2. The Origin and Evolution of the Earth

1. Multiple choice question

(i) Which one of the following figures represents the age of the earth?

(a) 4.6 million years
(b) 13.7 billion years
(c) 4.6 billion years
(d) 13.7 trillion years

Answer: (c) 4.6 billion years

(ii) Which one of the following has the longest duration?

(a) Eons
(b) Period
(c) Era
(d) Epoch

Answer: (a) Eons

(iii) Which one of the following is not related to the formation or modification of the present atmosphere?

(a) Solar winds
(b) Differentiation
(c) Degassing
(d) Photosynthesis

Answer: (b) Differentiation

(iv) Which one of the following represents the inner planets?

(a) Planets between the sun and the earth

(b) Planets between the sun and the belt of asteroids

(c) Planets in gaseous state

(d) Planets without satellite(s)

Answer: (b) Planets between the sun and the belt of asteroids

(v) Life on the earth appeared around how many years before the present?

(a) 13.7 billion
(b) 4.6 billion
(c) 3.8 million
(d) 3.8 billion

Answer: (d) 3.8 billion

2. Answer the following questions in about 30 words

(i) Why are the terrestrial planets rocky?

Answer: Mercury, Venus, Earth and Mars are called "rocky" or "terrestrial" planets. Terrestrial planets mean earth-like planets. These are similar to Earth in composition. Heat from the Sun evaporated lightweight elements like hydrogen and helium into interplanetary space. Mostly rock and metal was left in this zone and clumped together to form the inner rocky planets.

(ii) What is the basic difference in the arguments related to the origin of the earth given by:

(a) Kant and Laplace

Answer: Immanuel Kant argued that the earth was formed from small and cold particles. Laplace revised this theory and postulated nebular hypothesis. The hypothesis considered that the planets were formed out of a cloud of material associated with the youthful sun.

(b) Chamberlain and Moulton

Answer: Chamberlain and Moulton considered that a wandering star approached the sun. As a result, a cigar- shaped extension of material was separated from the surface of the sun. As the passing star moved away, the material continued to revolve around the sun and it slowly condensed into planets.

(iii) What is meant by the process of differentiation?

Answer: The process through which the earth forming material got separated into different layers is called differentiation. The interior structure of the Earth is layered in spherical shells, like an onion and it may be divided into the crust, upper mantle, lower mantle, outer core and inner core.

(iv) What was the nature of the earth surface initially?

Answer: In the beginning, the earth was barren, rocky and hot sphere with a very thin atmosphere consisting of hydrogen and helium.

(v) What were the gases which initially formed the earth's atmosphere?

Answer: Initially the earth's atmosphere consisted of hydrogen and helium. Later on, the earth's atmosphere was stripped off these gases due to solar winds.

3. Answer the following questions in about 150 words

(i) Write an explanatory note on the 'Big Bang Theory'.

Answer: The most popular argument regarding the origin of the universe is the Big Bang Theory. It is also called expanding universe hypothesis. In 1920, Edwin Hubble provided evidence that the universe is expanding. The Big Bang Theory was postulated in 1950s and 1960s and validated in 1972. According to this theory, everything in the universe emerged from a point known as singularity about 13.7 billion years ago. As the universe expanded, the hot radiation in the original fireball also expanded and cooled down. Misty clouds of matter already existed. As those clouds collapsed upon themselves, they were pulled together by their own gravity and formed clusters of galaxies with the galaxies themselves breaking up into stars like those of the Milky Way. The stars might have broken up to form their planets like those of our solar system.

(ii) List the stages in the evolution of the earth and explain each stage in brief.

Answer: The Big Bang Theory considers the following stages in the development of the universe.

(i) In the beginning, all matter forming the universe existed in one place in the form of a "tiny ball" with an unimaginably small volume, infinite temperature and infinite density.

(ii) At the Big Bang, the "tiny ball" exploded violently. This led to a huge expansion around 13.7 billion years ago.

(iii) Within 300,000 years from the Big Bang, temperature dropped to 4,500 Kelvin and gave rise to atomic matter.

These conditions are conducive to the existences of life on the earth, which have led to evolution of life between 4600 million years and the present. The earth has layered structure with each layer, form the outermost end of the atmosphere to the centre of the earth, having different material. Life on the earth, evolved at a much later stage.