CHAPTER

6 Evolution

6.1. Origin of Life

1. After about how many years of formation of earth, life appeared on this planet?
   (A) 500 billion years (B) 50 million years
   (C) 500 million years (D) 50 billion years
   [NEET Oct. 2020]

2. From his experiments, S.L. Miller produced amino acids by mixing the following in a closed flask.
   (A) CH_3, H_2, NH_4 and water vapour at 800°C
   (B) CH_4, H_2, NH_3 and water vapour at 600°C
   (C) CH_3, H_2, NH_3 and water vapour at 600°C
   (D) CH_4, H_2, NH_3 and water vapour at 800°C
   [NEET Sept. 2020]

3. Following are the two statements regarding the origin of life.
   (I) The earliest organisms that appeared on the earth were non-green and presumably anaerobes.
   (II) The first autotrophic organisms were the chemoautotrophs that never released oxygen.
   Of the above statements which one of the following option is correct?
   (A) (II) is correct but (I) is false.
   (B) Both (I) and (II) are correct.
   (C) Both (I) and (II) are false.
   (D) (I) is correct but (II) is false. **[NEET Phase-I 2016]**

4. Which of the following is the correct sequence of events in the origin of life?
   (I) Formation of protobionts.
   (II) Synthesis of organic monomers.
   (III) Synthesis of organic polymers.
   (IV) Formation of DNA-based genetic systems.
   Options:
   (A) (I), (II), (III), (IV) (B) (I), (III), (II), (IV)
   (C) (II), (III), (I), (IV) (D) (II), (III), (IV), (I)
   [NEET Phase-II 2016]

5. The concept of chemical evolution is based on:
   (A) interaction of water, air and clay under intense heat.
   (B) effect of solar radiation on chemicals.
   (C) possible origin of life by combination of chemicals.
   (D) crystallization of chemicals under suitable environmental conditions. **[AIPMT 2007]**

6. Which of the following amino-acids was not found to be synthesized in Miller's experiment?
   (A) Alanine (B) Glycine
   (C) Aspartic acid (D) Glutamic acid
   [AIPMT 2006]

7. Which one of the following experiments suggests that simplest living organisms could not have originated spontaneously from non-living matter?
   (A) Larvae could appear in decaying organic matter.
   (B) Microbes did not appear in stored meat.
   (C) Microbes appeared from unsterilized organic matter.
   (D) Meat was not spoiled, when heated and kept sealed in a vessel. **[AIPMT 2005]**

8. According to Oparin, which one of the following was not present in the primitive atmosphere of the earth?
   (A) Methane (B) Oxygen
   (C) Hydrogen (D) Water vapour.
   [AIPMT 2004]

9. First life on Earth was:
   (A) cyanobacteria (B) chemoheterotrophs
   (C) autotrophs (D) photoautotrophs.
   [AIPMT 2001, 1992]

10. At the time of origin of life, which gas was absent in the atmosphere.
    (A) NH_3 (B) CH_4
    (C) H_2 (D) O_2 **[AIPMT 1991]**

6.2. Evolution of Life forms-A Theory

11. According to Darwin, the organic evolution is due to:
    (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. **[NEET 2013]**

12. Select the correct statement from the following:

(A) Fitness is the end result of the ability to adapt and gets selected by nature.

(B) All mammals except whales and camels have seven cervical vertebrae.

(C) Mutations are random and directional.

(D) Darwinian variations are small and directionless.

[AIPMT 2007]

13. Evolution is:

(A) history of race

(B) development of race

(C) progressive development of a race

(D) history and development of race along with variations **[AIPMT 1989]**

6.3. What are the Evidences for Evolution?

14. The flippers of the Penguins and Dolphins are the example of the:

(A) natural selection (B) convergent evolution

(C) divergent evolution (D) adaptive radiation

[NEET 2024]

15. Natural selection where more individuals acquire specific character value other than the mean character value, leads to:

(A) Directional Change (B) Disruptive change

(C) Random change (D) Stabilizing change

[NEET 2022]

16. Which of the following statement is not true?

(A) Sweet potato and potato is an example of analogy.

(B) Homology indicates common ancestry.

(C) Flippers of penguins and dolphins are a pair of homologous organs.

(D) Analogous structures are a result of convergent evolution. **[NEET 2022]**

17. Embryological support for evolution was proposed by:

(A) Ernst Haeckel (B) Charles Darwin

(C) Karl Ernst von Baer (D) Alfred Wallace.

[NEET Sept. 2020]

18. Which of the following refer to correct example(s) of organisms which have evolved due to changes in the environment brought about by anthropogenic action?

(I) Darwin's Finches of Galapagos islands.

(II) Herbicide resistant weeds.

(III) Drug resistant eukaryotes.

(IV) Man-created breeds of domesticated animals like dogs.

Options:

(A) (I) and (III) (B) (II), (III) and (IV)

(C) Only (IV) (D) Only (I)

[NEET Sept. 2020]

19. The similarity of bone structure in the forelimbs of many vertebrates is an example of:

(A) convergent evolution (B) analogy

(C) homology (D) adaptive radiation.

[NEET 2018]

20. Analogous structures are a result of:

(A) convergent evolution (B) shared ancestry

(C) stabilising selection (D) divergent evolution.

[NEET Phase-I 2016]

21. Which of the following structures is homologous to the wing of a bird?

(A) Wing of a moth

(B) Hind limb of rabbit

(C) Flipper of whale

(D) Dorsal fin of a shark **[NEET Phase-I 2016]**

22. The wings of a bird and the wings of an insect are:

(A) homologous structures and represent divergent evolution

(B) analogous structures and represent convergent evolution

(C) phylogenetic structures and represent divergent evolution

(D) homologous structures and represent convergent evolution. **[AIPMT Latest July 2015]**

23. Industrial melanism is an example of:

(A) Neo Darwinism

(B) Natural selection

(C) Mutation

(D) Neo Lamarckism **[AIPMT Latest July 2015]**

24. Forelimbs of cat, lizard used in walking; forelimbs of whale used in swimming and forelimbs of bats used in flying are an example of:

(A) analogous organs

(B) adaptive radiation

(C) homologous organs

(D) convergent evolution. **[AIPMT 2014]**

25. Which one of the following are analogous structures?

(A) Wings of bat and wings of pigeon

(B) Gills of prawn and lungs of man

(C) Thorns of *Bougainvillea* and tendrils of *Cucurbita*

(D) Flippers of dolphin and legs of horse **[AIPMT 2014]**

26. The eyes of Octopus and eyes of cat, show different patterns of structure, yet they perform similar function. This is an example of:

(A) homologous organs that have evolved due to convergent evolution

(B) homologous organs that have evolved due to divergent evolution

(C) analogous organs that have evolved due to convergent evolution

(D) analogous organs that have evolved due to divergent evolution. **[NEET 2013]**

27. Dinosaurs dominated the world in which of the following geological eras?

(A) Cenozoic (B) Jurassic

(C) Mesozoic (D) Devonian

[NEET Karnataka 2013]

28. Which one of the following options gives one correct example each of convergent evolution and divergent evolution?

	Convergent evolution	Divergent evolution
(A)	Eyes of Octopus and mammals	Bones of forelimbs of vertebrates
(B)	Thorns of *Bougainvillea* and tendrils of *Cucurbita*	Wings of butterflies and birds
(C)	Bones of forelimbs of vertebrates	Wings of butterfly and birds
(D)	Thorns of *Bougainvillea* and tendrils of *Cucurbita*	Eyes of *Octopus* and mammals

[AIPMT Screening 2012]

29. Sweet potato is homologous to:

(A) potato (B) *Colocasia*

(C) ginger (D) turnip

[AIPMT Mains 2011]

30. Given below are four statements (a-d) each with one or two blanks. Select the option which correctly fills up the blanks in two statements.

(a) Wings of butterfly and birds look alike and are the results of ____(i)____ evolution.

(b) Miller showed that CH_4, H_2, NH_3 and _____ (i) _____, when exposed to electric discharge in a flask resulted in the formation of _____ (ii) _____.

(c) Vermiform appendix is a _____(i)_____ organ and an _____ (ii) _____ evidence of evolution.

(d) According to Darwin, evolution took place due to _____ (i) _____ and _____ (ii) _____ of the fittest.

Choose the correct option:

(A) (d)—(i) small variations, (ii) survival, (a)—(i) convergent

(B) (a) —(i) convergent, (b)—(i) oxygen, (ii) nucleosides

(C) (b)—(i) water vapour, (ii) amino acids (c)—(i) rudimentary, (ii) anatomical

(D) (c)—(i) vestigial, (ii) anatomical (d)—(i) mutations, (ii) multiplication. **[AIPMT Mains 2010]**

31. Crocodile and penguin are similar to whale and dogfish in which one of the following features?

(A) Possess a solid single-stranded central nervous system

(B) Lay eggs and guard them till they hatch

(C) Possess bony skeleton

(D) Have gill slits at some stage **[AIPMT Mains 2010]**

32. In the case of peppered moth *(Biston betularia)* the black-coloured form became dominant over the light-coloured form in England during the industrial revolution. This is an example of:

(A) natural selection whereby the darker forms were selected.

(B) appearance of the darker coloured individuals due to very poor sunlight.

(C) protective mimicry.

(D) inheritance of darker colour character acquired due to the darker environment.

[AIPMT Screening 2009]

33. Thorn of *Bougainvillea* and tendril of *Cucurbita* are examples of:

(A) analogous organs

(B) homologous organs

(C) vestigial organs

(D) retrogressive evolution. **[AIPMT Screening 2008]**

34. Which one of the following pair of items correctly belongs to the category of organs mentioned against it?

(A) Thorn of *Bougainvillea* and tendrils of *Cucurbita* — Analogous organs

(B) Nictitating membrane and blind spot in human eye — Vestigial organs

(C) Nephridia of earthworm and Malpighian tubules of cockroach — Excretory organs

(D) Wings of honey bee and wings of crow — Homologous organs

[AIPMT Screening 2008]

35. When two species of different genealogy come to resemble each other as a result of adaptation, the phenomenon is termed as:

(A) microevolution (B) co-evolution

(C) convergent evolution (D) divergent evolution.

[AIPMT 2007]

36. Industrial melanism as observed in peppered moth proves that:

(A) the melanic form of the moth has no selective advantage over lighter form in industrial area.

(B) the lighter-form moth has no selective advantage either in polluted industrial area or non-polluted area

(C) melanism is a pollution-generated feature

(D) the true black melanic forms arise by a recurring random. **[AIPMT 2007]**

37. What is common to whale, seal and shark?

(A) Thick subcutaneous fat

(B) Convergent evolution

(C) Homoeothermy

(D) Seasonal migration. **[AIPMT 2007]**

38. An important evidence in favour of organic evolution is the occurrence of:

(A) homologous and analogous organs

(B) homologous and vestigial organs

(C) analogous and vestigial organs

(D) homologous organs only. **[AIPMT 2006]**

39. Jurassic period of the mesozoic era is characterised by:

(A) flowering plants and first dinosaurs appear

(B) gymnosperms are dominant plants and first birds appear

(C) radiation of reptiles and origin of mammal like reptiles

(D) dinosaurs become extinct and angiosperms appear. **[AIPMT 2006]**

40. Which one of the following is not a living fossil?

(A) *Peripatus* (B) king crab

(C) *Sphenodon* (D) *Archaeopteryx*

[AIPMT 2006]

41. Which one of the following phenomena supports Darwin's concept of natural selection in organic evolution?

(A) Development of transgenic animals

(B) Production of 'Dolly', the sheep by cloning

(C) Prevalence of pesticide resistant insects

(D) Development of organs from 'stem cells' for organ transplantation. **[AIPMT 2005]**

42. Which of the following is the relatively most accurate method for dating of fossils?

(A) Radio-carbon method

(B) Potassium-argon method

(C) Electron-spin resonance method

(D) Uranium-lead method. **[AIPMT 2005]**

43. Age of fossils in the past was generally determined by radio-carbon method and other methods involving radioactive elements found in the rocks. More precise methods, which were used recently and led to the revision of the evolutionary periods for different groups of organisms, includes:

(A) study of carbohydrates or proteins in fossils

(B) study of the conditions of fossilization

(C) electron spin resonance (ESR) and fossil DNA

(D) study of carbohydrates / proteins in rocks.

[AIPMT 2004]

44. Convergent evolution is illustrated by:

(A) rat and dog

(B) bacterium and protozoan

(C) starfish and cuttlefish

(D) dogfish and whale. **[AIPMT 2003]**

45. Which one of the following sequences was proposed by Darwin and Wallace for organic evolution?

(A) Overproduction, variations, constancy of population size, natural selection

(B) Variations, constancy of population size, overproduction, natural selection

(C) Overproduction, constancy of population size, variations, natural selection

(D) Variations, natural selection, over production, constancy of population size **[AIPMT 2003]**

46. Industrial melanism is an example of:

(A) drug resistance

(B) darkening of skin due to smoke from industries

(C) protective resemblance with the surroundings

(D) defensive adaptation of skin against ultraviolet radiations. **[AIPMT 2003]**

47. Darwin in his "Natural Selection Theory" did not believe in any role of which one of the following in organic evolution?

(A) Parasites and predators as natural enemies

(B) Survival of the fittest

(C) Struggle for existence

(D) Discontinuous variations **[AIPMT 2003]**

48. Which one of the following describes correctly the homologous structures?

(A) Organs with anatomical similarities, but performing different functions.

(B) Organs with anatomical dissimilarities, but performing same function.

(C) Organs that have no function now, but had an important function in ancestors.

(D) Organs appearing only in embryonic stage and disappearing later in the adult. **[AIPMT 2003]**

49. Some bacteria are able to grow in the streptomycin containing medium due to:

(A) natural selection

(B) induced mutation

(C) reproductive isolation

(D) genetic drift. **[AIPMT 2002]**

50. Which of the following are homologous organs?

(A) Wings of birds and Locust

(B) Wings of birds (sparrow) and pectoral fins of fish

(C) Wings of bat and butterfly

(D) Legs of frog and cockroach **[AIPMT 2002]**

51. In which era reptiles were dominated?

(A) Coenozoic era (B) Mesozoic era

(C) Paleozoic era (D) Archaeozoic era

[AIPMT 2002, 1994]

52. Half-life period of C^{14} is about:

(A) 500 yrs (B) 5730 yrs

(C) 50 yrs (D) 5×10^4 yrs **[AIPMT 2001]**

53. Similarities in organism with different genotype indicates:

(A) microevolution

(B) macroevolution

(C) convergent evolution

(D) divergent evolution **[AIPMT 2001]**

54. Which one of the following pair has homologous organs?

(A) Wings of a bat and wings of cockroach

(B) Pectoral fins of a fish and forelimbs of a horse

(C) Wings of a bird and wings of a butterfly

(D) Air sac of fish and lungs of frog **[AIPMT 1999]**

55. Which one of the following includes all homologous organs?

(A) The wing of butterfly, wing of bird, wing (patagia) of bat.

(B) The forelimb of frog, wing of bird and forelimb of rabbit.

(C) The thoracic leg of cockroach, the hind leg of frog and fore leg of rabbit.

(D) The wing of bird, the wing of bat and wing of "flying lizard". **[AIPMT 1997]**

56. Evolutionary convergence is the development of:

(A) Random mating

(B) Dissimilar characters in closely related groups

(C) Common set of characters in a group of different ancestry

(D) Common set of characters in closely related groups

[AIPMT 1996, 93]

57. The presence of gill slits, in the embryos of all vertebrates, supports the theory of:

(A) biogenesis (B) recapitulation

(C) metamorphosis (D) organic evolution.

[AIPMT 1995]

58. The homologous organs show similarity in:

(A) Origin (B) Function

(C) Appearance (D) Size **[AIPMT 1995]**

59. Study of fossils is:

(A) palaeontology (B) herpetology

(C) saurology (D) organic evolution.

[AIPMT 1991]

60. Basic principles of embryonic development were pronounced by:

(A) Weismann (B) Morgan

(C) Von Baer (D) Haeckel **[AIPMT 1990]**

61. 'Origin of species' was written by:

(A) Lamarck (B) Darwin

(C) Weismann (D) Oparin **[AIPMT 1989]**

62. Humming bird and hawk shows:

(A) Homology

(B) Parallel evolution

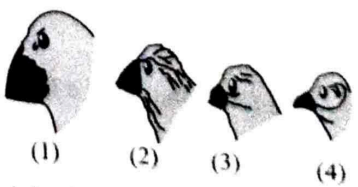
(C) Convergent evolution

(D) Adaptive radiation

[AIPMT 1988]

6.4. What is Adaptive Radiation?

63. Which evolutionary phenomenon is depicted by the sketch given in figure?



(A) Artificial selection

(B) Genetic drift

(C) Convergent evolution

(D) Adaptive radiation

[Re-NEET 2024]

64. Match List-I with List-II with respect of convergent evolution:

List-I	List-II
(a) Lemur	(i) Flying phalanger
(b) Bobcat	(ii) Numbat
(c) Ant eater	(iii)Spotted cuscus
(d) Flying squirrels	(iv)Tasmanian tiger cat

Choose the correct answer from the options given below:

	(a)	(b)	(c)	(d)
(A)	(iii)	(iv)	(ii)	(i)
(B)	(iii)	(ii)	(iv)	(i)
(C)	(iv)	(iii)	(ii)	(i)
(D)	(iv)	(ii)	(iii)	(i)

[Re-NEET 2024]

65. Select the correct group/set of Australian Marsupials exhibiting adaptive radiation.

(A) Mole, Flying squirrel, Tasmanian tiger cat

(B) Lemur, Anteater, Wolf

(C) Tasmanian wolf, Bobcat, Marsupial mole

(D) Numbat, Spotted cuscus, Flying phalanger

[NEET 2023]

66. Match List-I with List-II.

List-I	List-II
(a) Adaptive radiation	(i) Selection of resistant varieties due to excessive use of herbicides and pesticides
(b) Convergent evolution	(ii) Bones of forelimbs in Man and Whale
(c) Divergent evolution	(iii) Wings of Butterfly & Bird
(d) Evolution by anthropogenic action	(iv) Darwin Finches

Choose the correct answer from the options given below.

	(a)	(b)	(c)	(d)
(A)	(iv)	(iii)	(ii)	(i)
(B)	(iii)	(ii)	(i)	(iv)
(C)	(ii)	(i)	(iv)	(iii)
(D)	(i)	(iv)	(iii)	(ii)

[NEET 2021]

67. The phenomenon of evolution of different species in a given geographical area starting from a point and spreading to other habitats is called:

(A) saltation (B) co-evolution

(C) natural selection (D) adaptive radiation.

[NEET Oct. 2020, AIPMT 2012 Screening]

68. In Australia, marsupials and placental mammals have evolved to share many similar characteristics. This type of evolution may be referred to as:

(A) adaptive radiation (B) divergent evolution

(C) cyclical evolution (D) convergent evolution.

[NEET Odisha 2019]

69. Which of the following conditions will lead to adaptive radiation, if a population of a species invades a new area?

(A) Area with many types of vacant habitats

(B) Area with a single type of vacant habitat

(C) Area with many habitats occupied by a large number of species

(D) Area with large number of habitats having very low food supply **[NEET Odisha 2019]**

70. The finch species of Galapagos islands are grouped according to their food sources. Which of the following is not a finch food?

(A) Carrion (B) Insects

(C) Tree buds (D) Seeds

[NEET Karnataka 2013]

71. Darwin's finches are a good example of:

(A) industrial melanism (B) connecting link

(C) adaptive radiation (D) convergent evolution.

[AIPMT Screening 2010, 08]

72. The Finches of Galapagos island provide an evidence in favour of:

(A) evolution due to mutation

(B) retrogressive evolution

(C) biogeographical evolution

(D) special creation. **[AIPMT 2007]**

73. Adaptive radiation refers to:

(A) evolution of different species from a common ancestor

(B) migration of members of a species to different geographical areas

(C) power of adaptation in an individual to a variety of environments

(D) adaptations due to geographical isolation.

[AIPMT 2007]

74. Darwin's finches provide the best evidence in favour of evolution. This evidence comes from the field of:

(A) Embryology (B) Palaeontology

(C) Biogeography (D) Anatomy **[AIPMT 2000]**

75. Diversity in the type of beaks of finches adapted to different feeding habits on the Galapagos Islands, as observed by Darwin, provides evidence for:

(A) Interspecific competition

(B) Intraspecific competition

(C) Intraspecific variation

(D) Origin of species by natural selection

[AIPMT 1998]

76. Parallelism is:

(A) adaptive divergence

(B) adaptive divergence of widely separated species

(C) adaptive convergence of widely different species

(D) adaptive convergence of closely related groups

[AIPMT 1990]

6.5. Biological Evolution

77. Which one of the following is incorrect about the characteristics of protobionts (coacervates and microspheres) as envisaged in the abiogenic origin of life?

(A) They were able to reproduce.

(B) They could separate combinations of molecules from the surroundings.

(C) They were partially isolated from the surroundings.

(D) They could' maintain an internal environment.

[AIPMT Screening 2008]

78. Which one of the following statements is correct?

(A) Ontogeny repeats phylogeny

(B) Stem cells are specialized cells

(C) All plant and animal cells are totipotent

(D) There is no evidence of the existence of gills during embryogenesis of mammals **[AIPMT 2007]**

79. Evolutionary history of an organism is known as:

(A) Palaeontology (B) Phylogeny

(C) Ontogeny (D) Ancestry **[AIPMT 2006]**

80. If Darwin's theory of pangenesis shows similarity with the theory of inheritance of acquired characters, then what will be correct according to it?

(A) Size of organs increase with ageing.

(B) Development of organs is due to will power.

(C) There should be some physical basis of inheritance.

(D) Useful organs become strong and developed while useless organs become extinct. These organs help in struggle for survival. **[AIPMT 2001]**

81. Which is not a vestigial part in humans?

(A) Finger nails

(B) Third molar

(C) Coccyx

(D) Segmental muscles of abdomen. **[AIPMT 2000]**

82. In general, in the developmental history of a mammalian heart, it is observed that it passes through a two-chambered fish-like heart, three-chambered frog-like heart and finally to four-chambered stage. To which hypothesis can this above mentioned statement be approximated?

(A) Mendelian laws (B) Biogenetic law

(C) Hardy-Weinberg law (D) Lamarck's principle

[AIPMT 1998]

83. Which one of the following sets includes only the vestigial structures in man?

(A) Wisdom teeth, mammary glands, coccyx, patella

(B) Body hair, olecranon process, coccyx, patella

(C) Coccyx, body hair, ear ossicles, vermiform appendix

(D) Coccyx, nictitating membrane, vermiform appendix, ear muscles **[AIPMT 1996]**

84. Theory of natural selection depends on:

(A) Changes in gene complex resulting in heritable variations

(B) Natural selection acting on favourable variations

(C) Role of environment in evolution

(D) None of the above **[AIPMT 1993]**

85. Who gave the theory of 'inheritance of acquired characters'?

(A) De Vries (B) Darwin

(C) Lamarck (D) Wallace **[AIPMT 1989]**

6.6. Mechanism of Evolution

86. As proposed by Hugo de Vries, variations caused by mutations are:

(A) small and directional

(B) small and directionless

(C) random and directional

(D) random and directionless **[NEET National 2019]**

87. According to Hugo de Vries, the mechanism of evolution is:

(A) phenotypic variations

(B) saltation

(C) multiple step mutations

(D) minor mutations. **[NEET 2018]**

88. De Vries gave his mutation theory on organic evolution while working on:

(A) *Pisum sativum*

(B) *Drosophila melanogaster*

(C) *Oenothera lamarckiana*

(D) *Althea rosea.* **[AIPMT 2005]**

6.7. Hardy-Weinberg Principle

89. Match List-I with List-II:

List-I	List-II
(a) Gene pool	(i) Stable within a generation
(b) Genetic drift	(ii) Change in gene frequency by chance
(c) Gene flow	(iii) Transfer of genes into or out of population
(d) Gene frequency	(iv) Total number of genes nad their alleles

Choose the correct answer from the options given below:

	(a)	(b)	(c)	(d)
(A)	(iii)	(ii)	(i)	(iv)
(B)	(iv)	(ii)	(iii)	(i)
(C)	(i)	(ii)	(iii)	(iv)
(D)	(ii)	(iii)	(iv)	(i)

[Re-NEET 2024]

90. Which one of the following factors will not affect the Hardy-Weinberg equilibrium?
(A) Genetic drift (B) Gene migration
(C) Constant gene pool (D) Genetic recombination
[NEET 2024]

91. The factor that leads to Founder effect in a population is:
(A) mutation (B) genetic recombination
(C) genetic drift (D) natural selection
[NEET 2021]

92. Genetic drift operates in:
(A) large isolated population
(B) small isolated population
(C) slow reproductive population
(D) non-reproductive population
[NEET Phase II 2016, AIPMT 2002, 1998]

93. According to Hardy-Weinberg equation, the frequency of heterozygous individual is represented by:
(A) p^2 (B) $2pq$
(C) pq (D) q^2
[NEET Phase II 2016]

94. A population will not exist in Hardy-Weinberg equilibrium if:
(A) there is no migration
(B) there are no mutations
(C) individual mate selectively
(D) the population is large **[AIPMT 2015]**

95. In a population of 1000 individuals 360 belong to genotype AA, 480 to Aa and the remaining 160 to aa. Based on this data, the frequency of allele A in the population is:
(A) 0.4 (B) 0.5
(C) 0.6 (D) 0.7 **[AIPMT 2014]**

96. Variation in gene frequencies within populations can occur by chance rather than by natural selection. This is referred to as:
(A) genetic flow (B) genetic drift
(C) random mating (D) genetic load. **[NEET 2013]**

97. Random unidirectional change in allele frequencies that occurs by chance in all populations and especially in small populations is known as:
(A) Genetic drift (B) Natural selection
(C) Mutation (D) Migration
[NEET Karnataka 2013]

98. At a particular locus, frequency of 'A' allele is 0.6 and that of '*a*' is 0.4. What would be the frequency of heterozygotes in a random mating population at equilibrium?
(A) 0.48 (B) 0.36
(C) 0.16 (D) 0.24 **[AIPMT 2005]**

99. Random genetic drift in a population probably results from:
(A) highly genetically variable individuals
(B) karge population size
(C) interbreeding within the population
(D) constant low mutation rate **[AIPMT 2003]**

100. In recent years, DNA sequences (nucleotide sequence) of *mt*DNA and Y chromosomes were considered for the study of human evolution, because:
(A) they are small and therefore, easy to study
(B) they are uniparental in origin and do not take part an recombination
(C) their structure is known in greater detail
(D) they can be studied from the samples of fossil remains. **[AIPMT 2003]**

101. In which condition the gene ratio remains constant for any species?
(A) Mutation (B) Gene flow
(C) Random mating (D) Sexual selection
[AIPMT 2002]

102. Frequency of allele in an isolated population may change due to:
(A) genetic drift (B) gene flow
(C) mutation (D) natural selection
[AIPMT 2001]

103. Frequency of a character increases when it is:
(A) adaptable (B) dominant
(C) recessive (D) inheritable **[AIPMT 1994]**

104. Genetic drift is change of:

(A) gene frequency in same generation
(B) gene frequency from one generation to next
(C) appearance of recessive genes
(D) none of the above **[AIPMT 1993]**

6.8. A Brief Account of Evolution

105. Match List-I with List-II:

List-I	List-II
(a) Living Fossil	(i) Elongated canine teeth
(b) Connecting Link	(ii) Vermiform apendix
(c) Vestigial Organ	(iii) *Echidna*
(d) Atavism	(iv) *Latimeria*

Choose the correct answer from the options given below:

	(a)	(b)	(c)	(d)
(A)	(iv)	(iii)	(ii)	(i)
(B)	(iv)	(ii)	(iii)	(i)
(C)	(iv)	(iii)	(i)	(ii)
(D)	(iii)	(iv)	(i)	(ii)

[Re-NEET 2024]

106. What is the correct order (old to recent) of periods in Paleozoic era?

(A) Silurian, Devonian, Permian, Carboniferous
(B) Silurian, Devonian, Carboniferous, Permian
(C) Permian, Devonian, Silurian, Carboniferous
(D) Silurian, Carboniferous, Permian, Devonian

[Re-NEET 2024]

107. Match List I with List II:

List I	List II
(a) Mesozoic Era	(i) Lower invertebrates
(b) Proterozoic Era	(ii) Fish and Amphibia
(c) Cenozoic Era	(iii) Birds and Reptiles
(d) Paleozoic Era	(iv) Mammals

Choose the correct answer from the options given below:

	(a)	(b)	(c)	(d)
(A)	(iii)	(i)	(ii)	(iv)
(B)	(i)	(ii)	(iv)	(iii)
(C)	(iii)	(i)	(iv)	(ii)
(D)	(ii)	(i)	(iii)	(iv)

[NEET 2024]

108. From evolutionary point of view, retention of the female gametophyte with developing young embryo on the parent sporophyte for some time, is first observed in:

(A) mosses (B) pteridophytes
(C) gymnosperms (D) liverworts.

[NEET National 2019]

109. Which one of the following in birds, indicates their reptilian ancestry?

(A) Egg with a calcareous shell
(B) Scales on their hind limbs
(C) Four chambered heart
(D) Two special chambers crop and gizzard in their digestive tract **[AIPMT 2008]**

110. The gills present in the tadpole of a frog indicates that:

(A) fishes evolved from frog-like ancestors
(B) fishes were amphibians in the past
(C) frogs evolved from gilled ancestors
(D) frogs will have gills in future **[AIPMT 2004]**

111. Correct order is:

(A) Palaeozoic → Archaeozoic → Coenozoic
(B) Archaeozoic → Palaeozoic → Proterozoic
(C) Palaeozoie → Mesozoic → Coenozoic
(D) Mesozoic → Archaeozoic → Proterozoic

[AIPMT 1991]

6.9. Origin and Evolution of Man

112. Given below are some stages of human evolution. Arrange them in correct sequence: (Past to Recent)

(I) *Homo habilis*
(II) *Homo sapiens*
(III) *Homo neanderthalensis*
(IV) *Homo erectus*

Choose the correct sequence of stages from the options given below:

(A) (II)-(I)-(IV)-(III) (B) (III)-(II)-(IV)-(I)
(C) (I)-(IV)-(III)-(IV) (D) (IV)-(I)-(III)-(IV)

[NEET 2024]

113. A hominid fossil discovered in Java in 1891, now extinct having cranial capacity of about 900 cc was:

(A) *Homo erectus* (B) Neanderthal man
(C) *Homo sapiens* (D) *Australopithecus*.

[NEET Oct. 2020]

114. Which of the following statements is correct about the origin and evolution of men?

(A) Agriculture came around 50,000 years back.
(B) The *Dryopithecus* and *Ramapithecus* primates existing 15 million years ago, walked like men.
(C) *Homo habilis* probably ate meat.
(D) Neanderthal men lived in Asia between 1,00,000 and 40,000 years back. **[NEET Odisha 2019]**

115. The chronological order of human evolution from early to the recent is:

(A) *Australopithecus* → *Ramapithecus* → *Homo habilis* → *Homo erectus*

(B) *Ramapithecus* → *Australopithecus* → *Homo habilis* → *Homo erectus*

(C) *Ramapithecus* → *Homo habilis* → *Australopithecus* → *Homo erectus*

(D) *Australopithecus* → *Homo habilis* → *Ramapithecus* → *Homo erectus*

[NEET Phase-II 2016]

116. Which of the following had the smallest brain capacity?

(A) *Homo erectus*

(B) *Homo sapiens*

(C) *Homo neanderthalensis*

(D) *Homo habilis* **[AIPMT Cancelled 2015]**

117. What was the most significant trend in the evolution of modern man (*Homo sapiens*) from his ancestors?

(A) Shortening of jaws

(B) Binocular vision

(C) Increasing cranial capacity

(D) Upright posture

[AIPMT Screening 2012, 11, Mains 2010]

118. The extinct human who lived 100000 to 40000 years ago, in Europe, Asia and parts of Africa, with short stature, heavy eye brows, retreating foreheads, large jaws with heavy teeth, stocky bodies, a lumbering gait and stooped posture was:

(A) *Homo habilis* (B) Neanderthal human

(C) Cro-magnon humans (D) *Ramapithecus*

[AIPMT Screening 2012]

119. Among the human ancestors the brain size was more than 1000 cc in:

(A) *Homo erectus* (B) *Ramapithecus*

(C) *Homo habilis* (D) *Homo neanderthalensis.*

[AIPMT 2007]

120. What kind of evidence suggested that man is more closely related to chimpanzee than with other hominoid apes?

(A) Evidence from DNA from sex chromosomes only.

(B) Comparison of chromosomes morphology only.

(C) Evidence from fossil remains, and the fossil mitochondrial DNA alone.

(D) Evidence from DNA extracted from sex chromosomes, autosomes and mitochondria.

[AIPMT 2004]

121. According to fossils that are discovered up to present time, from which country the origin and evolution of man was started?

(A) France (B) Java

(C) Africa (D) China **[AIPMT 2002]**

122. Which of the following is the closest relative of man?

(A) Orangutan (B) Chimpanzee

(C) Gorilla (D) Gibbon

[AIPMT 2001, 2000]

123. *Homo sapiens* evolved during:

(A) Pliocene (B) Pleistocene

(C) Oligocene (D) Miocene **[AIPMT 2000]**

124. Which of the following feature is closely related with the evolution of humans?

(A) Flat nails (B) Loss of tail

(C) Shortening of Jaws (D) Binocular vision

[AIPMT 2000]

125. The age of fossil of *Dryopithecus* on the geological time scale is:

(A) 5×10^6 years back (B) 25×10^6 years back

(C) 50×10^6 years back (D) 75×10^6 years back

[AIPMT 1998]

126. Which one of the following statements is correct?

(A) Cro-magnon man's fossil has been found in Ethiopia.

(B) *Homo erectus* is the ancestor of man.

(C) Neanderthal man is the direct ancestor of *Homo sapiens.*

(D) *Australopithecus* is the real ancestor of modern man.

[AIPMT 1998]

127. Common origin of man and chimpanzee is best shown by:

(A) banding pattern in chromosomes number 3 and 6

(B) cranial capacity

(C) binocular vision

(D) dental formula. **[AIPMT 1997]**

128. Which one of the following is regarded as the direct ancestor of modern man?

(A) *Homo erectus* (B) *Ramapithecus*

(C) *Homo habilis* (D) Cro-magnon man

[AIPMT 1996]

129. Which one is irrelevant to evolution of man?

(A) Change of diet from hard nuts/roots to soft food

(B) Perfection of hand for tool making

(C) Loss of tail

(D) Increased ability to communicate or develop community behaviour **[AIPMT 1994]**

SOLUTIONS

1. (C) During course of evolution, earth probably formed about 4.5 billion years ago. After its formation, life appeared 500 million years ago in ocean. The first living forms were believed to be heterotrophs and used to derive nutrition from external sources.

Caution

Students usually get confused in the timeline for the chapter Evolution. Some students choose 500 billion years instead of 500 million years. So, they should understand the difference between million and billion.

2. (D) In 1953, the Miller-Urey experiment was the first attempt to scientifically explore ideas about the origin of life. Stanley Miller stimulated conditions thought to be common on the ancient Earth. They created electric discharge in a closed flask containing of methane, water, hydrogen, and ammonia at 800°C which they considered were found in the early Earth's atmosphere.

Related Theory

Miller Urey Experiment failed to explain how proteins were responsible for the formation of amino acids. A few scientists have contradicted that the gases used by Miller and Urey are not as abundant as shown in the experiment. They were of the notion that the gases released by the volcanic eruptions such as oxygen, nitrogen, and carbon dioxide make up the atmosphere. Therefore, the results are not reliable.

3. (B) The earliest organism appeared on earth were anaerobic prokaryotic chemoheterotrophs. Even the first autotrophs were dependent on chemicals as oxygen was not released. They were unable to perform photolysis of water and hence did not release oxygen.

Related Theory

The first life forms originated from protocell in Archaeozoic era and were anaerobic chemoheterotrophs that used the organic component as a source of energy and carbon. Since the first life forms fed on available organic compounds, they were heterotrophs. Due to the limited supply of organic compounds, organisms evolved photosystem to capture sunlight to be used as a source of energy thereby leading to the origin of photoautotrophs. The organisms that use light as a source of energy and carbon dioxide as a chief carbon source are referred to as photoautotrophic organisms. Phototrophs appeared much later in evolution.

4. (C) The sequential manner of events of origin of life is:

Synthesis of organic monomers.
↓
Synthesis of organic polymers.
↓
Formation of protobionts.
↓
Formation of DNA-based genetic systems.

Related Theory

Stanley Miller and H.C. Urey built an apparatus of glass tubes and flasks and created an atmosphere rich in H_2, NH_3, CH_4 and water vapour in one chamber and allowed condensed liquids to accumulate in another chamber. They supplied energy by heating the liquid containing chamber as well as by electric sparks from electrodes in gaseous chamber. After running the experiment for a week, they found that liquid in the apparatus had many organic compounds including amino acids. This proved abiotic synthesis of organic compounds.

5. (C) The chemical evolution is the formation of complex organic molecules from simpler inorganic molecules through chemical reactions in the oceans during the early history of the Earth. It is the first step in the development of life on this planet.

6. (D) Miller and Urey through their experiment abiotically synthesised amino acids and bases. They synthesised glycine, aspartic acid and alanine in abundant quantities. However, glutamic acid could not be synthesised in their experiment.

7. (D) The simplest living organisms could not have originated spontaneously from non-living matter. Microbes were killed by heating the meat and the sealed vessel formed a closed system wherein the new microbes could not come in contact with the nutrient medium and hence no spoilage of meat occurs.

Related Theory

Pasteur performed experiments in which he took sterilized yeast and sugar solution in a long necked flask, then he bent the neck of the flask like a neck of swan. After one month he observed that no life appeared in flask solution because the curved flask neck acts as a filter. He later on broke down the neck and observed the solution. He found that many micro-organisms were originated in solution.

8. (B) According to Oparin, the atmosphere of primitive earth was reducing because H-atoms were most numerous and most reactive. Large quantities of H_2, N_2, water vapour, CO_2, CH_4 and NH_3 were present, but free oxygen was not present in significant amount.

Related Theory

Oparin and Haldane suggested that life originated from non-living organic molecules like proteins and RNA. This was followed by the theory of chemical evolution which suggested that atmospheric conditions of earth led to the formation of organic molecules from inorganic molecules.

9. (B) Scientists presumed that the first living organisms were chemoheterotrophs. They obtained energy by the fermentation of complex organic substances available to them from the sea broth. These were anaerobes.

10. (D) The primitive atmosphere of the earth was reducing with little or no oxygen. Oxygen came into existence after the evolution of the process of photosynthesis. Hydrogen atoms combined with all available oxygen atoms to form water.

11. (B) According to Darwin, the organic evolution is due to interspecific competition. Interspecific competition is a form of competition in which individuals of different species compete for the same resource in an ecosystem.

Related Theory

Charles Darwin proposed a theory to explain the process of organic evolution by giving following points:

(1) Rapid multiplication and overcrowding
(2) Limited food and space
(3) Struggle for existence leading to interspecific and intraspecific competition
(4) Variation.
(5) Survival of fittest
(6) Inheritance of useful variations
(7) Formation of new species due to gradual accumulation of useful variations in the successive generation

12. (A) Survival of the fittest is a result of selection and proliferation of only those organisms which were most suitably adapted to the environment and get selected by nature. To survive in a particular environment, an organism need to adapt in that environment. If the organism becomes successful for in adapting themselves then, that organism is selected by nature.

Related Theory

Darwinism can explain the survival of fittest but is unable to account for arrival of the fittest. It is difficult to suppose that small variations could have formed organs like wings and mimicry colouration which are useful only in their fully developed state but what about their presence in early stages.

13. (D) Evolution is a process in which something changes into different and usually more better form over time and in response to environment. This results in descendents becoming different from ancestors. Thus, evolution is defined as the history and development of race along with variations. In Biology, the term 'evolution' means gradual changes, emphasizing on diversity of organisms. Evolution helps to understand the history of life.

14. (B) The flippers of penguins and dolphins have a similar function (helps in swimming), but different origin, so they are called analogous organs. Thus, they show convergent evolution.

15. (A) Natural selection is a process in which organisms better adapted to the environment have more chances of survival and reproduction. Natural selection can affect Hardy-Weinberg equilibrium and can lead to the following changes:

Natural selection can lead to stabilization (where more individuals acquire mean character value). In this case, genetic diversity decreases as the population stabilizes on a particular trait value.

The type of natural selection where more individuals acquire specific character value other than the mean character value, results in directional change. In this case, extreme phenotype is favoured over other phenotypes, causing the allele frequency to shift over time in the direction of that phenotype. This happens in response to gradual changes in environmental condition, for example, during industrial revolution in peppered moths.

In disruptive change, more individuals acquire peripheral character value at both ends of the distribution curve. This type of natural selection occurs when selective pressures are working in favour of the two extremes and against the intermediate trait.

Related Theory

Hardy Weinberg equilibrium is a model of relationship between alleles and genotype frequencies. It states that allele frequencies in a population are stable and constant. They are passed on from generation to generation. The conditions on which the equilibrium is maintained are no mutations, no selection, random mating, no migration and the population size is infinite.

16. (C) The flippers of penguins and dolphins are the example of analogous organs. Just like the eyes of an octopus and of mammals. Flippers in both help in swimming. So they are functionally similar, but structurally different as penguins are birds and dolphins are mammals.

Related Theory

Homologous organs are organs which are similar in structure and share a common ancestor, but functionally they are different. On the contrary, analogous organs are structurally different but similar in their functions.

17. (A) Ernst Haeckel proposed biogenetic law in 1864. This law states the embryological support for evolution. Karl Ernst von Baer disapproved the embryological support for evolution. Charles Robert Darwin gave scientific theory of evolution by natural selection which became the foundation of modern evolutionary studies. Alfred Wallace co-developed the theory of natural selection and evolution with Charles Darwin. In addition to his contribution to 'On the Origin of Species', Wallace also studied the biogeography of the region.

Related Theory

Biogenetic law, also called Recapitulation Theory, was given by Ernst Haeckel in 1866, stating 'ontogeny recapitulates phylogeny' i.e., the development of the animal embryo and young ones traces the evolutionary development of the species. It hypothesizes that the various phases, an animal embryo undergoes during development which are a sequential replay of that species' past ancestral forms. It states that an embryo's developmental stage depicts an adult form of an ancestor post-evolution. The confirmation from embryology reinforced the theory that all species have evolved from a common ancestor.

18. (B) Herbicide resistant weeds, drug resistant eukaryotes and man created breeds of domesticated animals are the examples of anthropogenic (caused or influenced by humans) activities. Darwin's Finches of Galapagos Islands are the example of natural selection (adaptive radiation).

19. (C) Similarity of bone structure in the forelimbs of many vertebrates is an example of homology, as they have same fundamental structure but perform different functions.

20. (A) Analogous structure has different origin but evolved to perform the same function. This leads to convergent evolution. Homologous organs result in divergent evolution. All these organs have shared common ancestors, at one time during their evolution. Stabilising selection is a type of natural selection in which the population mean stabilizes on a particular non-extreme trait value.

21. (C) Wings of bird and flipper of whale are homologous organs as they both are modified forelimbs, where wing help in flying while flipper help in swimming. Wings of a moth are membranous and wings of a bird are muscular, thus they are analogous organs as they have different origin. Hind limb of rabbit and dorsal fin of a shark are also analogous organs.

22. (B) The wings of a bird and the wings of an insect are analogous structure and represent convergent evolution. Analogous organs have the same function and are superficially alike only. However, their fundamental structures are quite different in morphology, analogy and embryonic origin. Analogy is an example of convergent evolution.

23. (B) Industrial melanism is an example of natural selection where the moths living in the industrial areas developed melanin pigment to hide themselves from their predators. According to Neo-Darwinism theory, population is a unit of evolution. This explains the reasons for variation *i.e.,* mutation, genetic recombination, natural selection, reproductive isolation and heredity. Accumulation of genetic variations is a major driving force for evolution. Neo-Lamarckism stresses on the direct effect of changed environment on the organisms. Mutation is the sudden heritable change in DNA sequence.

Related Theory

➥ *Industrial melanism was responsible for increase in the population of dark-coloured moths (Biston betularia) along with the loss of lichens during industrialisation in England. The tree trunks became darker (after industrialisation) with deposits of soot and smoke; hence the number of dark moths increased due to the added advantage of camouflage as they were not easily visible to their predators while the white-winged ones were easily picked up by the predators. Thus, dark ones were selected by nature (natural selection) and light ones failed to survive.*

24. (C) All the forelimbs mentioned are homologous organs as the origin is same *i.e.,* from bone modifications, performing similar or different functions. Hence, they show divergent evolution.

Caution

➥ *Students usually make mistake in Homologous and Analogous organs as they compare between the functions of the organs, rather than their basis of origin. Homologous organs have same basis of origin, phylogenetically or structurally but could be or could not be modified into different structures to perform different functions. Analogous organs have different origin, phylogenetically (e.g., wings of butterfly and wings of bat. Here one belongs to arthropods while other belongs to mammals), but perform the same functions.*

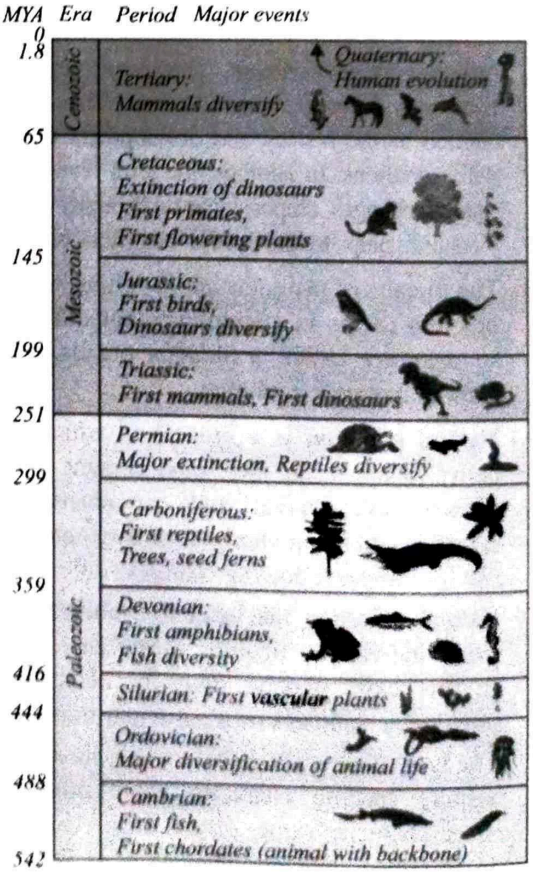
25. (A) The wings of bat are analogous to the wings of pigeon as the basic structure of the wings of the mammal is different from the wings of bird but have similar functions. Similarly, gills of prawn (arthropod) and lungs of man (mammal), both are respiratory organs but have different basic structure. Thorns of *Bougainvillea* and tendrils of *Cucurbita* are both stem modification, hence they are homologous organs. Flippers of dolphin and legs of horses are homologous organs as both are mammals.

26. (C) Convergent evolution is the process whereby organisms are not closely related and independently evolve similar traits as a result of having to adapt to similar environments or ecological niches. Structures that are the result of convergent evolution are called analogous structures. They should be contrasted with homologous structures, which have a common origin leading to divergent evolution.

27. (C) Dinosaurs dominated in Jurassic period of Mesozoic era and were extinct by cretaceous period.

Related Theory

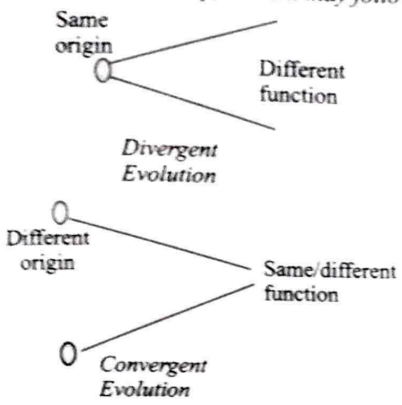
➥ *Geological Time Scale*



28. (A) Convergent evolution is shown by analogous organs and divergent evolution by homologous organs. Eyes of octopus and mammals, wings of insects and birds shows convergent evolution, while bones of forelimbs of vertebrates, thorns of *Bougainvillea* and tendrils of *Cucurbita* are homologous organs.

Caution

Students usually get confuse between divergent and convergent evolution. To remember easily, student may follow this:



29. (D) Sweet potato is homologous to turnip as both are having same origin *i.e.*, both are root but modified for different functions. Sweet potato is a modified root for storage and vegetative propagation while turnip is modified for storage only. Potato is a stem tuber, ginger is a rhizome, and *Colocasia* is a corm (underground stem).

Related Theory

Difference between rhizome and tuber:

Rhizome	*Tuber*
Grows horizontally inside the soil	*Grows vertically inside the soil*
Have thickened underground stems.	*Have modified starchy stems*
Nodes present	*Nodes absent*
Pear-shaped.	*Do not have a standard shape.*
Underground stem	*Underground branches of the stem or underground root.*
E.g., Asparagus, Bamboo, ginger, Lotus, turmeric, etc.	*E.g., Carrot, Dahlia, oxalis, potato, sweet potatoes, etc.*

30. (A) (a) Wings of butterfly and birds look alike and are the results of convergent evolution.

(b) Miller showed that CH_4, H_2, NH_3 and H_2O, when exposed to electric discharge in a flask resulted in formation of small organic compounds.

(c) Vermiform appendix is a vestigial organ and a palaeontological evidence for evolution.

(d) According to Darwin, evolution took place due to small variations and survival of the fittest.

31. (D) Crocodile, Penguin, Whale and Dogfish all are chordates. So, all have gill slits at some stage of development. They possess dorsal hollow nerve chord that is towards the back compared to the notochord. Crocodile and penguin are oviparous, dogfish is ovo-viviparous, and whale is viviparous. Dogfish is a cartilaginous fish.

Related Theory

In most land-living chordates, the gill slits are present only in embryonic stages. Infact, we humans have pharyngeal slits at one time.

32. (A) The classical example of natural selection is provided by the response of a peppered moth *Biston betularia*. Industrial melanism is an adaptation where the moths living in the industrial areas developed melanin pigment to hide themselves from their predators. Before the industrial revolution, most of the peppered moths in the UK were white and very few were melanic (black). After their habitats become polluted with soot from the coal-fired industries, the white moths were selectively picked up predators. On the other hand, dark-coloured moths were camouflaged very well by the blackened trees and in turn their population rapidly increased.

33. (B) Thorns of *Bougainvillea* and tendrils of *Cucurbita* are homologous organs. These are modified branches and are axillary in position. They shows divergent evolution. The analogous organs have almost similar appearance and perform the same function but these develop in totally different groups and are totally different in their basic structure and developmental origin. The vestigial or rudimentary organs are useless remnants of structures or organs, which might have been large and functional in ancestors. Retrogressive evolution is a process in which complex forms of the organism develop into a simpler form.

Related Theory

The examples of analogous organs in plants are:

(1) Potato is a stem while sweet potato is a root; both perform storage and vegetative propagation.

(2) Cactus and Euphorbia belong to two different species but both have a photosynthetic stem and leaves reduced to spines.

(3) Pyracantha (firethorn) and Berberis (barberry) both have thorns for protection but in firethorn plant, the thorns are modified stem while in barberry the thorns are modified leaves.

34. (C) In annelids like *Nereis*, earthworm, leech, *etc.* the tubular coiled structures called nephridia are excretory organs.

In phylum-Arthropoda, insects, centipedes, millipedes and arachnids possess Malpighian tubules as their principal excretory organ.

The Examples of Analogous organs are wings of butterfly birds, bats.

The Examples of homologous organs are thorns of *Bougainvillea* and tendrils of *Cucurbita*.

Vestigial organs are useless remnants, which might have been large and functional in the ancestors, *e.g.*, nictitating membrane, vermiform appendix, *etc.*

35. (C) The analogous organs show convergent evolution due to similar adaptions which do not support organic evolution. Divergent evolution occurs when two groups of the same species evolve different traits within those groups in order to accommodate for differing environmental and social pressures. Microevolution is the change in allele frequencies that occurs over a relatively short period of time within a population. This change is due to four different processes: mutation, selection, gene flow and genetic drift. Co-evolution refers to the evolution of at least two species, which occurs in a mutually dependent manner.

36. (D) Industrial melanism is a term used to describe the evolutionary process in which darker individuals came to predominate over lighter individuals because of the Industrial Revolution. This occurred as a result of natural selection in which a black 'melanic' form arose by a recurring random mutation, but its phenotypic appearance had a strong selective advantage in industrial areas.

Related Theory

- *During the period when the number of coal burning factories in England was increasing (during the so-called Industrial Revolution) it was noticed that the number of melanic individuals of the species of Peppered Moth (Biston betularia) was becoming more common. Originally rare in the population of normally light-coloured moths, the frequency of the melanic form increased in polluted areas until it was over 90%. This change in colour has come to be known as "industrial melanism."*

37. (B) The analogous organs show convergent evolution due to similar adaptation. They do not support organic evolution. Distantly related animals (whale, seal and shark) inhabiting similar habitats often develop similar morphological features which make them look similar. This is termed as adaptive convergence or convergent evolution.

38. (B) An important evidence in favour of organic evolution is the occurrence of homologous and vestigial organs. Homologous organs have a common origin and are built on the same fundamental pattern, but they perform different functions and have different appearances. Vestigial organs in animals have no function now, but they had important functions in ancestors. Analogous organs are quite different in fundamental structure and embryonic origin but perform the same function. The study of analogous organs illustrates the occurrence of convergent evolution.

39. (B) The Jurassic period is the second geological period of the Mesozoic era. In that period, the gymnosperms were dominant and the plants included were ferns, cycads, *Ginkgo*, rushes and conifers; among animals, important invertebrates included are ammonites, corals, brachiopods, bivalves and echinoids. Reptiles dominated the vertebrates and the first flying reptile, the pterosaurs appeared. The first primitive bird *Archaeopteryx* also made its appearance.

40. (D) *Archaeopteryx* is not a living fossil. It is a fossil bird which lived in the Jurassic period and is considered a connecting link between birds and reptiles. King crab (arthropoda), *Sphenodon* (reptile) and *Peripatus* (oviparous mammal) are living fossils.

41. (C) According to Darwin's theory of natural selection, The individual possessing useful variations survive whereas the others are eliminated. Nature selects the best suited and discards the others (survival of the fittest). Pesticide resistant insects are selected over pesticide sensitive insects by nature, and are thus survive through the course of evolution, until more suited (fittest) individual is selected, eliminating the former.

42. (A) Radiocarbon dating (also referred to as carbon dating or carbon-14 dating) is a method for determining the age of an object containing organic material by using the properties of radiocarbon, a radioactive isotope of carbon-14.

Related Theory

- *The basis of radiocarbon dating is simple: all living things absorb carbon from the atmosphere and food sources around them, including a certain amount of natural, radioactive carbon-14. When the plant or animal dies, they stop absorbing, but the radioactive carbon that they've accumulated continues to decay.*

43. (C) Electron Spin Resonance (ESR) measures number of charges occupying deep traps in crystal band gap. The basic principle of ESR is same as those for luminescence *i.e.*, electrons become trapped and stored as a result of ionising radiations *e.g.*, Dating of tooth enamel.

44. (D) Convergent evolution occurs when species occupy similar ecological niches and adapt in similar ways in response to similar selective pressures. For example, Dogfish (Pisces) and whale (mammals) have acquired aquatic character though distantly related.

Rat and dog (mammals), bacterium and protozoan (unicellular), and starfish (mollusc) and cuttlefish (Echinodermata) show divergent evolution.

Related Theory

Sea stars do not have gills, scales, or fins. Sea stars live only in saltwater. Sea water, instead of blood, is actually used to pump nutrients through their bodies via a water vascular system. Hence, they are not considered as fish.

45. (C) Overproduction, the constancy of population size, variations, natural selection sequence was proposed by Darwin and Wallace for organic evolution.

Overproduction: There is an overproduction of organisms due to high reproductive rate, even when the resources are limited. Even though the population increases enormously, the number of individuals in every generation remains constant.

Variation: It means differences, like you have black and white peppered moths, red and green capsicum and hundreds of colours of butterflies. And they are all different because they are adapting themselves, to be better than each other.

Natural selection: It states that nature creates struggle and selects those animals which win in the competition. The organisms which have useful variations will win in the competition. Whereas the organisms which have no such useful variations will die.

46. (C) During the period when the number of coal burning factories in England was increasing (during the so-called Industrial Revolution) it was noticed that the number of melanic individuals of the species of Peppered Moth (*Biston betularia*) was becoming more common. Originally rare in the population of normally light-coloured moths, the frequency of the melanic form increased in polluted areas until it was over 90%. This change in colour has come to be known as industrial melanism.

In this case, moths with dark coloured will be selected by nature and hence they will be reproductively successful as compared to moths of light colour. Hence, it is an example of protective resemblance with the surrounding.

47. (D) The theory of natural selection is based on the following factors:

(1) Rapid multiplication and limited food and space which leads to struggle for existence.

(2) Struggle for existence and variations which leads to natural selection or survival of the fittest.

(3) Natural selection and inheritance of useful variation over many generation which leads to formation of new species.

Darwin in his 'Natural Selection Theory, did not believe in the role of discontinuous variation in natural selection. Darwin always believed in the universal occurrence of variation. In his opinion, variation is continuous in nature.

Related Theory

As resources are limited in nature, organisms with heritable traits that favour survival and reproduction will tend to leave more offsprings than their peers, causing the traits to increase in frequency over generations.

48. (A) The organs which have the same structure and origin but look different and perform different functions are called homologous organs. The organs which have the same function and are superficially alike but are quite different in their fundamental structure and embryonic origin are called analogous organs.

49. (A) Bacteria are able to grow in a streptomycin containing medium due to development of resistance to the antibiotic by a process called natural selection. Normally bacteria cannot survive in antibiotic containing medium but if it does so it must have acquired resistance against that antibiotic. These are well adapted to grow in streptomycin containing medium and thus are more evolved. So, due to natural selection only, the more evolved and better-adapted species are able to survive.

50. (B) The wings of a bird and pectoral fins of a fish have similarity in their basic anatomical structure (made of skeletal musculature) but the wings are used for flying whereas the fins are used for swimming.

51. (B) The Mesozoic era (Devonian period) is called the age of reptiles because this is when dinosaurs dominated the Earth. When a mass extinction occurred, it killed off all of the dinosaurs and was one of the largest in the history of the Earth.

52. (B) The half-life period of a substance is defined as the time in which the concentration of substance (reactant) reduces to half of the initial concentration. The half-life period of C-14 is 5730 years.

53. (C) Convergent evolution is a process that starts off with two or more unrelated groups getting adapted to a similar environment. Due to this, they develop more or less similar features. *i.e.*, unrelated ancestors "converged" towards the same function while adapting to a similar environment.

54. (B) Pectoral fins of a fish and forelimbs of a horse are homologous organs. They are similar in structure but different in functions. Pectoral fin is used for swimming and forelimb of a horse is used for walking. Homology is based on divergent evolution. All the other pairs are analogous, which are structurally different but functionally similar.

55. (B) Homologous organs have similar anatomical structure but perform different functions. Homology indicates common ancestry. On the contrary, the organs which are not anatomically similar but perform similar functions are analogous organs like the wings of butterfly and of birds look alike but are anatomically different but perform similar function.

56. (C) Evolutionary convergence is a type of evolutionary pattern in which unrelated organisms or different species develop analogous structures (*i.e.*, organs with different structure but same function). Convergent evolution does not share common ancestors but have evolved independently, for *e.g.*, wings of insects, birds and bats.

57. (B) Recapitulation theory of Ernst Haeckel says that the embryo of an animal go through stages resembling their ancestors. It is also known as embryological parallelism. Vertebrates like reptiles, birds and mammals are evolved from fishes and amphibians over time. Therefore, the presence of gill slits in vertebrate embryo stages can be explained by recapitulation.

Related Theory

- *Ernst Haeckel proposed recapitulation theory. We can understand it by taking example of tadpoles, which are frog larvae that have the tail and gills which indicate they are developed from fishes.*

58. (A) The homologous organs show similarity in origin. Homologous organs indicate common ancestry. They have the same embryonic origin and anatomical structure, but they do not perform the same function. They result in divergent evolution.

59. (A) Study of fossils is known as Palaeontology. Fossils are the dead remains of plants, animals, fungi, bacteria, and single-celled living things that have been replaced by rock material or impressions of organisms preserved in rock.

60. (C) Von Baer, in 1828, gave the basic principles of embryonic development. According to him, fertilisation results in zygote formation and leads to embryonic development. During embryo development generalized features like brain, spinal cord, *etc.* appeared earlier than special structures like hair. Ernst Haeckel gave the law of biogenesis. The law states that 'ontogeny repeats phylogeny', where ontogeny is the life history of an organism and phylogeny represents the evolutionary history of the race of the organism. Weismann gave the theory of 'continuity of germplasm'. T. H. Morgan gave the chromosomal theory of inheritance.

61. (B) The book 'Origin of Species' was written by Charles Darwin. Darwin and Wallace jointly published a paper titled 'Origin of Species' in 1858. Later in 1859, Darwin published his detailed theory in his book 'Origin of Species by Natural Selection'. According to Darwin, variations are the progressive factors for evolution.

62. (D) Adaptive radiation, also known as divergent evolution. It is the development of different functional structures from a common ancestral form, *e.g.*, wings of humming bird and hawk; bat and human beings. Whereas development of similar adaptive functional structures in unrelated group of organisms is called adaptive convergence or convergent evolution, eg., wings of insect, birds and bats. When convergent evolution occurs in closely related group of organisms, it is called parallel evolution, *e.g.*, development of running habit in deer (two-toed) and horse (one-toed). Adaptive radiation is the evolutionary process where many related species evolved from a single ancestor homology is based on divergent evolution. Homologous organs are the organs that are anatomically similar but functionally different.

63. (D) The sketch depicts different beak shapes of finches, commonly known as Darwin's finches, which illustrate the concept of adaptive radiation. Adaptive radiation occurs when a single ancestral species diversifies into multiple distinct species, each adapted to a different environment or niche. This phenomenon is a hallmark of how species adapt to different ecological niches over time.

64. (A) Convergent evolution is a phenomenon where unrelated organisms independently develop similar traits due to adapting to comparable environments or ecological niches. Both lemur and spotted cuscus are arboreal mammals from different continents that have evolved similar traits.Both bobcat and Tasmanian tiger cat are predatory mammals that have evolved similar hunting traits. Both anteater and numbat are insectivorous mammals that have evolved similar feeding adaptations. Both Flying squirrels and flying phalanger are gliding mammals that have evolved similar adaptations for moving between trees.

65. (D) The correct group/set of Australian marsupials exhibiting adaptive radiation is (D) Numbat, Spotted cuscus, Flying phalanger.

Adaptive radiation refers to the diversification of a single ancestral species into multiple descendant species, each occupying different ecological niches. In the case of Australian marsupials, they have diversified to occupy a variety of ecological niches, resulting in a wide range of species with different characteristics and adaptations.

66. (A) Adaptive radiation – Darwin Finches
Convergent evolution – Wings of Butterfly and Birds
Divergent evolution – Bones of forelimbs in Man and Whale

Evolution by anthropogenic action – Selection of resistant varieties due to excessive use of herbicides and pesticides.

67. (D) Adaptive radiation is a process in which organisms diversify rapidly from an ancestral species into a multitude of new forms, particularly when a change in the environment makes new resources available, alters biotic interactions or opens new environmental niches. In the early 20th century, a mechanism of saltation was proposed as large mutations. It was seen as a much faster alternative to the Darwinian concept of a gradual process of small random variations being acted on by natural selection. Coevolution is the evolution of two or more species which reciprocally affect each other, sometimes creating a mutualistic relationship between the species. Natural selection occurs when individuals with certain genotypes are more likely than individuals with other genotypes to survive and reproduce, and thus to pass on their alleles to the next generation.

68. (D) Convergent evolution is the process in which non-related organisms, evolve independently with similar traits as a result of having to adapt to similar environments or ecological niches. Australian Marsupials and placental animals are best examples. Adaptive radiation is a process, also known as divergent evolution, in which one species gives rise to many species that appear different externally but are similar in their genetic traits and have homologous structures. According to Cyclical Theory, every society has a predetermined life cycle—birth, growth, maturity and decline. Cyclical change is a variation on unilinear theory of life.

69. (A) Adaptive radiation occurs when a single or small group of ancestral species rapidly diversifies into a large number of descendent species. Therefore, when a population invades a new area with many types of vacant habitats, they face different environmental pressures and eventually adapt exhibiting adaptive radiation. It is because it provides an organism with plenty of niche spaces in the new vacant habitat. Darwin's finches represent one of the best example of the phenomenon of adaptive radiation.

70. (A) Darwin's Finches show adaptive radiation, which occurred in response to various food resources available. They feed on insects, tree buds, seeds, cactus, *etc.* Carrion are dead bodies and no finches feed on them.

Related Theory

Darwin studied the climatic conditions, fauna and flora of Galapagos islands. He noticed varieties of small birds in these islands which differed mainly in the shape and size of their beak and in the colour of their plumage. These birds are now called Darwin's finches. Darwin concluded that the American mainland species was the original one from which different forms migrated to the different islands of Galapagos and adapted to the different environmental conditions of these islands. These adapted forms are considered to be the new species. Thus, Darwin's finches provide a beautiful example of adaptive radiation supporting the concept of evolution.

71. (C) Darwin noticed that related varieties of small birds in Galapagos islands which differed mainly in the shape and size of their beak and in the colour of their plumage. He concluded that the American mainland species was the original one from which different forms migrated to the different environmental conditions of these islands and adapt to their environment.

72. (C) The finches of Galapagos islands provides an evidence in favour of biogeographical evolution.

73. (A) Adaptive radiation refers to evolution of different species from a common ancestor. It is the evolutionary process by which many species originate from one species in an area and radiate to different species. The mammals are adapted for different mode of life *i.e.*, they show Adaptive radiation. They can be aerial (bat), aquatic(whale and dolphins), burrowing or fossorial (rat), cursorial (horse), or arboreal (monkey). The adaptive radiation is also known as Divergent evolution.

74. (C) Darwin's finches are the example of adaptive radiation. Adaptive radiation is the process of evolution of different species in a given geographical area starting from a point and radiating to other geographical areas. Therefore, biogeography is the study of geographical distribution of organisms.

Related Theory

Darwin went on a sea voyage on the ship HMS Beagle to study different organisms on earth. During his journey, Darwin reached Galapagos Islands, where he observed an amazing diversity of creatures. These were small black birds, later named as Darwin's finches. He saw variety of finches on the same island but with different beak structures due to their feeding habits. This was best explained to be due to natural selection.

75. (D) Diversity in the type of beaks of finches adapted to different feeding habits provides evidence for origin of species by natural selection. The selection of those set of characters that are best adapted to the environment, has resulted in great diversity as seen in the population of the finches.

76. (D) In convergent evolution similar adaptive functional structures develop in different species (unrelated group of organisms), but when convergent evolution is found in separate but closely related species it is

called parallel evolution. In parallel evolution or parallelism, the two species have a relatively recent common ancestors.

77. (A) Coacervates are the cluster of molecular aggregates in colloidal form which are bounded by a membrane, grow by absorbing molecules from environment and divide by budding are termed as coacervates. According to the "Theory of chemosynthesis", the life on this earth originated as a result of chemical combination of various inorganic materials occurring in the atmosphere. They reproduce asexually and do not show homeostasis.

78. (A) The law of biogenesis or the recapitulation theory states that ontogeny repeats phylogeny. This means that the development of an embryo or an organism (ontogeny) expresses evolutionary history and all the intermediate forms of its ancestors (phylogeny).

79. (B) Phylogeny is the history of an organism through ages during evolution. It is the origin and diversification of any taxon or the evolutionary history of its origin and diversification. It is usually represented as a diagrammatic phylogeny tree called dendrogram.

80. (C) According to Darwin's theory of pangenesis and Mendel's theory of inheritance of acquired characters, something is passed from parents to offsprings, which leads to the development of specific character in the offspring. These tiny particles that passed on from generation to generation were called gemmule or pangenes. Therefore, there should be some physical basis of inheritance.

81. (A) Vestigial organs are the organs that were present in the past but now have reduced in size and are no longer useful to an organism. There are about 90 vestigial organs in a human body among which are coccyx (tail bone), third molar (wisdom tooth) and segmental muscles of abdomen. Therefore, finger nail is the correct option. These are not the vestigial part in humans.

82. (B) According to the Biogenetic Law proposed by Ernst Haeckel in 1866, during its development an animal passes through ancestral adult stages. Mendelian laws explain the inheritance of genetic characters from one generation to another. Hardy-Weinberg law is the principle of genetic equilibrium, according to which a randomly mating population remains in genetic equilibrium in the absence of any external environmental disturbances like mutation, migration, gene flow, genetic drift, recombination and natural selection. Lamarck postulated the theory of inheritance of acquired characters.

83. (D) Vestigial organs are those organs that are no more functional, degenerate and rudimentary but were fully developed and functional in their ancestors and in related animals. Human beings possess many vestigial organs like Coccyx of the tail bone and tail muscles, nictitating membrane in the eye, vermiform appendix at the end of the caecum, muscles of ear pinna, third molar (wisdom tooth), segmental muscles of abdomen and mammary glands in males.

84. (B) According to Darwin's theory of natural selection, as published in his book 'Origin of Species by Natural Selection', all species have great reproductive potential; most populations are stable in size; natural resources are limited; individuals in a population have variations; and most of the variations are heritable. According to Darwin, more individuals are produced in each generation than can survive. In the struggle for existence, only those individuals can survive which possess the most useful variations or can better adapt themselves to their environment. These surviving individuals can transmit their acquired genetic characters to the succeeding generations and the one that are less adapted to their surroundings will not survive. Only the fittest will survive. Next generation further repeats the process of development of variations and natural selection. Therefore, natural selection acts on favourable variations.

85. (C) Jean Baptiste de Lamarck, a French naturalist was the first person who attempted to explain the mechanism of evolution. His theory was inheritance of acquired characters or the use and disuse of organs. The theory states that the characters acquired by an individual during his lifetime are passed on to the progeny and then to further generations and new species are produced. Hugo de Vries gave the idea of mutation. Charles Darwin gave the law of natural selection as the basis of evolution. Alfred Russel Wallace, was a naturalist who worked in Malay Archipelago and drew the same idea of evolution by natural selection but entirely independent of Charles Darwin.

86. (D) According to Hugo de Vries, variations caused by mutations are random and directionless. These are the sudden heritable changes in the DNA or the genetic material. Evolution occurs due to the variations caused by mutation. He believed that mutation caused speciation and used the term saltation for single step large mutation.

87. (B) According to Hugo de Vries, the mechanism of evolution is saltation. He stated that evolution is a jerky process in which new species are evolved due to discontinuous sudden variations or saltation. These are the single step large mutations occurring in population.

88. (C) Hugo de Vries conducted his experiments on *Oenothera lamarckiana* (Evening Primrose), and found several aberrant types. He suggested that new types of inherited characteristics may appear suddenly without any previous indication of their presence in the race.

89. (B) The gene pool refers to the total number of genes and their alleles found within a population.

Genetic drift refers to the change in the frequency of an existing gene variant in a population due to random events.

Gene flow is the transfer of genes into or out of a population.

Gene frequency (allele frequency) refers to how often a particular gene variant is found in a population and can remain stable within a generation unless affected by other factors.

90. (C) Gene migration or gene flow, genetic drift, mutation, genetic recombination and natural selection are the five factors that are known to affect Hardy-Weinberg equilibrium.

According to Hardy- Weinberg equilibrium, constant gene pool (total number of genes and alleles in a population) called genetic equilibrium does not change over time.

91. (C) Genetic drift is a random process that can lead to large changes in population over a short span of time. Random drift is caused by small population size and founder events where original drifted population becomes founder and a new population starts from a small number of individuals. Mutation is a sudden heritable change. Genetic recombination occurs due to crossing over at the time of gamete formation. It results in variation in population.

92. (B) Genetic drift operates in small isolated population. It is the drastic variation in the allele frequency when population size is very small, owing to the chance disappearance of particular genes as individuals die or do not reproduce. The reason for genetic drift occurring in small population is occasional occurrence of alleles getting lost with higher probability. When this loss of allele starts then the genetic drift continues until that specific allele is totally lost in the entire population.

93. (B) According to Hardy-Weinberg principle, in a large randomly breeding population, the allelic frequencies of sexually reproducing organisms will remain stable and constant from generation to generation. The Hardy Weinberg equation is:

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

In this equation, p^2 represents the frequency of individuals that are homozygous dominant. q^2 represents the frequency of individuals that are homozygous recessive. $2pq$ is the frequency of heterozygous dominant.

94. (C) According to Hardy-Weinberg's equilibrium, allelic frequencies in a population are stable and constant. This is genetic equilibrium. Sum total of all the allelic frequencies is 1. The change in the allelic frequency results in the evolutionary changes. The factors that affect the equilibrium are gene migration or gene flow, genetic drift, mutation, genetic recombination and natural selection. If the individuals in the population mate selectively, it will result in mutation causing the shift in the Hardy-Weinberg equilibrium.

95. (C) According to Hardy-Weinberg principle

$$p^2 + 2pq + q^2 = 1$$

or $$(p + q)^2 = 1$$

$$AA = p^2 = 360$$

out of 1000 individuals or 36 out of 100 individuals

$$aa = q^2 = 160$$

out of 1000 individuals or 16 out of 100 individuals

Therefore $$q = \sqrt{0.16}$$

$$= 0.4.$$

As $$p + q = 1$$

so $$p = 1 - 0.4$$

$$= 0.6$$

96. (B) Genetic drift is a random change in allele frequencies over the generations. Gene flow or gene migration is the physical movement of alleles into and out of a population.

97. (A) Genetic drift is a random change in gene frequency, which occurs by chance (in small population size). The change in gene frequency is caused by sampling error or error in gene pool sample that is to form the next generation. The sampling gene pool is small in size and the chances of variability are also limited.

98. (A) According to Hardy-Weinberg principle,

$$p^2 + 2pq + q^2 = 1 \qquad p = 0.6$$

or $$(p + q)^2 = 1 \qquad q = 0.4$$

where, p^2 = homozygous dominant

$= 0.36$

q^2 = homozygous recessive

$= 0.16$

$2pq$ = heterozygous dominant

Therefore, frequency of heterozygous individuals

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

99. (C) Genetic drift occurs when the occurrence of variant forms of a gene (allele) increases or decreases by chance over time. These changes in the allele frequencies occur in a small population. The genetic

drift becomes a significant factor in the origin of new species on small islands and other isolated populations. These small populations develop characters, different from the one found in main population. This deviation in characters may even lead to speciation or formation of new species. Hence, interbreeding of the population may result in the development of new species.

100. (B) Sequence of both *mt*DNA and Y chromosomes are considered for the study of human evolution because they are uniparental in origin. *mt*DNA is inherited along with the maternal cytoplasm and Y chromosome is inherited from father. So they do not take part in recombination. In addition, *mt*DNA has a higher mutation rate then nuclear DNA so that it is more useful for short term evolutionary studies.

101. (C) According to Hardy Weinberg principle, the allele frequencies in a population are stable and constant from generation to generation, provided the individual in a population interbreed without restriction or breed randomly. In genetics, random mating is not influenced by any environmental, hereditary or social interaction. Mutation is any random sudden heritable change occurring in the genetic material. Sexual selection refers to selection of a mate by an organism. Gene flow happens due to migration of genes that may change the allele frequency of the subpopulation.

102. (A) Genetic drift is a random change in gene frequency in a population, which occurs by chance and not by selection (in small population size). It is also known as random drift or allelic drift.

103. (A) Adaptation increases the biological fitness of a population. An adaptation or adaptive trait is a characteristic that has evolved in a population of organisms and provides a functional advantage. According to Charles Darwin, variation causes evolution. The variations are continuous and those that are helpful in the adaptation of an organism towards its surrounding, would be passed onto the next generation. These modifications or adaptations become more pronounced in the offsprings, if they face the similar environment as their parents.

104. (B) Genetic drift refers to the random changes in the gene frequencies in a population by chance, either due to intensive inbreeding or death of a small section of population by natural calamity. It may result in large changes in the population in a short time span. The genetic drift becomes a significant factor in the origin of new species on small islands and other isolated populations. These small populations develop characters different from the one found in main population.

105. (A) *Latimeria* (coelacanth) is considered a living fossil. *Echidna* shows characteristics of both mammals and reptiles, serving as a connecting link between the two. The vermiform appendix is a vestigial organ in humans. Atavism refers to the reappearance of ancestral traits, such as elongated canine teeth.

106. (B) The correct order of periods in the Paleozoic era from oldest to most recent is as follows:

(1) Silurian

(2) Devonian

(3) Carboniferous

(4) Permian

107. (C) In geologic time:

(1) Mesozoic era is known for the rise of birds and reptiles.

(2) Proterozoic era saw the emergence of lower invertebrates.

(3) Cenozoic era is marked by the dominance of mammals.

(4) Paleozoic era was crucial for fish and amphibians.

108. (B) In pteridophytes, megaspore is retained for a significant amount of time within female gametophyte on the parent sporophyte, however the permanent retention of seed is seen in gymnosperms. Thus, pteridophytes exhibit precursor to seed habit.

Related Theory

Pteridophytes are considered as the first plants to be evolved on land. They are cryptogams, seedless and contain vascular tissues but lack xylem vessels and phloem companion cells. They have well-differentiated plant body into root, stem and leaves. The sporangium is the structures in which spores are formed. They are usually homosporous and are also heterosporous, Leaves that bear the sporangia are termed as sporophylls. The tip of the leaves tends to curl inwards to protect the vulnerable growing parts. The male sex organs are called antheridia, while the female sex organs are called archegonia. The sporophytic generation and the gametophytic generation are observed in Pteridophytes. The diploid sporophyte is the main plant body.

109. (B) Scales on the hind limbs of birds indicates their reptilian ancestry. The dry reptilian skin is covered with scales to prevent water loss or also to crawl on grounds, as an adaptation to terrestrial habitat. The hind limbs of birds also have scales which confirm their reptilian ancestry. The digestive system of reptiles is similar to that of all higher vertebrates, whereas the birds digestive system has the two special chambers crop and gizzard. Birds lay hard-shelled calcareous eggs, while the eggs of reptiles have thick leathery soft-shell. Birds have four-chambered heart, while most reptiles have three-chambered heart.

110. (C) Amphibians live both on land and in water. They have moved onto terrestrial habitat, but reproduces in water. The lifecycle of a tadpole starts in water. The presence of gills in tadpole indicates that amphibians have evolved from fishes. Moreover, resemblance of amphibians to fish is seen in most systems of the body as both are cold blooded; both respire by gills (tadpole of frog); both lays egg in water. All this leads to the conclusion that amphibians evolved from gilled ancestors.

111. (C) A geological time scale is a diagram that details the history of earth's geology, noting major events in the formation of earth, origin of first life form and mass extinctions. The history of the earth has been sub-divided into eras, followed by periods and periods into major divisions. The correct geological time scale of the earth is:

Palaeozoic → Mesozoic → Coenozoic

Palaeozoic era is the age of early life/age of fishes. Mesozoic era is the age of reptiles, dinosaurs and cycads. Coenozoic era is the age of mammals and birds.

112. (C) *Homo habilis* inhabited parts of sub-Saharan Africa from roughly 2.4 to 1.5 million years ago (mya). Fossils discovered in Java in 1891 revealed the next stage, *i.e.*, *Homo erectus* from about 1.5 mya. The Neanderthal man with a brain size of 1400 cc lived in near east and central Asia between 1,00,000-40,000 years back. During ice age between 75,000-10,000 years ago modern *Homo sapiens* arose. Thus, the correct sequence of human evolution from past to recent is as follows:

Homo habilis → Homo erectus → Homo neanderthalensis → Homo sapiens.

113. (A) In 1891, hominid fossils named *Homo erectus* were discovered in Java that flourished about 1.5 mya. It had a large brain capacity (around 900 cc) and probably ate meat. First discovered hominid fossils were that of *Homo habilis* with 650-800 cc brain capacity and they probably did not eat meat. The Neanderthals are closely related to modern humans, differing in DNA by just 0.12%. Remains left by Neanderthals include bone and stone tools with cranial capacity larger than the 1400 cm^3. *Homo sapiens* is the only surviving species of the genus *Homo*. Modern humans are the subspecies *Homo sapiens sapiens*. *Australopithecus* were bipedal, and had a small brain and a long jaw with average cranial capacity of 440 cc.

114. (D) Neanderthal men lived in Asia between 1,00,000 and 40,000 years back. Agriculture came around 10,000 years back. About 15 mya, *Dryopithecus* and *Ramapithecus* existed. They were hairy and walked like gorillas and chimpanzee. *Homo habilis* probably did not eat meat, while *Homo erectus* ate meat.

Related Theory

Neanderthals had a long, low skull with a characteristic prominent brow ridge above their eyes. The central part of the face protruded forward and was dominated by a very big, wide nose. Their front teeth were large, and scratch-marks show they were regularly used like a third hand when preparing food and other materials. They were skilled tool makers and the brain size of ranged from at least 1200 cm^3 to 1750cm^3.

115. (B) The fossils of *Ramapithecus* was discovered from Pliocene rocks in Shivalik hill in India. They were present nearly 14-15 mya. *Australopithecus* was the first ape man found in African Pliocene rocks, present nearly 5 mya. *Homo habilis* were thought to be present 2 mya in Pliocene era. *Homo erectus* appeared nearly 1.5 mya.

116. (D) *Homo habilis* has brain capacity of 700 cc. *Homo erectus* has cranial capacity of 800-1300 cc. *Homo neanderthalensis* had 1300 – 1600 cc brain capacity. *Homo sapiens* have cranial capacity of 1450 cc.

117. (C) Modern man (*Homo sapiens sapiens*) is most evolved. The most significant trend in the evolution of modern man (*Homo sapiens*) from the ancestors is increasing brain capacity. *Homo habilis* has 650–800 cc, brain capacity which increased around 900 cc, in *Homo erectus*. The Neanderthal man had 1400 cc, brain capacity which evolved to around 1450 cc, in *Homo sapiens sapiens*.

118. (B) The extinct human who lived 1,00,000 to 40,000 years ago in Europe, Asia and parts of Africa, with short stature, heavy eye brows, retreating foreheads, large jaws with heavy teeth, stocky bodies, a lumbering gait and stooped posture was Neanderthal man. They were closely related to modern humans having DNA over 99.5% the same. With an average cranial capacity of 1600 cm^3, the cranial capacity of Neanderthals is notably larger than the 1400 cm^3 average for modern humans, indicating that their brain size was larger.

119. (D)

Homo habilis	– 680 - 720 cc
Homoerectus erectus	– 775 - 990 cc
Ramapithecus	– Primitive man (Primate)
Homo neanderthalensis	– 1300-1600 cc

120. (D) Chimpanzee is more closely related to man than other hominoids. Chimpanzees are genetically closest to humans, and in fact, chimpanzees share about 98.6% of our DNA. Some similarities between human and chimpanzee in the chromosome banding pattern are in sex chromosomes, autosomes and mitochondria. There is little difference in banding pattern in chromosomes 3 and 6 in human

and chimpanzee. Serum test indicate maximum homology between human and chimpanzee.

Related Theory

- *Humans and monkeys are both primates. But humans are not descended from monkeys or any other primate living today. We do share a common ape ancestor with chimpanzees. It lived between 8 and 6 million years ago. They determined that chimpanzees are more closely related to humans than gorillas.*

121. (C) Modern humans originated in Africa 200,000 years ago and evolved from their most likely recent common ancestor, *Homo erectus* that lived between 1.9 million and 135,000 years ago.

122. (B) Chimpanzee is the closest relative of man. Banding pattern of human chromosome number 3 and 6 are remarkably similar to that of Chimpanzee, indicating their common ancestry or origin. Gibbons are apes similar to gorillas and chimpanzees found in Southern Asia. Gorillas are ground-dwelling apes that usually live in rainforests. Orangutans are also similar to apes, usually found in Malaysia and Indonesia.

Related Theory

- *Chimpanzee shares 99 percent genetic resemblance to humans. They have same ancestors who lived 7 million years ago. The difference of chromosome number between chimpanzee (48) and humans (46) is only two. Gorilla has 15 percent DNA similarity with man. Genomic study shows 96% similarity in the DNA between humans and Gibbons and so they are distantly related to other apes.*
- *Previously, Orangutan were believed to be the closest ancestors of humans, because of some physiological resemblance, the genetic differences were overshadowed, but later genetical studies dismissed this notion.*

123. (B) Oligocene is masked by the rise of monkeys and apes. Miocene is masked by the appearance of man like apes. Pliocene is characterized by the origin of man *i.e.*, hominids appeared during Pliocene but modern human (*Homo sapiens*) are believed to have appeared in Pleistocene Epoch. This period began 2.6 mya and lasted till 1700 years ago. By the end of this period, the modern man (*Homo sapiens*) were dominating all over the world.

Caution

- *Students of ten get confused in Pliocene and Pleistocene Epoch. They should understand that Hominids appeared during Pliocene Epoch whereas Homo sapiens appeared in the Pleistocene Epoch.*

124. (C) With the evolution of modern man, the feature that is closely related is reduction in the length of jaw bone with smaller teeth and jaw line becoming semi-circular instead of U-shaped. The other features were bipedal locomotion with straightening of knees, shortening of toes; higher cranial capacity; and loss of hair from many body parts.

Binocular vision is a feature seen in almost all primates. It has not evolved during human evolution. Apes like gibbon and chimpanzee also have binocular vision. In humans tailbone is present as a vestigial organ, so tail is not completely lost during human evolution.

125. (B) *Dryopithecus* lived around 25×10^6 years back (25 million years ago). About 15-25 mya, primates called *Dryopithecus* and *Ramapithecus* existed. They were hairy and walked like gorillas and chimpanzees. The former were more ape-like while the latter were more man-like. It is discovered from the Miocene rocks of Africa and Europe. They were regarded as the common ancestors of ape and man.

126. (B) *Homo erectus* is the ancestor of man. Fossils discovered in Java in 1891 revealed that *Homo erectus* appeared about 1.5 mya. They had large brain about 900 cc. And walked straight or erect over legs. *Homo sapiens* appeared in the Pleistocene Epoch. They evolved from *Homo erectus* in Africa. During ice age between 75,000-10,000 years ago, modern *Homo sapiens* arose *(Homo sapiens sapiens)* and spread to various parts of the world. Cro-magnon fossils have been found in Europe. Neanderthal man existed in Eurasia. It is the transitional stage. *Australopithecus* lived in East African grasslands.

127. (A) The common origin of man and chimpanzee is best shown by banding pattern in chromosome number 3 and 6. According to DNA studies, DNA of humans and chimpanzees is about 98% similar. Humans and chimpanzees share a common ancestry.

128. (D) The direct ancestors of *Homo sapien sapien* or the living man was the Cro-magnon (*Homo sapiens fossilis*) discovered in 1868 from Cro-magnon rocks in France by Mac Gregor from Holocene epoch. Cro-magnon man evolved about 34,000 years ago and was believed to be more intelligent and cultured than todays man.

129. (C) Evolution simply means descent with some changes or modifications. Tail is a vestigial organ in present day man. Disappearance of tail brought forth an anatomical improvement that finally lead to bipedal locomotion and upright or erect posture in human beings. Tail provides an evidence of atavism or reversion (reappearance of certain ancestral characters which had disappeared or were reduced). Now a days, the tail is represented in adults by a string of caudal vertebrae, which constitute the coccyx (tail bone). Change in diet brought about changes in the dental and facial make over and other anatomical changes; and development of voice were important events during evolution of man.