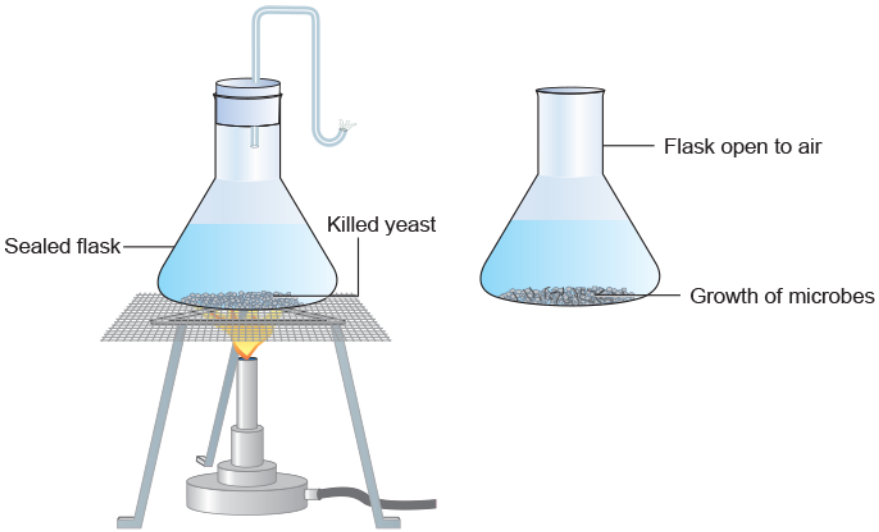
Short Answer Questions-I (PYQ)

[2 Marks]

Q.1. Describe the experiment that helped Louis Pasteur to dismiss the theory of spontaneous generation of life.

Ans. Two pre-sterilised flasks with killed yeast were taken. One of the flask was sealed, and the other was open to kept air. Differential growth of life were observed in the two flasks. Life was found only in the open flask.



Q.2. Write the Oparin and Haldane's hypothesis about the origin of life on Earth. How does meteorite analysis favour this hypothesis?

Ans. The hypothesis stated that life originated from pre-existing non-living organic molecules (e.g., RNA, protein, etc.). When the meteorites were analysed, it was observed that presence of similar compounds was confirmed which conclude that similar process is going on elsewhere in the space.

Q.3. Mention the contribution of S.L. Miller's experiments on Origin of Life.

Ans. S.L. Miller created an environment in laboratory similar to the one that existed before life originated. In a closed flask containing CH_4, H_2, NH_3 and water vapour at 800°C, electric discharge was created. The conditions were similar to those in primitive atmosphere. After a week, they observed presence of amino acids and complex molecules like sugars, nitrogen bases, pigments and fats in the flask. This provided experimental evidence for the theory of chemical origin.

Q.4. Convergent evolution and divergent evolution are the two concepts explaining organic evolution. Explain each one with the help of an example.

OR

Differentiate between divergent and convergent evolution. Give one examples of each.

Ans.

Convergent evolution: When more than one adaptive radiation appeared to have occurred in an isolated geographical area and two or more groups of unrelated animals resemble each other for similar mode of life or habitat, it is called convergent evolution, *e.g*., Australian marsupials, placental mammals.

Divergent evolution: In some animals, the same structures developed along different directions due to adaptations to different needs. This is known as divergent evolution. For example, forelimbs of whales, bats, cheetah and human perform different functions but have similar anatomical structure with similar bones arranged in similar segments.

Q.5. Explain convergent evolution with the help of two examples.

Ans. Different structures evolved similarly due to same functions. This is called convergent evolution.

Examples:

i. Wings of butterfly and birds.
ii. Sweet potato (root modification) and potato (stem modification).

Q.6. What is divergent evolution? Explain taking an example of plants.

OR

Explain divergent evolution with two examples.

Ans.

Some structures developed along different directions due to adaptations to different needs performing different functions. This is called divergent evolution. Examples:

i. Forelimbs of whales, bat, cheetah and humans have similar pattern of bones.
ii. Thorns of *Bougainvillea* and tendrils of *Cucurbita* are modifications of stem.

Q.7.

i. Forelimbs of Cheetah and mammals
ii. Flippers of dolphins and penguins
iii. Wings of butterflies and birds
iv. Forelimbs of whales and mammals

Ans.

(*i*) and (*iv*) exhibit divergent evolution.
There pairs have similar anatomical structure or origin but perform different functions.

Q.8.

a. **Select the homologous structures from the combinations given below:**
    i. **Forelimbs of whales and bats**
    ii. **Tuber of potato and sweet potato**
    iii. **Eyes of octopus and mammals**
    iv. **Thorns of Bougainvillea and tendrils of Cucurbita**
b. **State the kind of evolution they represent.**

Ans.

a. (*i*) Forelimbs of whales and bats. (*iv*) Thorns of *Bougainvillea* and tendrils of *Cucurbita*.
b. Divergent evolution.

Q.9. How do homologous organs represent divergent evolution? Explain with the help of a suitable example.

Ans.

Organs with similar structure or same origin developed along different directions due to adaptation or different needs, to perform different functions are called homologous organs.
For example, the fore limbs of some animals (Vertebrates) like whales, bats, cheetah and human have similar anatomical structure (*i.e.*, humerus, radius, ulna, carpals, metacarpals and phalanges) develop differently to meet different need and to perform different functions.

Q.10.

a. **Select the analogous structures from the combinations given below:**
    i. **Forelimbs of whales and bats**
    ii. **Eyes of octopus and mammals**
    iii. **Tuber of sweet potato and potato**
    iv. **Thorns of *Bougainvillea* and tendrils of *Cucurbita*.**
b. **State the kind of evolution they represent.**

Ans.

a. (*ii*) and (*iii*) are analogous structures.
b. Convergent evolution.

Q.11. Identify the following pairs as homologous or analogous organs:

i. Sweet potato and potato
ii. Eye of octopus and eye of mammals
iii. Thorns of *Bougainvillea* and tendrils of *Cucurbits*
iv. Forelimbs of Bat and Whale

Ans.

(*i*) and (*ii*): Analogous (*iii*) and (*iv*): Homologous.

Q.12. Branching descent and natural selection are the two key concepts of Darwinian theory of evolution. Explain each concept with the help of a suitable example.

Ans.

Branching descent: Different species descending from the common ancestor get adapted in different habitats, *e.g.*, Darwin's finches—varieties of finches arose from grain eaters; Australian marsupials evolved from common marsupial.

Natural selection: It is a process in which heritable variations enable better survival of the species to reproduce in large number, *e.g.*, white moth surviving before the industrial revolution and black moth surviving after industrial revolution; long-necked giraffe survived the evolution process; DDT-resistant mosquitoes survive. (*Any suitable example*)

Q.13. How is Darwin's concept of evolution different from that of de Vries?

Ans.

S.No.	Darwin's concept of evolution	de Vries' concept of evolution
(*i*)	Continuous variations among individuals of a species is the basis of evolution.	Mutations are the basis of evolution.
(*ii*)	Darwinian variations are gradual.	de Vries' mutation appear all of a sudden.

Q.14. Explain adaptive radiation with the help of a suitable example.

Ans. Adaptive Radiation

- It is the evolutionary process in which different species starting from a common point in a geographical area radiate to other geographical areas. Examples:
  i. **Darwin's finches**
  - Darwin observed many varieties of finches in the same island.
  - All varieties had evolved from original seed-eating finches.
  - With alteration in beaks some became insectivorous and some vegetarian.

Q.15. Why are the wings of butterfly and birds said to be analogous organs? Name the type of evolution of which the analogous organs are a result of.

Ans. Wings of butterfly and birds are not anatomically similar structures though they perform similar functions. Hence, they are called analogous structures. Analogous organs result from convergent evolution.

Q.16. What do you infer from the resemblance between flying squirrel and flying phalanger with reference to their evolution?

Ans. Evolution of marsupial mammals has resulted in flying phalanger through adaptive radiation. Evolution of placental mammals has led to the evolution of a flying squirrel (independently). The resemblance between the two proves convergent evolution.

Q.17. "Post-industrialisation, the population of melanised moth increased in England at the expense of white-winged moths." Provide explanations.

Ans. Pre-industrialisation period had more white winged moth against grey lichens on tree trunks. During industrialisation large amount of soot and smoke deposited on tree trunks, making the bark dark. Against the dark background white moths could easily be preyed upon. Melanised moth could camouflage against dark bark. This natural selection increased their number.

Q.18. Explain the increase in the numbers of melanic (dark winged) moths in the urban areas of post-industrialisation period in England.

Ans. During post-industrialisation period, the tree trunks became dark due to accumulation of industrial smoke and soot. Under this condition the white-winged moth was easily spotted by the predators against the dark background. Whereas the dark-winged or melanised moth camouflaged against the dark background and survived.

Q.19. In England, during the post-industrialised period, the count of melanic moths increased in urban areas but remained low in rural areas. Explain.

Ans. Industrial melanism:

- In England, before industrialisation, white-winged moths were more in number than darkwinged moths.
- But after industrialisation, dark-winged moths became more in number than white-winged moths.
- This is because during industrialisation, the tree trunks covered by white lichens became dark due to deposition of dust and coal particles.
- As a result, white-winged moths could be easily picked up by predators from the dark background and dark-winged moths survived.

Q.20.

(*a*) (*b*)

What do these pictures 'a' and 'b' illustrate with reference to evolution? Explain.

Ans.

a. A white-winged moth and dark-winged moth on a tree trunk in an unpolluted area.
b. A white-winged moth and a dark-winged moth on a tree trunk in a polluted area.

These pictures depict industrial melanism. In England, it was observed before industrialisation that white-winged moth were more than dark-winged moth. But the situation reversed after industrialisation.

Q.21. Explain the interpretation of Charles Darwin when he observed a variety of small black birds on Galapagos Islands.

Ans.

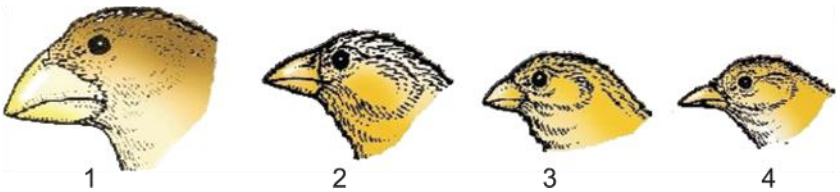
In Galapagos Islands, the small black birds amazed Darwin and he later called them finches. He realised that there were many varieties of finches in the same island. All the varieties evolved on the island itself. This process of evolution was called adaptive radiation, According to Darwin this evolution was based on available resources, food and space. There is survival of the fittest.

Q.22. How do Darwin's finches illustrate adaptive radiation?

Ans. Darwin during his journey to Galapagos Islands observed that there were many varieties of small black birds later called Darwin's finches.

- All the varieties he conjectured, evolved on the island itself.
- From the original seed-eating features, many other forms with altered beaks arose, enabling them to become insectivorous and vegetarian finches.
- This process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called adaptive radiation.

Q.23.



a. Write your observations on the variations seen in the Darwin’s finches shown above.
b. How did Darwin explain the existence of different varieties of finches on Galapagos Islands?

Ans.

a. By the process of evolution many other forms with altered beaks, arose from the original seed-eating features, enabling them to become insectivorous and vegetarian finches.
b. Darwin explained it as the process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats), called adaptive radiation.

Q.24. Anthropogenic action can hasten the evolution. Explain with the help of a suitable example.

Ans.

Excessive use of herbicides, pesticides, etc., has only resulted in selection of resistant varieties in a much lesser time scale which is equally true for microbes against which we employ antibiotics or drugs against eukaryotic organisms/cells. As a result of which resistant organisms/cells are appearing in a time scale of months or years and not centuries. For example, when the DDT was used for the first time, maximum mosquitoes died but few survived due to variation in a population. These mosquitoes show resistance to DDT and survived to reproduce successfully in the presence of DDT and gradually such mosquito population become DDT resistance, following natural selection.

Q.25. With the help of any two suitable examples explain the effect of anthropogenic actions on organic evolution.

Ans. Industrial melanism:

- In England, before industrialisation, white-winged moths were more in number than darkwinged moths.
- But after industrialisation, dark-winged moths became more in number than white-winged moths.
- This is because during industrialisation, the tree trunks covered by white lichens became dark due to deposition of dust and coal particles.

- As a result, white-winged moths could be easily picked up by predators from the dark background and dark-winged moths survived .

Chemical resistance:

- Excessive use of herbicides and pesticides has resulted in evolution of resistant varieties of microbes in much lesser time scale.
- As a result, pathogenic bacteria are appearing in very short period.

Q.26. According to the Darwinian theory, the rate of appearance of new forms is linked to their life cycles. Explain.

Ans.

Microbes have a very short life cycle and divide fast. They can produce millions of organisms within few hours. Thus, it is easy to see variant population in less span of time. On the other hand, higher organisms have a long time span and the variations are not visible fast.

Q.27. What does the following equation represent? Explain.

$\boldsymbol{p^2 + 2pq + q^2 = 1}$

Ans.

The equation represents Hardy-Weinberg's Principle which states that allele frequencies in a population are stable and is constant from generation to generation. 1 represents stable allelic frequency indicating no evolution occurring. *p* represents frequency of homozygous dominant (AA), 2 *pq* represents frequency of heterozygous (Aa) and *q* represents frequency of homozygous recessive (aa).

Q.28. State Hardy–Weinberg principle of genetic equilibrium. Knowing that genetic drift disturbs this equilibrium, mention what does this disturbance in genetic equilibrium lead to.

Ans. Hardy–Weinberg principle states that gene pool remains constant, *i.e.*, the allele frequencies in a population are stable and remains constant from generation to generation. Genetic drift refers to change in allele frequencies of a population occurring by chance. The change in allele frequency may be so different that the population becomes a different species. This effect is called founder effect.

Q.29. Discovery of lobefins is considered very significant by evolutionary biologists. Explain.

Ans. Lobefins were fish-like animals with stout and strong fins that lived both on water as well as on land. Their discovery is significant as they prove that amphibians have evolved from fish-like organisms. Lobefins are ancestors of modern day frogs and salamanders.

Q.30.

a. Rearrange the following in an ascending order of evolutionary tree: reptiles, salamanders, lobefins, frogs.
b. Name two reproductive characters that probably make reptiles more successful than amphibians.

Ans.

a. Lobefins, frogs, salamanders, reptiles
b. Reptiles are more successful than amphibians as:
    i. reptiles lay eggs on land.
    ii. reptiles lay thick shelled eggs which do not dry up in sun unlike those of amphibians.

Short Answer Questions-I (OIQ)

[2 Mark]

Q.1. What was the composition of the primitive atmosphere that favoured abiotic origin of life on earth?

Ans. The primitive earth or primordial earth contained large amounts of hydrogen, nitrogen, water vapour, ammonia and gases evolved from molten lava but no free oxygen was found. The primitive atmosphere was reducing which favoured abiotic origin of life.

Q.2. What are we referring to when we say 'simple organisms' or 'complex organisms'?

Ans. These are the terms to classify organisms according to their evolutionary history. Simple organisms have simple structural and functional organisation and are considered primitive, whereas complex organisms have complex structural and functional organisation and are said to have arise from simple organisms.

Q.3. Who proposed the theory of origin of life? What were the conditions prevailing about 3.6 billion years ago, to create life on primitive earth?

Ans. Oparin and Haldane proposed the theory of origin of life. Initially, on the primitive earth there was no atmosphere. The volcanic eruption and molten mass released water vapour, methane, carbon dioxide, and ammonia which formed earth's atmosphere. The earth's atmosphere was reducing one, *i.e.*, no free oxygen was present. Huge amount of energy was liberated from lightning, and UV rays as there was no ozone layer.

Q.4. What is Oparin–Haldane theory? Can life be originated abiotically inside the laboratory today?

Ans.

Oparin–Haldane's theory states that the first life form originated from non-living organic molecules like RNA, protein, etc. Yes, life can be originated abiotically inside the laboratory under controlled conditions.

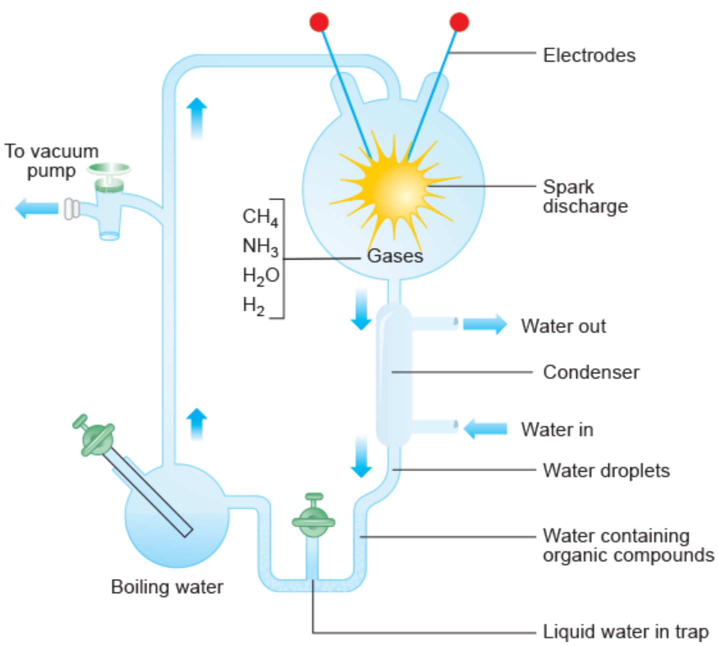
Q.5. What is meant by abiotic synthesis? Who proposed the idea and who supported it experimentally?

Ans.

Abiotic synthesis means origin of life from non-living constituents, *i.e.*, chemical evolution of life states that diverse organic molecules were synthesised from inorganic constituents. These complex organic molecules adapt to autocatalyst property, *i.e.*, self-duplication or self-replication. This idea was proposed by Oparin and Haldane. It was experimentally proved by Urey and Miller.

Q.6. Diagrammatically represent the experimental set up that proves Oparin–Haldane hypothesis.

Ans.



Diagrammatic representation of Miller's experiment

Q.7. What is the study of fossils called? Mention any three points how the fossils throw light on past life.

Ans.

Study of fossils is called paleontology.
The fossils throw light on past life in following ways:

i. Distribution of fossil gives information about habitat of an organism.
ii. Establishes phylogenetic links.
iii. Some fossils provide evidence of connecting link.
iv. Age of the organisms can be determined by fossils.
v. Fossils also throw light on morphology and anatomy of past life.

Q.8. During an excavation assignment, scientists collected pollen grains of a plant preserved in deeper layers of soil. Analyse the properties of pollen grains which help in the fossilization.

Ans.

Pollen has an outer layer called exine which is made of sporopollenin.
It is the most resistant organic material known. It can withstand high temperature, strong acids and alkali as well. No enzyme that degrades sporopollenin is so far known.

Q.9. Define homologous organ. Give one example of an organ homologous to hand of man.

Ans.

The organs with same structural design and developmental origin but differing in their functions are called homologous organs. Forelimbs of human being are homologous to forelimbs of whales and bats.

Q.10. Define analogous organ. Give one example of an organ analogous to human hand.

Ans.

The organs with different structural designs and developmental origin but performing similar functions are called analogous organs. Trunk of an elephant is analogous to human hand.

Q.11. Give one example of analogy and homology in plants.

Ans.

Homology: Tendrils of *Cucurbita* and thorns of *Bougainvillea*.
Analogy: Sweet potato (root modification) and potato (stem modification) to store food.

Q.12. What is meant by analogous organ? Taking a suitable example, explain how they support the theory of organic evolution.

Ans.

The organs which have different developmental origin and structural design but perform similar functions are called analogous organs. The wings of birds and insects are analogous organs indicating that they have different ancestors but show a convergent evolution.

Q.13. What is meant by homologous organ? Taking suitable example, explain how they support the theory of organic evolution.

Ans.

The organs which have same basic structural design and development origin but differ in their uses and functions are called homologous organs. The forelimbs of some animals have similar anatomical structure. They possess humerus, radius, ulna, carpals, metacarpals and phalanges in their forelimbs, *e.g.*, forelimbs of man, whales, bats, cheetah, indicates that they have common ancestors, thus supporting organic evolution.

Q.14. Amongst pea tendrils, *Opuntia* spines, lemon thorns, and *Cucurbita* tendrils, which are homologous structures? Why do you call them homologous?

Ans.

Opuntia spines and pea tendrils are homologous because both are leaf modifications. Lemon thorns and *Cucurbita* tendrils are homologous because both are modified stems having same basic design and developmental origin but different functions.

Q.15. How do you consider tendrils of *Cucurbita* and thorns of *Bougainvillea* as homologous structure?

Ans.

Both of them are stem modifications and thus are structurally similar but both have different functions. Thus, they are homologous structures as tendrils and thorns both arise in axillary position and hence are modified branches but tendrils help in climbing and thorns protect the plant.

Q.16. What is speciation? List any two events leading to speciation.

Ans.

The process involving formation of new species from the existing species is called speciation.
Two events leading to speciation are:

i. Interbreeding among different populations or species.
ii. Migration.

Q.17. What was Lamarck's theory of evolution? Explain the theory by quoting an example.

Ans.

Lamarck's theory of evolution states that use and disuse of an organ can bring about a change in that organ which is then acquired and passed on to the next generation, *e.g.*, the long neck of giraffe was explained by Lamarck, as an outcome of these animal to stretch their neck constantly to eat the leaves from the upper branches of the trees.

Q.18. Define biogeography. How do Darwin's finches provide the biogeographical evidence in favour of evolution?

Ans.

The study of distribution of various organisms in different parts of the earth is called biogeography. All the varieties of Darwin's finches have evolved on the same island itself from a common seed-eating ancestor due to adaptive radiation.

Q.19. Give two examples of biogeographical evidence in favour of evolution.

Ans.

i. Darwin's finches
ii. Australian marsupials

Q.20. How do Darwin's finches illustrate adaptive radiation?

Ans.

Original stock of seed eating finches migrated to different habitats (of Galapagos Islands), adapted to different feeding methods, by altered beak structure, evolved into different types of finches.

Q.21. Explain the concept of differential reproduction as a major component of theory of natural selection.

Ans. The rate of reproduction among the different individuals in a population varies. Some produce more offsprings and some produce only few offsprings. This biological phenomenon is called differential reproduction. So, the reproductively fit individual produces more offsprings than other. They are thus selected by nature to survive and evolve into new species.

Q.22. Protein synthesis machinery revolves around RNA but in the course of evolution it was replaced by DNA. Justify.

Ans. Since RNA was unstable and prone to mutations, DNA evolved from RNA with chemical modifications that makes it more stable.

DNA has double stranded nature and has complementary strands. These further resist changes by evolving a process of repair.

Q.23. What is the significance of *Archaeopteryx* in the study of organic evolution?

Ans.

Archaeopteryx is a connecting link between reptiles and birds. It shows features of both birds and reptiles giving an evidence that birds have evolved from reptiles.

Q.24. Explain briefly how the principle of natural selection can be applied to the development of resistance in mosquitoes for DDT.

Ans. When DDT was used for the first time, maximum mosquitoes died but few survived due to variation in the population. These mosquitoes showed resistance to DDT and survived to reproduce successfully in the presence of DDT and gradually such mosquito population became DDT resistant due to natural selection.

Q.25. How does Darwin's theory of Natural Selection explain the appearance of new forms of life on earth?

Ans.

Darwinian theory of evolution

- Charles Darwin, based on his observations during a sea voyage around the world in the ship H.M.S. Beagle, concluded the following:
- Varying degrees of similarities can be observed between existing life forms and those that existed millions of years ago.
- There has been **gradual evolution** of life forms with new forms arising at different periods of history.
- Any population has built-in variations in characteristics which adapt it better to environment.
- The characteristics which enable some populations or individuals to survive better in natural conditions (climate, food, physical factors) would out-breed others **(Survival of the fittest)**.
- Those populations which are better fit (reproductively fit) in an environment will be selected by nature and will survive more **(Natural selection)**.
- Adaptability is inherited and fitness is the end result of ability to adapt and get selected by nature.

Q.26. Birds have evolved from reptiles. How does paleontology provide evidence in support of the above statement?

Ans. The fossil *Archaeopteryx* is a connecting link between reptiles and birds and provide evidence that birds have evolved from reptiles. Its features are:

i. It has beak and wings like that of a birds.
ii. It has teeth and scales like that of a reptiles.

Q.27. What do you understand by differential reproduction and reproductive isolation? In what context are these term used?

Ans.

Differential reproduction: The phenomenon in which all organisms who reach reproductive stage reproduce with varying degree of success, some reproduce more offsprings and some reproduce only few and other reproduce none depending upon their degree of fitness.
Reproductive isolation: The biological phenomenon in which the individual belonging to same species reproduce among themselves, to maintain the species integrity. Both these terms are used in reference to natural selection.

Q.28. If abiotic origin of life is in progress on a planet other than earth, what should be the condition there? Explain.

Ans. The atmosphere will be reducing, *i.e.*, no free oxygen will be present. There must be continuous supply of energy like that from lightning, thunder, volcanic eruption and stellar radiation. The presence of autocatalyst or self-replicating molecules is essential.

Q.29. What must have provided energy for the warmth for life to originate on primitive earth? Name the first organism to release oxygen into the atmosphere.

Ans. Energy for life to originate must have been provided by heat, cosmic rays and lightning. Cyanobacteria was the first organism to release oxygen into the atmosphere.

Q.30. While creation and presence of variation is directionless, natural selection is directional as it is in the context of adaptation. Comment.

Ans. Creation and variation occur in a sexually reproducing population as a result of crossing-over during meiosis and random fusion of gametes. It is however the organisms that are selected over a period of time which are determined by the environmental conditions. In other words, the environment provides the direction with respect to adaptations so that the organisms are more and more fit in terms of survival.

Q.31. Gene flow occurs through generations and can occur across language barriers in humans. If we have a technique of measuring specific allele frequencies in different population of the world, can we not predict human migratory patterns in pre-history and history? Do you agree or disagree? Provide explanation to your answer.

Ans. Yes, I agree. Gene flow occurs through generations. By studying specific allele frequencies, we can predict the human migratory patterns in pre-history and history. Studies have used specific genes/chromosomes/mitochondrial DNA to trace the evolutionary history and migratory patterns of humans. (The project is known as the Human Genographics Project).

Q.32. In a certain population, the frequency of three genotypes is an followers.
Genotypes: BB Bb bb
Frequency: 22% 62% 16%
What is the likely frequency of B and b alleles?

Ans.

Frequency of B allele = all of BB + ½ of Bb = 22 + 31 = 53%
Frequency of b allele = all of bb + ½ of Bb = 16 + 31 = 47%.

Q.33. How can you say the lobefin fish were the ancestors of amphibian?

Ans. Lobefins fish have stout and strong fins, so they can move on land and swim in water to maintain a dual lives like amphibians.

Q.34. Fill in the blank (*i*), (*ii*), (*iii*), (*iv*) with name of the mammals of Australia.

Placental mammal	Marsupial mammal
Anteater	(*i*)
(*ii*)	Spotted cuscus
Bob cat	(*iii*)
(*iv*)	Tasmanian wolf

Ans.

i. Numbat
ii. Lemur
iii. Tasmanian tiger cat
iv. Wolf