources - r - selection

II. Geneflow

- ii) -Movement of alleles from one population to another because of interbreeding between members of two populations is called -**Gene flow**
- Random introduction of alleles into the recipient population and their removal from donor population effect the -**Allelic frequencies of both populations**

iii) Genetic load :

- Existence of deleterious genes within the population is called - **Genetic load**
- Existence for Genetic load is - **Single pair of alleles involved in highly fatal sickle cell disease**
- Homozygous for sickle cell usually die early due to - **Anaemia**
- Heterozygous for sickle cell live reasonably healthy but - **Perpetuate the disadvantageous gene**
- Heterozygous condition for sickle cell sometimes found beneficial
- **They possess resistance to malaria**
- Recessive mutations which are disadvantageous also

lead to - **Genetic load**

IV Genetic drift :

Genetic drift / Sewall wright effect

- End result of genetic drift is either - Fixation of (P or Q=1) or Loss (P or Q= 0) of any given allele.
 - The rate of approach to reach the fixation or loss end point depends on - size of the population
 - Variations that occur by chance in a small population can also causes deviations from
 - Hardy Weinberg equilibrium
 - Any deviation due to chance variation is called - Random genetic drift or Sewall wright effect
 - 1. Genetic drift is also known - Sewall wright effect
 - 2. Genetic drift is seen in a limited population or geographically
 - **isolated population or sub population**
 - 3. Random variation in gene frequencies of a limited population constitute - **genetic drift**
- Note : The essential feature of genetic drift is that the (smaller the population, the greater are random variations in gene frequencies from generation to generation)

Founder Effect

- New Population derived from a small isolated group of individual called - **Founders**
- Founders genetically different from - **Parent population**
- Genetic drift seen in - Sub population
- In sub population the allelic frequencies are similar to the founders rather than to the - ancestral parent population.
- Best example for founder effect is
- Pitcarian island population
- Pitcarian island population resulted from small numbers of founders of - Caucasian and polynesian individuals

Bottleneck effect :

- Another form of Genetic drift is - **Bottle neck effect**
- Natural calamities earth quakes, volcanic eruption and floods called - **Bottlenecks**
- After the bottle necks the parents of the next generations have been - **Original population reduced to a small number and may be genetically different from the ancestors**
- Genetic drift reduces the amount of genetic variation within the population mainly by removing - **Alleles which have low frequency**
- Genetically different population from parent popula-

tion may arise from these individuals that are left after - **Bottle necks**

V. Change in mutation rate :

- Number of new mutant alleles per given number of gametes is called - **Mutation rate**
- New alleles produced by mutations have negligible influence in the absence of other forces like
- **Natural selection**
- Mutations occur at random

B. Factors responsible for changes in genotypic frequencies without changes in allelic frequencies also called - Gene reshuffling

i. Sexual recombination:

- Crossing over during meiosis or
- Independent segregation during meiosis by random fertilisation is - **Called sexual recombination**

ii) Assortative mating or Non random mating or Preferential mating

- Deviation from random mating alters
- **Genotypic frequencies but not the allelic frequencies**

SPECIATION :

- One sps evolved into different species called
- Speciation or Anagenesis or Phyletic evolution
- If one species diverge to become two or more sps it is called - **Cladogenesis**

Anagenesis :

- Species 1 gave rise to species 2 is called - **Anagenesis**
- Species 1 gave rise to species 2 and species 3 or more is called - **Cladogenesis**

ALLOPATRIC & SYMPATRIC SPECIATION

- The speciation in which the Isolated group is geographically separated from its original larger population is called

- Allopatric speciation

- Geographically barriers are - **Mountains, seas and rivers etc.**
- The geographically adjacent populations are called **Parapatric populations**
- When a sub population within the large population develops large characters that tend to isolate it from its neighbours, the type of speciation is - **sympatric speciation**
- The evolution of several species from the common ancestor to live in varied habitats in known as - **divergent evolution (or) adaptive**

radiation.

- Organisms live in the same habitat capable of interbreeding do not interbreed because of differences in behavioural, structural, physiological reproductive mechanism leads to formation of a new sps called **- sympatric speciation**
- Evolution of taxa higher than the level of species is **macroevolution**
- The evolutionary changes that occur in populations causing differences in populations of a species are referred as **micro evolution**
- Evolution of one species into a different species is called **anagenesis (or) phyletic evolution**
Ex: *Aglaspis eatoni* of cambrian period is evolved into *Limulus polyphenus* of recent epoch
- Evolution of one species into two or more species is called **cladogenesis**
- Evolutionary lineage follows a long term intervals in which there is relatively little change and punctuated by bursts of speciation (or) macro evolutionary events during which new taxa arise **punctuated equilibrium.**
- Diversification of a group into a large variety of groups is **- adaptive radiation**
Ex: Evolution of seed eating finches of South America into different finches of Galapagos islands.
- Two species having the same phenotype due to common ancestry is called **homology**
Ex: Fore limbs of eutherian mammals
- The evolution of similar characters in unrelated lineages, because they have been subjected selective pressure is called **homoplasy (or) convergence**
Ex: Shark (fish), Ichthyosaur (dinosaur) and porpoise (mammal) explain homoplasy as they adapt to sea life.
- The evolution of similar characters in related lineages whose common ancestor was phenotypically different was called **Parallelism**
Ex: Long tongue, clawed digits and long snout in anteaters like *Echidna* (Prototherian), *Myrmecobius* (metatherian) and *Myrmecophaga* (eutherian)

NEO DARWINISM or SYNTHETIC THEORY OF EVOLUTION LEVEL-I

42. Gene flow is possible in
1. Interbreeding between the two populations
 2. Interbreeding between within the population
 3. Intra breeding between within the population
 4. 1, 2 and 3

43. Presence of deleterious alleles in the population is called
1. Gene flow
 2. Genetic drift
 3. Genetic load
 4. Genetic non load
44. Identify the correct Statement(s)
- i. Homozygous for sickle cell anaemia will die earlier
 - ii. Heterozygous for sickle cell anaemia will die earlier
 - iii. Homozygous for sickle cell anaemia will die later
1. i, ii are correct
 2. ii, iii are correct
 3. i, iii are correct
 4. only i is correct
45. Name the selection which shows adaptive radiation
1. Disruptive selection or directional selection
 2. Stabilising selection
 3. Directional selection
 4. Disruptive selection
46. In which selection the removal of nonreproductive individuals occurs
1. Directional selection
 2. Disruptive selection
 3. Stabilising selection
 4. 1, 2 and 3
47. Bateson called sudden random, large heritable changes (macro variations as)
- 1) mutations
 - 2) saltations
 - 3) discontinuous
 - 4) sports
48. The disturbed equilibrium in Hardy - Weinberg populations can be reestablished within one generation by
1. Assortative mating
 2. Non - random mating
 3. Pannictic mating
 4. Preferential mating
49. The force responsible for fixing in population of neutral characteristic is :
- 1) Genetic drift
 - 2) Mutation
 - 3) Reproductive isolation
 - 4) Genetic recombination
50. Arrange the periods of palaeozoic era in ascending order in a geological time scale (EAMCET 2005)
- 1) Cambrian → Ordovician → Silurian → Carboniferous → Permian
 - 2) Cambrian → Devonian → Ordovician → Silurian → Carboniferous → Permian
 - 3) Cambrian → Ordovician → Devonian → Silurian → Carboniferous → Permian
 - 4) Silurian → Devonian → Cambrian → Ordovician → Permian → Carboniferous
51. The natural selection that acts against change in the form and keeps the population constant through the time is : (EAMCET 2006)
- 1) Directional
 - 2) Disruptive
 - 3) Not acting
 - 4) Stabilizing
52. Identify the correct chronological sequence periods of Mesozoic era : (EAMCET 2006)

- 1) Carboniferous → Permian → Triassic → Jurassic → Cretaceous
 - 2) Cretaceous → Permian → Jurassic → Carboniferous → Triassic
 - 3) Cretaceous → Carboniferous → Permian → Triassic → Jurassic
 - 4) Carboniferous → Jurassic → Permian → Triassic → Cretaceous
53. "A brief reduction in size of a population due to natural calamities usually leads to random genetic drift". For this statement, identify the correct example from the following.
 - 1) Human population of Pitcairn Island
 - 2) Polydactylic dwarfs in Amish population
 - 3) Long necked giraffe
 - 4) Industrial melanism
 54. Experimental verification of natural selection is done by
 - 1) Darwin
 - 2) Weismann
 - 3) Bernard Kettlewell
 - 4) Simpson
 55. Polydactylic dwarf individuals are more in old order Amish population of Lancaster in USA, It is due to
 - 1) Gene flow
 - 2) Genetic load
 - 3) Founder effect
 - 4) Bottle neck effect
 56. In California, the sunflower population dividing into two sub-populations is example for
 - 1) Directional selection
 - 2) Centrifugal selection
 - 3) Centripetal selection
 - 4) Stabilizing selection
 57. Evolutionary change that brought by centrifugal selection is
 1. Divergent evolution
 2. Convergent evolution
 3. Parallel evolution
 4. Homoplasy
 58. One of the factors responsible for changes in genotypic frequencies without change in allelic frequencies, in the following is:
 - 1) Random mating
 - 2) Preferential mating
 - 3) Mutation
 - 4) Selective migration
 59. During evolution, the development of resistance to DDT by mosquitoes is due to-
 - 1) Directional selection
 - 2) Centrifugal selection
 - 3) Adaptive radiation
 - 4) Random mating
 60. Sewall Wright effect is-
 - 1) Change in genotypic frequency without change in allelic frequency
 - 2) Evolution of new species within the range and habitat of the parent species
 - 3) Deviation from Hardy – Weinberg equilibrium due to chance variations
 - 4) Change in mutation rate leading to the evolution of new species
 61. Which one of the following conditions disturb the Hardy – Weinberg equilibrium in a population?
 - 1) Overlapping of generations, in a population
 - 2) Equal fertility of all genotypes
 - 3) Random mating
 - 4) Large populations
 62. Neo-Darwinists in the following pairs are
 - 1) R.A Fisher & Lamarck
 - 2) G.G Simpson & DeVries
 - 3) Sewall Wright & Huxley
 - 4) Mayr & Bateson
 63. The term panmictic refers to-
 - 1) Large population
 - 2) Genetic load
 - 3) Parallel evolution
 - 4) Random mating
- LEVEL - II**
64. In England weights of babies in a large sample were taken. This is an example for
 - 1) Directional selection
 - 2) Stabilising selection
 - 3) Disruptive selection
 - 4) Artificial selection
 65. The type of selection that can split a population into two or more sub populations is -
 - 1) Centrepetal selection
 - 2) Centrifugal selection
 - 3) Directional selection
 - 4) Artificial selection
 66. During the evolution of giraffes the length of the neck is stabilised due to stabilising selection, but the length is increased due to
 - 1) Disruptive selection
 - 2) Directional selection
 - 3) Centrepetal selection
 - 4) Artificial selection
 67. One of the following is a factor responsible for gene reshuffling –
 - 1) Change in mutation rate
 - 2) Genetic drift
 - 3) Sexual recombination
 - 4) Genetic load
 68. Due to genetic drift the amount of genetic variation within a population
 1. Increases
 2. Stabilises
 3. Reduces
 4. Varies frequently
 69. The selection that is responsible for species populations is
 - 1) Centripetal selection
 - 2) Centrifugal selection
 - 3) Directional selection
 - 4) Stabilizing selection
 70. A highly competitive groups of animals of same species are living in a highly variable environmental conditions. The type of natural selection that is going to operate on them is
 1. Centripetal selection
 2. Directional selection
 3. Centrifugal selection
 4. Stabilising selection
 71. Hardy-Weinberg equilibrium makes several assumptions. Which of those listed below are not assumptions which must be met for a population to reach Hardy-Weinberg Equilibrium?

- (a) Sexual Reproduction
(b) Non-overlapping Generations
(c) Random Mating
(d) Natural Selection occurs
(e) Population size is small
1. a and b 2. a, b and c
3. d and e 4. c and d
72. In malaria endemic areas like certain African countries heterozygous sickle cell individuals are far greater than others. This explains.
(1) Stabilising selection (2) Artificial selection
(3) Genetic load (4) Disruptive selection
73. Statement (S) : Adaptive radiation results in homology
Reason (R) : Diversification results in adaptive radiation
1. S, R are correct R is the correct explanation to S
2. S, R are correct R is not correct explanation to S
3. s is correct, but R is wrong
4. Both S & R are wrong
74. Following are the process that leads to formation of new Sps
a. Accumulation of genetic variations among sub sps
b. Genetic divergence among the subsp
c. Reproductive isolation among the subsp
1. a, b correct 2. b, c correct
3. c only correct 4. a, b and c
75. Statement (S) : separation of smaller group from larger group of population due to geographical barriers, reproductively leads to formation of a new sps called allopatric speciation
Reason (R) : Mountains, Rivers, oceans are the factors for reproductive isolation of terrestrial populations
1. S, R are correct R is the correct explanation to S
2. S, R are correct R is not correct explanation to S
3. s is correct, but R is wrong
4. Both S & R are wrong
76. In a linear sequence with regular change the formation of a new sps called
1. Phyletic change/cladogenesis
2. Phyletic change/ Anagenesis
3. Anagenesis/Cladogenesis
4. Only cladogenesis
77. The evolution of *Limulus polyphenus* of recent epoch from *Aglaaspis eatoni* of Cambrian period is an example for
1. Clandogenesis 2. Anagenesis
3. Adaptive radiations 4. Punctuated equilibrium
78. The fore limbs of eutherian mammals explain
1. Homoplasy 2. Convergence
3. Homology 4. Parallelism
79. Evolution of taxa higher than the level of species is
1. Macro evolution 2. Micro evolution
3. Punctuated equilibrium 4. Adaptive radiation
80. A lineage gives rise to two or more lineages due to branching in : (EAMCET 2004)
1) Phyletic change 2) Anagenesis
3) Cladogenesis 4) Paedogenesis
81. *Myrmecobius* and *Myrmecophaga* are closely related and have similar adaptations for the same habitat. This phenomenon is (EAMCET 2007)
1) Divergent evolution 2) Homoplasy
3) Convergent evolution 4) Parallel evolution
82. Allopatric speciation is caused by
1) Genetic drift 2) Gene flow
3) Physiological separation 4) Spatial separation
83. An example of co-adaptation is
1) Industrial melanism
2) Electric organs in fishes
3) Long tusk in the elephant
4) Both 2 and 3
84. Human population found in Pitcairn island is a good example for-
1) Genetic load 2) Bottle neck effect
3) Founder's effect 4) Centrifugal selection
85. The existence of deleterious genes within the populations is called-
1) Gene flow 2) Genetic load
3) Genetic drift 4) Fixation
86. Founder effect is one form of
1) Gene reshuffling 2) Genetic drift
3) Genetic load 4) Gene flow

LEVEL-III

87. Match the following

List – I

- A) Father Suarez
B) Francisco Redi
C) Cuvier, orbing
D) Oparin

List – II

- i) Abiogenesis theory
ii) Chemical origin of life
iii) Theory of catastrophism
iv) Biogenesis theory
v) Theory of special

creation

- | A | B | C | D |
|-------|-----|-----|-----|
| 1) I | III | II | V |
| 2) V | IV | III | II |
| 3) IV | V | II | III |
| 4) I | II | III | IV |

88. Following are the statements about Haldane & Oparin hypothesis
i) According to them the first phase of origin of life

- was spontaneous generation of early molecules
 ii) The early molecules transformed into protobionts
 iii) Protobionts evolved into early living organisms
 The **correct** combination is
 1) I & II are correct 2) II & III are correct
 3) I & III are correct 4) All are correct

Note:

- 1) Both S & R are correct, R is correct explanation to S
 - 2) Both S & R are correct, R is not correct explanation to S
 - 3) S is correct, R is false
 - 4) Both S & R are false
89. Statement (S): Sydney Fox observed the formation of microspheres when organic molecules were mixed with cold water
 Reason (R): The membrane bound molecules and self multiplication by budding are called microspheres
90. Statement (S): High temperature was responsible for mutations
 Reason (R): Errors during the copying of replicators are mutations
91. Statement (S): Evolutionary process giving rise to new species that are adapted to new habitats and ways of life is called **adaptive radiation**.
 Reason (R): **Homology** explains adaptive radiation
92. Study the following about the conditions for the formation of protobionts
 I. Self-reproducing structures called replicators are essential for origin of life
 II. Errors during copying of replicators
 III. Discontinuous supply of free energy
 IV. Lack of partial isolation of the molecules
 From the above the **wrong** statements are
 1) I and III 2) II and III
 3) I and IV 4) III and IV
93. The following are the statements about the origin of the Earth
 A) Solidification of planets
 B) Fragmentation of Interstellar cloud
 C) Condensation of nebular material into meteorites and protoplanetary bodies
 D) Contraction and flattening of nebula
 Arrange the above statements in a correct sequence according various phases in the formation of Earth.
 1) BDCA 2) BDAC 3) BCAD 4) BADC
94. Statement (S) : The primitive atmosphere of Earth was reducing atmosphere.
 Reason (R) : Oxygen in the free gaseous form was abundant in primitive atmosphere.
 1) Both S & R are correct, R is correct explanation to S

- 2) Both S & R are correct, R is not correct explanation to S
- 3) S is correct, R is false
- 4) Both S & R are false

95. Given below are the statements about the conditions for the origin of life. Find the incorrect one
 I) Self-reproducing molecules called free genes or replicates
 II) Errors during the copying of replicates i.e. mutations. High temperature was responsible for mutations
 III) A continuous supply of free energy and complete isolation of the molecules from the environment
 1) I and II 2) II and III 3) III only 4) I,II,III

Note:

- 1) Both S & R are correct, R is correct explanation to S
 - 2) Both S & R are correct, R is not correct explanation to S
 - 3) S is correct, R is false
 - 4) Both S & R are false
96. Statement (S) Fitness of a population is measured on the basis of reproduction
 Reason (R) Reproduction of a population depends upon Genotypic adaptive value
97. Statement (S) Natural selection cannot explain the formation of secondary sexual character
 Reason (R) Secondary sexual characters are not useful in the struggle for existence
98. Statement (S): Secret of evolution of sps by Huxley's evolutionary concept is mutation
 Reason (R) Formation of new sps in the evolution is suddenly, discontinuously with major changes
99. Statement (S) : Black coloured *Biston betularia* are abundant due to industrial pollution
 Reason (R) : Natural selection of darker forms occur in response to industrial pollution
100. Statement (S) Most common struggle for existence is interspecific
 Reason (R) : Most of the species have same struggle for food habits
101. Statement (S) : Evolution is a continuous process but not sudden
 Reason (R) : Discontinuous variations are evolutionary sports 1. A, R are correct R is the correct explanation to A
102. Statement (S) : Discontinuous variations are not accumulated in next generation
 Reason (R) : New sps are formed due to effect of discontinuous variations
103. Statement (S) : Any species population number is more or less constant in nature
 Reason (R) : Young individuals die in large number before reaching to reproductive age

104. Statement (S) : Intraspecific struggle is severe
Reason (R) : In between the same sps of animals the fighting is serious because the needs like food, and mating is same

105. Match the following : (EAMCET 2007)

Set - I

(a) T.R. Malthus

Set - II

1. On the tendency of varieties to depart from original types

(b) Sir Charles Lyell

2. Philosophie Zoologique

(c) Weismann

3. On the Principles of Populations

(d) Lamarck

4. Principles of Geology

(e) Alfred Russel Wallace

5. Germinal selection

The **correct** match is

- | | | | |
|---------|-----|-----|---------|
| (1) a-3 | b-2 | c-5 | d-4 e-1 |
| (2) a-3 | v-4 | c-5 | d-2 e-1 |
| (3) a-3 | b-4 | c-2 | d-5 e-1 |
| (4) a-3 | b-5 | c-4 | d-1 e-2 |

106. Identify the **correct** statements related to sexual selection according to Darwin

- I. In birds females select males for mating.
 - II. In mammals males select females for mating
 - III. In birds males select female for mating
 - IV. In mammals female select males for mating
- 1) I and II are correct
 - 2) III and IV are correct
 - 3) I and III are correct
 - 4) I and IV are correct

107. Match the following and choose the correct answer.

Name of Scientist Name of publication

A) Charles Lyell

I) Philosophie Zoologique

B) J.B. Lamarck

II) The origin of species by Natural selection

C) Charles Darwin

III) The origin of life on the Earth

D) A.I. Oparin

IV) Principles of Geology

V) Systema Nature

- | | | | | |
|----|----|-----|----|-----|
| | A | B | C | D |
| 1) | IV | I | II | III |
| 2) | IV | V | I | II |
| 3) | IV | III | II | I |
| 4) | IV | I | V | II |

108. Statement (S) : Secondary sexual characters cannot be explained by natural selection.

Reason (R) : These are highly useful in the struggle with the environment

- 1) Both S & R are correct, R is correct explanation to S
- 2) Both S & R are correct, R is not correct explanation to S
- 3) S is correct, R is false
- 4) Both S & R are false

109. The following are the statements regarding Industrial melanism

- I) This is an experimental verification of Artificial selection
- II) Natural selection of darker moths in response industrial pollution is known as industrial melanism
- III) Dorset is a more polluted area compared to Birmingham
- IV) Reverse evolution of gray moths is due to reduction in pollution

Correct statements are

- 1) I & II 2) II & IV 3) II & III 4) III & IV

110. Find out the correct statements with reference to Natural selection

- i) Reproductive success is the proportion of fertile offspring produced by a phenotype relative to other genotypes
- ii) The organism that fails to reproduce can be represented in future generations because of its fitness in the struggle for existence
- iii) Over a period of time the criterion for success is the reproductive success
- iv) The concept of differential reproductive success of various forms is more accurate

Correct statements are:

- 1) i, ii & iv 2) ii & iii 3) i, iii & iv 4) iii & iv

- 1) Both S & R are correct, R is correct explanation to S
- 2) Both S & R are correct, R is not correct explanation to S
- 3) S is correct, R is false
- 4) Both S & R are false

111. **Statement (S)** : According to Hugo de Vries there are no intermediate forms in the evolution of new species.

Reason (R) : Hugo de Vries is of the opinion, that the mutations which form the basis of Evolution are heritable and continuous, minor variations

112. Statement (S) : Natural selection fixes the character with adaptive value and operates both in small and larger populations

Reason (R) Natural selection increases the fitness of an organism by increasing the frequency of adaptive alleles and decreasing the frequency of deleterious alleles

113. Match the following & identify the correct combination.

- | | |
|-------------------|---|
| A) Devries | i) Constancy in allelic frequency in generations |
| B) Sewall Wright | ii) Artificial Mutations |
| C) Hardy Weinberg | iii) Genetic Drift |
| D) H. J. Muller | iv) Mutations |
| | v) Natural selection produces consistent increases in the fitness of population |

A	B	C	D
1. iv	iii	i	i
2. v	iv	iii	i
3. ii	iii	iv	v
4. ii	i	iii	v

114. Match the following

- | | |
|-------------------|--------------------------------------|
| A) Genetic drift | i) sum of genes in a population |
| B) Gene frequency | ii) Chance effect |
| C) Gene pool | iii) Ratio of genes in a genepool |
| D) Founder effect | iv) Special feature of genetic drift |
| | v) Rate of changes in DNA |

A	B	C	D
1. i	i	iii	iv
2. iii	i	v	i
3. ii	iii	i	iv
4. iv	i	i	iii

115. In a sample population 1400 mice 56 express recessive trait. If there are only two alleles for the trait what will be the individuals with homozygous dominant and heterozygous dominant trait in the population

- | | |
|-------------|-------------|
| 1. 896, 448 | 2. 448, 698 |
| 3. 698, 844 | 4. 448, 968 |

- 1) Both S & R are correct, R is correct explanation to S
- 2) Both S & R are correct, R is not correct explanation to S
- 3) S is correct, R is false
- 4) Both S & R are false

116. Statement (S) : Factor responsible for changes in genotypic frequencies without changes in allelic frequencies is assortative mating

Reason (R) : Sexual recombination causes changes in genotypic frequencies but not for allelic frequencies

117. Statement (S) : Movement of alleles from one population to another population is geneflow

Reason (R) : Geneflow is possible because of the interbreeding between members of the two populations

118. Statement (S) : The variations that occur in a small population cause deviations from Hardy Weinberg equilibrium

Reason (R) : These variations are called Sewallwright effect

119. In a population of 650 rabbits which are in Hardy-Weinberg equilibrium and 39 of them express a recessive allele(s) for short ears, estimate the number of Homozygous(ss) rabbits

(EAMCET 2004)

- 1) 234 2) 377 3) 432 4) 218

120. Statement (S) : The long neck of Giraffe is due to directional selection.

Reason (R) : During directional selection when the mean value of phenotype coincides with new optimum environmental conditions. Centripetal selection takes over. (EAMCET 2005)

- 1) Both statement and reason are true and reason is a correct explanation to statement
- 2) Only statement is true and reason is not true
- 3) Both statement and reason are not true
- 4) Both statement and reason are true, but reason is not the correct explanation to the statement.

121. In a population of 278, if observed number of 'MM' 'MN' blood groups is 78, 138 and 62 respectively, what would be the frequency of 'M' ?

(EAMCET 2006)

- 1) 0.532 2) 0.499 3) 0.468 4) 0.283

122. In Hardy-weinberg equilibrium, $2pq(x)$ total number of population denotes to

- (1) Homozygous dominant genotypic frequency
- (2) Heterozygous dominant genotypic frequency
- (3) Heterozygous dominant individuals in that population
- (4) Recessive dominant individuals in that population

123 Find out the recessive allelic frequency in a population of 100 individuals of a mono hybrid cross. ?

1. 0.5 2. 0.8 3. 0.75 4. 0.25

124. Match the following:

Set – I Set – II

- | | |
|--------------------|---|
| A) $2pq$ | I) Recessive genotype frequency |
| B) q^2 | II) Binomial equation |
| C) p^2 | III) Heterozygous dominant genotype frequency |
| D) $(p + q)^2 = 1$ | IV) Homozygous dominant genotype frequency |

A B C D

1) III, II, I, IV

3) III, IV, I, II

A B C D

2) I, III, IV, II

4) III, I, IV, II

125. In a population of Hardy – Weinberg equilibrium, there are 64% of non tasters of phenylthiocarbamide, which is a recessive trait. What is the percentage of homozygous tasters in that population?

- 1) 36% 2) 32% 3) 48% 4) 4%

126. In a population of Hardy – Weinberg equilibrium with 2500 guinea pigs, 225 are with white recessive phenotype. What is the expected number of homozygous dominant individuals?

- 1) 1050 2) 1225 3) 2000 4) 1250

127. Statement (S) : In evolution, over a time, the same average value of the phenotypic distribution in the population is maintained

Reason (R): Stabilising selection does not promote evolutionary change that leads to speciation but maintains phenotypic stability within the population over generations.

- 1) Both S & R are correct, R is correct explanation to S
 2) Both S & R are correct, R is not correct explanation to S
 3) S is correct, R is false
 4) Both S & R are false

128. Study the following and choose the correct combinations.

I : Centripetal selection operates in a stable environment.

II : A rare form of selection is disruptive selection.

III : In case of long necked giraffes, the length is increased due to directional selection but the length is stabilized due to centrifugal selection.

IV : In Natural selection, a measure of reproductive success is the fitness or adaptive value of a genotype.

The correct combinations are -

- 1) I & II 2) I, II, IV 3) I, II, III 4) II, IV

129. Match the following

- | | |
|--------------------------|--|
| A. Genetic load | I. Polydactylic dwarfness |
| B. Genetic drift | II. Sickle cell anaemia |
| C. Bottle neck effect | III. Sun flower population in California |
| D. Centrifugal selection | IV. Fixation or Loss |

A B C D

1. II, IV, I, III

3. I, II, III, IV

A B C D

2. II, III, IV, I

4. I, III, II, IV

130. In a population at Hardy - Weinberg equilibrium, the recessive individuals are 36%. Find out the number of heterozygous individuals.

- 1) 60 2) 48 3) 40 4) 36

131. In a population of Hardy – Weinberg equilibrium, men and women are in equal numbers. If the frequency of pattern baldness is 0.6, what is the ratio of bald and non-bald persons in that population?

- 1) 2 bald : 3 non-bald 2) 3 bald : 2 non-bald
 3) 1 bald : 3 non-bald 4) 1 bald : 1 non-bald

132. The following are the statements on the basic principles of Hardy – Weinberg equilibrium-

I) In a diploid population the frequency of alleles at an autosomal locus will not change over generations
 II) Ratio of dominant and recessive allelic frequencies will not remain constant

III) In a population genotypic frequencies are determined by allelic frequencies in a predictable way

IV) If the equilibrium is disturbed, it will be reestablished within one generation of non-random mating at the new frequencies

Correct statements are

- 1) I & IV 2) II & III 3) II & IV 4) I & III

133. On an island only homozygous dominant and homozygous recessive organisms are present and the frequency of dominant allele is 0.2. Due to environmental conditions, if all the homozygous dominant individuals die, then, the frequency of recessive allele on the island is-

- 1) 0.8 2) 1.0 3) 0.16 4) 0.4

134. The following are the statements about speciation-

I) A species consists of all individuals sharing a common gene pool

II) Horse and donkey belong to separate species

III) Individuals of a species maintain reproductive isolation

The **correct** combination is –

- 1) Only I & II are true 2) All are true
 3) Only I & III are true 4) Only II & III are true

135. In a population at Hardy – Weinberg equilibrium, 288 individuals show homozygous dominant trait. If the frequency of homozygous dominant allele is 0.6, what is the total number of the population.

- 1) 580 2) 468 3) 1200 4) 800

136. In a population which is maintaining Hardy-Weinberg's equilibrium for gene with two alleles of which the frequency of the recessive gene is 0.2. What is the genotypic frequency of homozygous dominant genotype

1. 0.064 2. 0.64 3. 0.8 4. 0.32

137. In a population which is maintaining Hardy-Weinberg's equilibrium the gene frequency of a dominant allele (A) is 0.7, then the genotypic frequency of Aa is

1. 0.21 2. 0.42 3. 0.36 4. 0.3

138. Read the following statements

- The development of resistance to DDT by mosquitoes is an example for centripetal selection.
- Stabilizing selection does not promote evolutionary change that leads to speciation
- Disruptive selection operates in a heterogeneous environment.

Identify the correct statement(s)

- 1) i, ii 2) ii, iii 3) only iii 4) only i

139. In a population in Hardy - Weinberg equilibrium 300 individuals are homozygous dominant in a population of 7500 then find out the heterozygous dominant individuals in the population

- 1) 4800 2) 2400 3) 1200 4) 600

140. Match the following

Column - I Column - II

- | | |
|---------------------------|--|
| A) Bottlenecks | i) Giraffe's neck elongation |
| B) Genetic load | ii) Pitcairn population |
| C) Directional selection | iii) Proteus |
| D) Founder effect | iv) Heterozygous for sickle cell anaemia |
| | v) Natural calamities |
| 1) A-v, B-ii, C-iv, D-iii | 2) A-i, B-ii, C-iii, D-iv |
| 3) A-ii, B-i, C-iv, D-v | 4) A-v, B-iv, C-i, D-ii |

141. In a population of 1000 penguins, 75% of the individuals are homozygous for the fat storage gene (BB), 22% of individuals are heterozygous for the same gene (Bb) and the remaining 3% of the population is homozygous recessive (bb). What is the frequency of the B allele in this population?

- 1) 0.25 2) 0.50 3) 0.75 4) 0.86

142. Statement (S): Stabilising selection removes deleterious genotype from population, for which reproductive success is zero.

Reason (R): Stabilising selection operates in response to gradual changes in environment

- Both S & R are correct, R is correct explanation to S
- Both S & R are correct, R is not correct explanation to S
- S is correct, R is false
- Both S & R are false

143. In a given population, only the "A" and "B" alleles are present in the ABO system; there are no individuals with type "O" blood or with O alleles in this particular population. If 200 people have type A

blood, 75 have type AB blood, and 25 have type B blood, what are the frequencies of I^A and I^B in this population?

- $I^A = 0.8$ and $I^B = 0.2$
- $I^A = 0.2$ and $I^B = 0.8$
- $I^A = 0.6$ and $I^B = 0.4$
- $I^A = 0.4$ and $I^B = 0.6$

144. Cystic fibrosis is a recessive condition that affects about 1 in 2,500 babies in the Caucasian population of the United States. Which of the following statements are true?

- The frequency of the recessive allele in the population is 0.0004
- The frequency of the dominant allele in the population is 98%.
- 1 in 25 are carriers.

- I and II
- II and III
- I and III
- I, II and III

145. If in a H.W. population of 1400 individuals recessive allelic frequency is 0.3 how many individuals in that population are homozygous

- (1) 686 (2) 588 (3) 126 (4) 812

146. In a H.W. population of 1400 individuals if 16% individuals are with recessive phenotype how many individuals are homozygous dominant.

- (1) 672 (2) 504 (3) 224 (4) 728

147. **Statement (S)** : Genetic drift tends to reduce the amount of genetic variation within the population.

Reason (R) : Mainly genetic drift removes the alleles, which have low frequency.

- Both S & R are correct, R is correct explanation to S
- Both S & R are correct, R is not correct explanation to S
- S is correct, R is false
- Both S & R are false

148. In a H.W. population of 1000, the number of individuals with recessive phenotype are 360. Find out the number of heterozygous individuals

- 1) 360 2) 240 3) 480 4) 160

149. Assume in a population of 1600, the homozygous dominant genotypic frequency is 0.36 find out the number of homozygous recessive individuals in the population

- 1) 768 2) 576 3) 256 4) 108

150. In a population of 800 individuals (maintaining Hardy - Weinberg equilibrium) 9% of individuals are recessive homozygous. How many of this population are homozygous dominants and heterozygous individuals

- 336, 372
- 392, 336
- 372, 356
- 728, 0

151. Statement (S) : Founder effect is one form of genetic drift
Reason (R) : Allelic frequencies of population remain constant from generation to generation in a large population is called genetic drift.
- 1) Both S & R are correct, R is correct explanation to S
 - 2) Both S & R are correct, R is not correct explanation to S
 - 3) S is correct, R is false
 - 4) Both S & R are false
152. In a population of 400 individuals which is in Hardy-Weinberg equilibrium, Homozygous dominant and recessive individuals are equal in numbers and heterozygous individuals are 200. what is the frequency of recessive allele
- 1) 0.5 2) 0.25 3) 0.80 4) 0.75
153. Following are the statements regarding mechanism of evolution according to synthetic theory of evolution
- I. Natural selection is an operative process that occurs in a population through difference in reproductive success.
 - II. Stabilizing selection does not promote evolutionary change but maintains phenotypic stability with in populations over generations.
 - III. Directional selection brings evolutionary change but when once mean value of phenotype coincides with new optimal environmental conditions it stops
 - IV. Centrifugal selection is the most common form of selection, which splits the population into sub populations.
- 1) All are correct 2) I, II and III are correct
 - 3) Only II and IV are correct
 - 4) I, III and IV are correct
154. In the Hardy-weinberg population 49% of individuals show recessive trait, what is the percentage of heterozygous individuals in that population
- 1) 9% 2) 42% 3) 48% 4) 36%
155. A- population in Hardy weinberg equilibrium for a gene with two alleles, if the gene frequency of an allele 'A' is 0.7 and the gene frequency of 'Aa' is
1. 0.9 2. 0.21 3. 0.42 4. 0.36
156. Following are the statements of "selection" in the mechanism of evolution
- I. Stabilising selection removes the deleterious genotypes
 - II. Disruptive selection give rise to new species
 - III. Directional selection shift the mean value of fitness constantly to both ends of the population

The correct combinations are

1. I and II are correct 2. I and III are correct
 3. II and III are correct 4. All are correct
157. Following are the steps in disruptive selection, arrange them in a correct sequence.
- A. Prevention of gene flow give rise to new species.
 - B. Heterogenous environment effects the population
 - C. Split in the population into two or more subpopulations.
 - D. Selection pressure removes the average of phenotypic distribution.
 - E. Phenotype move away from the average towards the ends of population distribution.
 - F. Increased competition leads to selection pressure
- 1) B-D-E-C-A-F 2) A-C-D-E-F-B
 - 3) B-F-D-C-E-A 4) B-F-D-E-C-A
158. In a population of 1500 individuals if 135 exhibit a recessive character, then the number of heterozygous individuals is (Population is in Hardy Weinberg equilibrium)
1. 420 2. 630 3. 210 4. 360
159. In a population in Hardy -Weinberg equilibrium if the dominant allele frequency is 0.50 then the frequency of heterozygotes is
1. 0.10 2. 0.25 3. 0.75 4. 0.50
160. In a population of 1400 individuals ; 56 are recessive for a trait. The total number of dominant individuals in that population is.
1. 448 2. 896 3. 1344 4. 952
161. In a Hardy - Weinberg population of 2500, 'q' frequency is 0.2. In that population, what is the number of homozygous individuals.
1. 100 2. 1700 3. 800 4. 2400
162. In a Hardy - Weinberg population of 2500 guinea pigs, if 2100 pigs are short haired, find the genotypic frequency of heterozygotes
1. 0.84 2. 0.48 3. 0.24 4. 0.18
163. Statement (S) : Separation of a sub population from parental group without geographical barriers but only because reproductive isolation leads to formation of new sps called sympatric speciation
Reason (R) : In sympatric speciation the reproductive isolation due to difference in behavioural structural physiological reproductive mechanism
- 1) Both S & R are correct, R is correct explanation to S
 - 2) Both S & R are correct, R is not correct explanation to S

- 3) S is correct, R is false
 4) Both S & R are false
164. The evolution of similar characters in related lineages whose common ancestor was phenotypically different is called
 1. Homoplasy 2. Parallalism
 3. convergence 4. Adaptive radiation
165. Which of the following are examples of parallel evolution
 1) Echidna, Macropus, Didelphys
 2) Myrmecobius, Echidna, Myrmecophaga
 3) Ornithorhynchus, Macropus, Tachyglossus
 4) Coenolestes, Macropus, Didelphys
166. The following are the statements about speciation
 I) If one species diverges to become two or more species it is called cladogenesis
 II) Sympatric speciation is characterized by the occurrence of spatial separation by geographical barriers.
 III) In allopatric speciation reproductive isolation occur within the range and habitat of the parent species
 The **correct** statement(s):
 1) II only 2) I only 3) III only 4) I & II only
167. Mark the correct sequence of events that occur in allopatric speciation
 A) Reproductive isolation B) Genetic divergence
 C) Geographical isolation D) Origin of species
 1) A,B,C,D 2) C,A,B,D
 3) A,B,D,C 4) A,C,D,B
168. Darwin finches form an example for
 1. sympatric speciation 2. anagenesis
 3. allopatric speciation 4. centripetal selection
169. In a population of 1500 mice, there are 60 mice with recessive short ears. What is the frequency of SS genotype?
 1) 0.32 2) 0.64 3) 0.48 4) 0.04
170. Statement (S) : In disruptive selection, phenotypes move away from the average towards the ends of population distribution
 Reason (R): The selection pressure due to increased competition removes the average of the phenotypic distribution in the population
 1) Both S & R are correct, R is correct explanation to S
 2) Both S & R are correct, R is not correct explanation to S
 3) S is correct, R is false 4) Both S & R are false

KEY

EVOLUTIONARY CONCEPTS & ORIGIN OF LIFE

- 1) 2 2) 3 3) 1 4) 4 5) 1 6) 3 7) 1
 8) 3 9) 2 10) 3 11) 1 12) 3 13) 1 14) 3
 15) 2 16) 3 17) 3 18) 1 19) 2

THEORIES OF EVOLUTION

- 20) 4 21) 1 22) 1 23) 1 24) 2 25) 3 26) 2
 27) 2 28) 1 29) 3 30) 2 31) 1 32) 3 33) 3
 34) 3 35) 2 36) 3 37) 3 38) 1 39) 4 40) 2
 41) 1

NEO DARWINISM or

SYNTHETIC THEORY OF EVOLUTION

- 42) 1 43) 3 44) 4 45) 4 46) 3 47) 3 48) 3
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LEVEL-III

- 87) 2 88) 4 89) 2 90) 2 91) 2 92) 4 93) 1
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