

EXAM
DRILL

Evolution

ANSWERS

- (d) : The cranial capacity of *Homo erectus* was 800 - 1100 cc.
- (b) : The term 'hot dilute soup' was termed by J.B.S. Haldane.
- (a) : Inheritance of acquired characters was associated with Lamarckism.
- (b) : Industrial melanism supports evolution by natural selection.
- (c) : Stabilising selection favours average sized individuals and eliminates extreme forms.
- (d)
- q^2 represents the frequency of the homozygous recessive genotype.
- The total aggregate genes in a population at any one time is called the population's gene pool.
- Ernst Haeckel
- Evolution of DDT resistant mosquitoes and industrial melanism in peppered moth show directional selection.
- (a) : Both are underground fleshy structures adapted for storage of food and negative reproduction but are analogous structures as potato tuber is an underground stem while sweet potato is a fleshy adventitious root.
- (d) : Cro-Magnon man was omnivorous.

OR

(c) : Theory of natural selection was given by Charles Robert Darwin in 1859.

13. (b)

14. (a)

15. (i) (d)

(ii) (a) : In clinical genetics, the Hardy-Weinberg principle is mainly used for determining the frequency of heterozygosity in autosomal recessive heritable disorders when only the frequency of disease is known.

(iii) Significances of Hardy-Weinberg principle :

- It provides a theoretical baseline for measuring evolutionary changes.
- It maintains heterozygosity in the population.

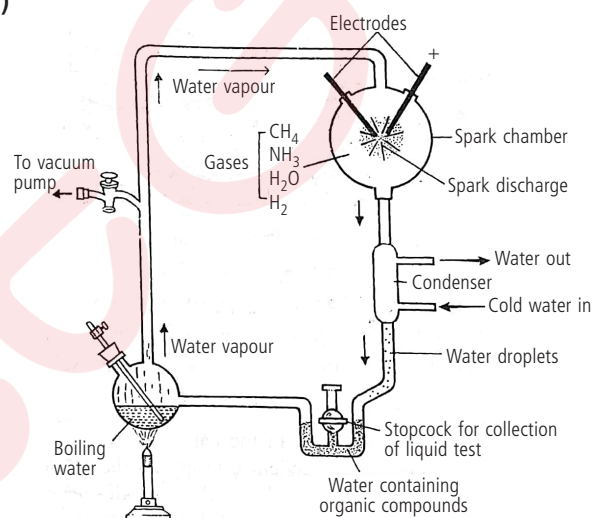
(iv) The factor includes :

- | | |
|-----------------------|------------------------|
| (a) Mutation | (b) Recombination |
| (c) Genetic Drift and | (e) Natural selection. |

16. (i) (c)

(ii) (c) : Miller's experiment (X) supported Oparin-Haldane theory which states the life originated on early earth through physico-chemical processes of atoms combining to form molecules, molecules in turn reacting to produce inorganic and organic compounds. Organic compounds interacting to produce all types of macromolecules which organised to form the first living system or cells.

(iii)



(iv) The ratio of methane, ammonia, and hydrogen in Miller's experiment was 2 : 1 : 2.

17. Atavism : It is the reappearance or refunctioning of certain ancestral characters or organs after several generations which has either completely disappeared or greatly reduced.

Examples of atavism are as follows –

- Presence of a short tail in some human babies
- Power of moving pinna in some persons
- Appearance of large canines in rare cases
- Presence of additional mammae in some individuals
- Long and dense hair on the body of some persons.

OR

Differences between connecting and missing links are :

	Connecting links	Missing links
(i)	The living organisms which have the characters of two different groups are called connecting links.	The fossil organisms which show characters of two different groups are called missing links.
(ii)	They are living organisms, e.g., <i>Neopilina</i> .	They are fossil organisms, e.g., <i>Ichthyostega</i> .

18. From the fossil records it has been concluded that evolution has taken place from simple to complex in a gradual manner.

Some evidences are as follows :

- (i) The rocks of early era contain less number of fossils than the rocks of later era.
- (ii) Early organisms were very different from their modern forms.

19. Variations are useful for survival of species in changed environmental situations. If a population of reproducing organisms are suited to a particular niche and if the niche is drastically altered, the population could be wiped out. However, if some variations were to be present in few individuals, there would be some chances for them to survive.

20. (a) Palaeontology

(b) Fossils throw light on evolution as :

- (i) Missing links show characters of two different groups.
- (ii) A study of fossils in different sedimentary layers indicates the geological period in which fossil organisms existed. Some of them appear similar to modern organisms.

21. (i) Alanine, glycine and aspartic acid are the amino acids formed in Miller's experiment.

(ii) Electrical discharge or spark.

22. Spallanzani disproved the spontaneous generation of microorganisms. He experimented that animal and vegetable broths boiled for several hours and soon after sealed, were never infested with microorganisms. From this experiment he concluded that high temperature had killed all living organisms in the broths and without them life could not appear. When broths were left exposed to air, were soon invaded by microorganisms.

23. (i) The first hypothesis for the formation of prebiont nonliving structures, coacervates was proposed by Oparin. They have been synthesised in the laboratory. Coacervates were nonliving structures that led to the formation of the first living cells from which the more complex cells have today evolved.

(ii) Some of their characteristics are –

- (a) They grow in size by absorbing nutrients from the medium.
- (b) On reaching a size, coacervates divide by budding like bacteria.
- (c) They are large enough to be seen under the microscope.

24. The primitive atmosphere was reducing in nature due to absence of free oxygen. Due to reducing atmosphere it was possible that abiotic synthesis of complex organic molecules took place.

25. (i) *Homo habilis* lived in East Africa about 2 million years ago.

(ii) Characteristic features of *Homo habilis* are :

- They had cranial capacity about 700 cc.
- They had bipedal locomotion and were omnivorous.
- They were also called handy man because heaps of tools found with these fossils included sharpened stones.

26. In 1828, Von Baer proposed Baer's law and later on this was modified as the biogenetic law by Ernst Haeckel in 1866.

Haeckel's biogenetic law states that '*Ontogeny recapitulates phylogeny*'. Ontogeny is the life history of an organism while

phylogeny is the evolutionary history of the race of that organism. In other words, an organism repeats its ancestral history during its development. For example, in the development of the frog, a fish like tailed larva is formed and this indicates that the frog has been evolved from a fish-like ancestor.

27. (a) *Archaeopteryx* was an ancient primitive bird, which had wings, feathers and a beak like other birds. Its fossil have been excavated from the Jurassic rocks. It shows the characters of both birds as well as reptiles. *Archaeopteryx* showed that birds have evolved from reptiles.

(b) Trunk of elephant and hand of chimpanzee are analogous structures as they perform the same function of holding objects but are originated from different parts. The analogous structures are the result of convergent evolution.

28. According to Hardy-Weinberg principle, gene frequencies will remain constant if there is no gene flow (gene migration). Gene flow refers to the movement of alleles from one population to another as result of interbreeding between members of two populations. The removal of alleles from one population or addition of alleles into another population is called gene flow.

29. (a) The movement of individuals from one place to another is called migration. If the migrating individuals breed within the new population, the immigrants will add new alleles to the local gene pool of the host population. This is called gene migration.

(b) The term genetic drift (or Wright effect) refers to the elimination of genes of certain traits when a section of a population migrates or dies of natural calamity. It alters the gene frequency of remaining population which causes variation. It is named after the American geneticist Sewall Wright. Although, genetic drift occurs in all populations but its effects are most marked in very small isolated population.

Two important examples of genetic drift are founder effect and bottleneck effect.

OR

Vestigial organs are believed to be remnants of organs which were complete and functional in their ancestors. They are non-functional and useless to the possessor but were functional in their ancestors. Examples of vestigial organs are as follows –

- (a) Human body has been described to possess about 90 vestigial organs. Some of these are – nictitating membrane, auricular muscles, vermiform appendix, caudal vertebrae, etc.
- (b) Some important examples of vestigial organs in animals are – vestiges of hindlimbs and pelvic girdles of pythons, wings of flightless birds, etc.

30. Charles Darwin proposed that evolution works on the theory of survival of the fittest. This means that individuals in a population are more likely to survive if they are provided with favourable variations. This concept is related with struggle for existence : It can be of three types :

- (a) Intraspecific struggle : It is the struggle between the individuals of the same species. This is the toughest form of struggle as the needs of the individuals of the same species are identical.

- (b) Interspecific struggle : It is the struggle between the members of different species.
- (c) Environmental struggle : It is the struggle between the organisms and the environmental factors.

31. Biogeography is the study of distribution of animals and plants on this earth. The evidences of evolution based on biogeography are called biogeographical evidences.

The evidences may be explained under the following points :

- (i) Biogeographical division of earth : P.L. Sclater (1858) proposed first time the division of the world into six realms or regions according to the distribution of birds. These realms are – Palaearctic, Oriental, Australian, Ethiopian, Nearctic and Neotropical realms.
- (ii) Discontinuous distribution of closely related species : When descendants of a common ancestor inhabit different geographical areas and differ from each other, it is called discontinuous distribution.

Examples of discontinuous distribution are as follows :

- (a) Three genera of lung fishes are found in three different continents as follows :

Protopterus in Africa

Neoceratodus in Australia

Lepidosiren in South America

- (b) Camels occur in Asia and their nearest allies Llamas are found in South America.

- (c) Alligators occur only in south-eastern United States and eastern China.

- (iii) Restricted distribution : Some areas of the world have unique organisms which are found nowhere else. This is called restricted distribution.

Examples of restricted distribution is as follows :

Egg laying and pouched mammals occur only in Australia, South America and New Zealand. The presence of marsupials and monotremes only in these areas indicates that these islands were once continuous with the mainland of Asia but got separated during mesozoic era before placental mammals evolved.

- (iv) Adaptive radiation: Development of different functional structures from a common ancestral form is called adaptive radiation. The concept was developed by H.F. Osborn in 1902.

Examples of adaptive radiation are as follows :

(a) Darwin's Finches : Charles Darwin observed diversity of creatures in Galapagos Islands. There were many varieties of finches in the same island and all the varieties had evolved on the island itself from original seed eating finches. On reaching different islands, each stock got adapted to different feeding habits developing a type of beak adapted to the type of food available on each island. Darwin differentiated thirteen species of finches.

(b) Australian marsupials : They are another example of adaptive radiation. A variety of marsupials each different from the other evolved from an ancestral stock but all within the Australian island continent.

OR

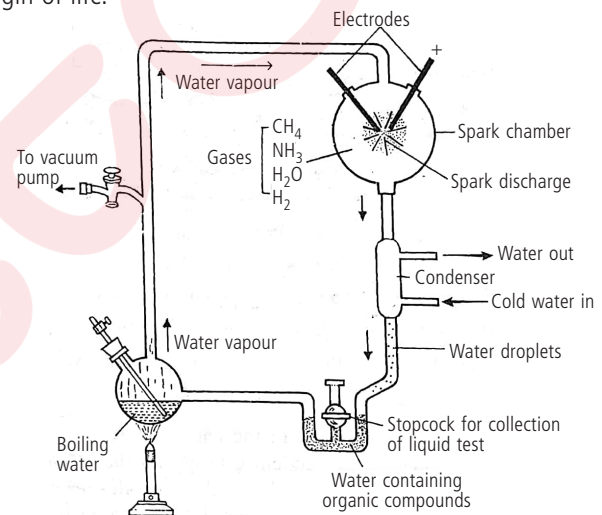
(a) The theory of biogenesis states that living organism arises from another pre-existing living organism.

(b) Stanley Miller and Harold Urey in 1953 did series of experiments and put Oparin-Haldane theory to test in 1953. They recreated the probable conditions on the primitive earth. Miller circulated four gases-methane, ammonia, hydrogen and water vapour in an airtight apparatus and passed electrical discharges from electrodes at 800°C. He circulated gases continuously in this way for one week and then analysed the chemical composition of the liquid inside the apparatus. He found a large number of simple organic compounds including some amino acids such as alanine, glycine and aspartic acid. Other substances, such as urea, hydrogen cyanide, lactic acid and acetic acid were also present.

Since then the experiment has been repeated by many scientists and many more types of molecules have been formed giving rise to the following conclusions.

The abiotic synthesis of organic molecules in the experimental conditions suggests the abiotic origin of life.

Abiotic synthesis of molecules is possible only in the reducing atmosphere. The abundance of free oxygen prevents the abiotic origin of life.



32. (a) In a diploid, if p represents the frequency of allele A and q represents the allele frequency of a , then frequency of AA individuals in a population is p^2 . Similarly of aa is q^2 and Aa is $2pq$. Hence, $p^2 + 2pq + q^2 = 1$. This is a binomial expansion of $(p + q)^2$. According to Hardy Weinberg principle, total genes and their alleles in a population or gene pool remains constant. This is called genetic equilibrium.

(b) Some factors that are essential for genetic equilibrium of allele frequencies in a population :

- (i) No mutation : Mutations are sudden heritable changes. They are mainly of two types : chromosomal mutations and gene mutations.

Chromosomal mutations are caused by change in the number of chromosomes. They are of further two types :

Polyploidy (increase in number of chromosome sets) and aneuploidy (numerical change in the chromosome number).

Gene mutations are changes in the number or sequence of nucleotides or nitrogen bases in DNA molecule. They are generally point mutations involving a change in a single base pair.

(ii) No gene migration or gene flow : The movement of individuals from one place to another is called migration. If the migrating individuals breed within the new population, the immigrants will add new alleles to the local gene pool of the host population. There must not be gene flow between the population.

OR

Characteristics of *Ramapithecus* are –

- Perhaps it walked erect on its hind feet.
- It lived on the tree tops.
- Its jaws and teeth were like humans.

Characteristics of *Australopithecus* are –

- It was about 1.5 metres high and had human as well as ape characters.
- It showed bipedal locomotion and erect posture.
- Its brain capacity was about 500 cc.
- Brow ridges projected over the eyes.

Characteristics of Neanderthal man –

- They had slightly prognathous face.
- They walked upright, had low brows, receding jaws and high domed heads.
- Their cranial capacity was 1300-1600 cc.

33. (a) Anthropogenic actions such as excessive use of herbicides, pesticides, etc., has only resulted in selection of resistant varieties in a much lesser time scale which is equally true for microbes against which we employ antibiotics or drugs. As a result of which resistant organisms or cells are appearing in a time scale of months or years or centuries. For example, when DDT was used for the first time, maximum mosquitoes died but few survived due to variation in the population. These mosquitoes showed resistance to DDT and

survived to reproduce successfully in the presence of DDT, thus lead to evolution.

(b) According to Darwin, the fitness of an organism is measured by its reproductive ability. Also the appearance of new forms is linked to the lifespan of an organism. The greater its lifespan, the more it can reproduce and hence greater new forms would appear.

OR

Natural selection can produce three different types of results and hence is divided into following three types :

(i) **Stabilising selection** : This type of selection favours average sized individuals while eliminates small sized individuals. It reduces variation and hence does not promote evolutionary change. However, it maintains the mean value from generation to generation. If we draw a graphical curve of population, it is bell-shaped. For example, there is an optimum wing length for a hawk of a particular size with a certain mode of life in a given environment. Stabilising selection, operating through differences in breeding potential, will eliminate those hawks with wing spans larger or smaller than this optimum length.

(ii) **Directional selection** : In this selection, the population changes towards one particular direction. It is progressive selection. It favours small or large-sized individuals and more individuals of that type will be present in next generation. The mean size of the population changes.

For example – evolution of DDT resistant mosquitoes, industrial melanism in peppered moth, etc.

(iii) **Disruptive selection** : This type of selection simultaneously favours individuals at both extremes of the distribution curve. As a result, two peaks in distribution of a trait are produced. It is rare in occurrence but important for evolutionary changes.

