

Chapter-2

The Origin and Evolution of the Earth

1. Multiple choice questions.

Question 1(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:

- (b) 4.6 billion years**

Question 1(ii).

Which one of the following has the longest duration?

- (a) Eons**
- (b) Period**
- (c) Era**
- (d) Epoch.**

Answer:

- (a) Eons**

Question 1(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

Question 1(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:

(d) Planets without satellite(s)

Question 1(v).

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

(a) 13.7 billion

(b) 3.8 million

(c) 4.6 billion

(d) 3.8 billion.

Answer:

(d) 3.8 billion.

2. Answer the following questions in about 30 words.

Question 2(i).

Why are the terrestrial planets rocky?

Answer:

Terrestrial planets are rocky because:

1. The terrestrial planets were formed in the close vicinity of the parent star where it was too warm for gases to condense to solid particles.

2. The solar wind was most intense nearer the sun; so, it blew off lots of gas and dust from the terrestrial planets.
3. The terrestrial planets are smaller and their lower gravity could not hold the escaping gases.

Question 2(ii).

What is the basic difference in the arguments related to the origin of the earth given by (a) Kant and Laplace (b) Chamberlain and Moulton.

Answer:

1. Kant and Laplace's Principle: The hypothesis considered that the planets were formed out of a cloud of material associated with a youthful sun, which was slowly rotating. According to this principle which emerged in 1796, the interior of the earth must be gaseous because the earth has originated from gas form.

2. Chamberlain and Moulton: In 1900, Chamberlain and Moulton considered that a wandering star approached the sun. As a result, a cigar-shaped extension of material was separated from the solar surface. As the passing star moved away, the material separated from the solar surface continued to revolve around the sun and it slowly condensed into planets. Later on, the arguments considered of a companion to the sun to have been coexisting. These arguments are called binary theories.

Question 2(iii).

What is meant by the process of differentiation?

Answer:

The process by which earth forming material got separated into different layers is called differentiation. Starting from the surface to the central parts, we have layers like the crust, mantle, outer core and inner core. From the crust to the core, the density of the material increases.

Question 2(iv).

What was the nature of the earth surface initially?

Answer:

The planet earth initially was a barren, rocky and hot object with a thin atmosphere of hydrogen and helium. This is far from the present day picture of the earth. It is said that in initial stage the earth was in liquid form. Certainly, there must have been some events- processes, which may have caused this change from rocky, barren and hot earth to a beautiful planet with ample amount of water and conducive atmosphere favouring the existence of life.

Question 2(v).

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

Answer:

Hydrogen and helium were the gases which initially formed the earth's surface. The early atmosphere with hydrogen and helium is supposed to have been stripped off as a result of intense solar wind. This happened not only in the case of earth, but also in all the terrestrial planets which were supposed to have lost their primordial atmosphere through the impact of solar winds. During the cooling of the earth, gases and water vapour were released from the interior solid earth. Continuous volcanic eruptions contributed water vapour and gases to atmosphere. It was the first stage of atmosphere development.

3. Answer the following questions in about 150 words.

Question 3(i).

Write an explanatory note on the 'Big Bang Theory'.

Answer:

The Big Bang Theory, also called as expanding universe hypothesis. Edwin Hubble in 1929 provided the evidence that the universe is expanding. The galaxies move farther as the time passes. It says that galaxies are moving away from each other. The universe appears to be growing larger.

The Big Bang Theory:-

1. 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.
2. At the Big Bang "tiny ball" exploded violently. This led to a huge expansion. It is now generally accepted that the event of big bang took place 13.7 billion years before the present. The expansion continues even to the present day. As it grew, some energy was converted into matter. There was particularly rapid expansion within fractions of a second after the bang. Thereafter, the expansion has slowed down. Within first three minutes from the Big Bang event, the first atom began to form.
3. Within 300,000 years from the Big Bang, temperature dropped to 4,500K and gave rise to atomic matter. The universe became transparent.
4. The expansion of the universe means increase in space between the galaxies. An alternative to this was Hoyle's concept of steady state. It considered the universe to be roughly the same at any point of time. However, with greater evidence becoming available about the expanding universe, scientific community at present favours argument of expanding universe.

Question 3(ii).

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

Answer:

The earth was mostly in a volatile state during its primordial stage. Due to gradual increase in density the temperature inside has increased. As a result the material inside started getting separated depending on their densities. This allowed heavier materials (like iron) to sink towards the centre of the earth and the lighter ones to move towards the surface. With passage of time it cooled further and solidified and condensed into a smaller size. This later led to the development of the outer surface in the form of a crust. It is through the process of differentiation that the earth forming material got separated into different layers. Starting from the surface to the central parts, we have layers like the crust, mantle, outer core and inner core. From the crust to the core, the density of the material increases.

The origin of life as a kind of chemical reaction, which first generated complex organic molecules and assembled them, This assemblage was such that they could duplicate themselves converting inanimate matter into living substance. The record of life that existed on this planet in different periods is found in rocks in the form of fossils. The microscopic structures closely related to the present form of the blue algae have been found in geological formations much older than some 3,000 million years. It can be assumed that life began to evolve sometime 3,800 million years ago,