Short Answer Questions-II (PYQ)

[3 Marks]

Q.1. State the theory of Biogenesis. How does Miller's experiment support this theory?

Ans. The theory of biogenesis states that a living organism arises from another living organisms.

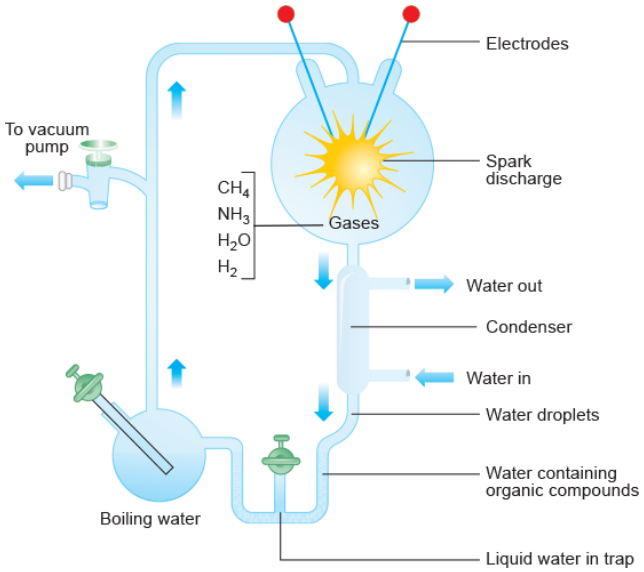
For Miller's experiment

Experimental evidence of chemical evolution/Miller's experiment

- Experiment was performed by S.L. Miller and H.C. Urey in 1953.
- **Experimental set-up:** 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.
- **Observations:** After a week, they observed presence of amino acids and complex molecules like sugars, nitrogen bases, pigments and fats in the flask.
- **Conclusions:.**
  i. It provides experimental evidence for the theory of chemical origin.
  ii. It showed that the first non-cellular form of life was created about 3 billion years ago.
  iii. It showed that non-cellular biomolecules exist in the form of DNA, RNA, polysaccharides and protein.

Q.2. Diagrammatically represent the experimental set up that proved Oparin-Haldane hypothesis.

Ans.

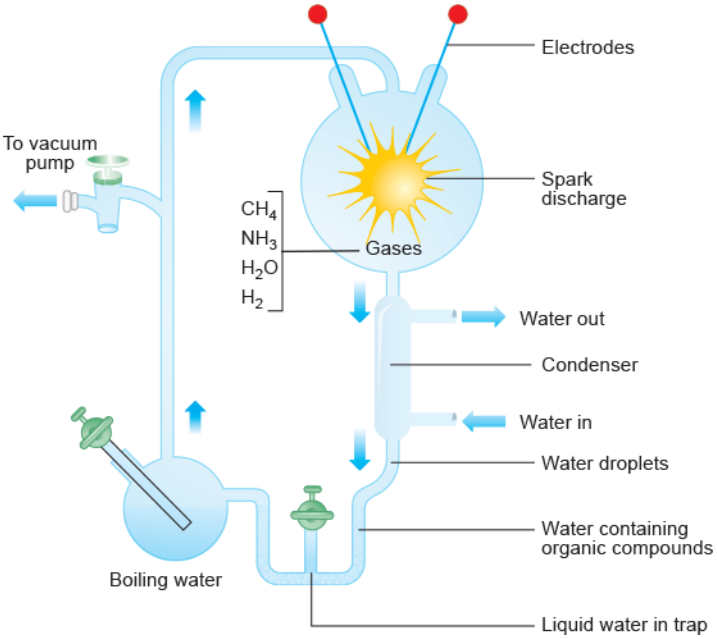


Diagrammatic representation of Miller's experiment

Q.3. Describe the experiment of S.L. Miller on the origin of life. Write the conclusion drawn at the end of the experiment.

Ans.

Experimental evidence of chemical evolution/Miller's experiment



- Experiment was performed by S.L. Miller and H.C. Urey in 1953.
- **Experimental set-up:** 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.
- **Observations:** After a week, they observed presence of amino acids and complex molecules like sugars, nitrogen bases, pigments and fats in the flask.
- **Conclusions:.**
  i. It provides experimental evidence for the theory of chemical origin.
  ii. It showed that the first non-cellular form of life was created about 3 billion years ago.
  iii. It showed that non-cellular biomolecules exist in the form of DNA, RNA, polysaccharides and protein.

Q.4. State the contribution of Louis Pasteur in understanding the origin of life on earth. Explain the procedure that he followed to arrive at his conclusion.

Ans.

Louis Pasteur dismissed the theory of spontaneous generation and demonstrated that life came from pre-existing life. He took two long-necked flasks. He left one flask with a

straight neck and the other was bent to from an ‘S’ shape. He put sterile broths in both the flasks. He placed killed yeast in pre-sterilised bent flask and the other flask was left open to air.

After several weeks he observed that the straight neck flask was discoloured and cloudy, while the curved flask had not changed. Thus he concluded that the germs in air were able to fall unobstructed down the straight necked flask while they got trapped in the curved flask.

Q.5. How do fossils help us in understanding the evolutionary history?

Ans. Paleontological evidences

- The study of fossil is called **paleontology**.
- **Fossils** are the remains or impressions of past organisms preserved in sedimentary rocks or other media.
- Different-aged rock sediments in earth’s crust indicate the presence of fossils of different life forms which died during the sediment formation.
- A variety of fossils ranging from the modern organisms to extinct organisms can be observed.
- By studying the different sedimentary layers, the geological time period in which the organism existed can be predicted.

Q.6. What are analogous structures? How are they different from homologous structures? Provide one example for each.

OR

Differentiate between homology and analogy. Give one example of each.

Ans.

Homology	Analogy
1. Organisms having the same structure developed along different directions due to adaptations/ different functions. 2. Result of divergent evolution. 3. Indicates common ancestry. 4. Anatomically same structures. 5. **Example:** Forelimbs of whale—bats—cheetah—human// Thorns of *Bougainvillea* and tendrils of *cucurbits*	1. Different structures having the same function (in different organisms). 2. Result of convergent evolution. 3. Does not indicate common ancestry. 4. Anatomically different structures. 5. **Example:** Wings of butterfly and birds, Sweet potato and potato

Q.7.

a. **What is adaptive radiation?**
b. **Explain with the help of a suitable example where adaptive radiation has occurred to represent convergent evolution.**

OR

What is adaptive radiation? When can adaptive radiation be referred to as convergent evolution? Give an example.

Ans.

a. The process of evolution of different species in a given geographical area starting from a point and radiating to other areas of geography (habitats) is called adaptive radiation.
b. When more than one adaptive radiation occurs in an isolated geographical area (representing different habitats), it can be called as convergent evolution.
For example, similarity between some individual members of placental mammals and marsupial mammals argues strongly that they are the result of convergent evolution. These animals have similar forms because of evolution in different, isolated areas because of similar selective pressures in similar environments. This means marsupials in Australia resemble placental mammals in the rest of the world. They evolved in isolation after Australia separated from other continents.

Q.8.

a. **Explain adaptive radiation with the help of a suitable example.**
b. **Cite an example where more than one adaptive radiations have occurred in an isolated geographical area. Name the type of evolution your example depicts and state why it is so named.**

Ans.

a. Adaptive radiation can be observed in black birds of Galapagos islands, which are also called Darwin's finches. These birds evolved on the island itself from the original seed eating features. Many forms with offered beaks arose which enabled them to become insectivorous and vegetarian in different habitats of the island.
b. More than one adaptive radiation have occurred in Australian marsupials and placental mammals.
The example depicts convergent evolution. It is named so, because more than one adaptive radiation occurred in isolated geographical area.

Q.9. Describe the three different ways by which Natural Selection can affect the frequency of a heritable trait in a population.

Ans. Natural selection: Heritable variations that enable survival of the fittest will leave greater number of progeny. Natural selection can have following three effects:

a. **Stabilisation:** Larger number of individuals acquire mean character value so peak gets higher and narrower.
b. **Directional change:** Large number of individuals acquire value other than mean character value so peak shifts in one direction.
c. **Disruption:** Large number of individuals acquire peripheral character values at both ends of the distribution curve and hence 2 peaks are formed.

Q.10. How does industrial melanism support Darwin's theory of Natural Selection? Explain.

Ans. Before industrial revolution the environment was unpolluted. The lichens on the barks of trees were pale. The white-winged moths could easily camouflage, while the dark-winged were spotted out by the birds for food. Hence, they could not survive. After industrial revolution the lichens became dark (due to soot deposit). This favoured the dark-winged moths while the white-winged were picked by birds. The population of the former which was naturally selected increased.

Q.11. Differentiate between the explanations given by Darwin and de vries respectively on the mechanism of evolution.

Ans.

S. No.	Darwin's evolution	de Vries' evolution
(*i*)	According to Darwin, evolution was gradual (stepwise).	According to de Vries, evolution occurred in a single step (saltation).
(*ii*)	Variations and natural selection occurs through a number of generations and are responsible for speciation.	Single step mutation caused speciation.
(*iii*)	Darwin's variations are small and directional.	de Vries' mutations are random and directionless.

Q.12. $p^2 + 2pq + q^2 = 1$. Explain this algebraic equation on the basis of Hardy Weinberg's principle.

Ans. In a diploid if *p* represents the frequency of allele A and *q* represents the allele frequency of a, then frequency of AA individuals in a population is p^2 . Similarly of aa is q^2 and of Aa is $2pq$. Hence $p^2 + 2pq + q^2 = 1$. This is a binomial expansion of $(p+q)^2$.

According to Hardy–Weinberg principle, total genes and their alleles in a population or gene pool remains constant. This is called genetic equilibrium. Sum total of all the allelic frequencies is 1 [$p+q = 1/(p+q)^2 = 1$].

Q.13. How does Darwin's theory of Natural Selection explain the appearance of new forms of life on earth?

Ans.

Darwin's theory of natural selection:

- Varying degrees of similarities can be observed between existing life forms and those existing 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 the 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.14.

a. How does the Hardy–Weinberg's expression ($p^2 + 2pq + q2 = 1$) explain that genetic equilibrium is maintained in a population?
b. List any two factors that can disturb the genetic equilibrium.

Ans.

a.

i. Sum total of all the allele frequencies is 1: Let there be two alleles *A* and a in a population. The frequencies of alleles *A* and *a* are *p* and *q*, respectively. The frequency of *AA* individual in a population is *p*2 and it can be explained that the probability that an allele *A* with a frequency of *P* appear on both the chromosomes of a diploid individual is simply the product of the probabilities, *i.e.*, p^2 . Similarly, the frequency aa is q^2 and that of *Aa* is 2*pq*. $p^2 + 2pq + q^2 = 1$, where p^2 represents the frequency of homozygous dominant genotype, 2*pq* represents the frequency of the heterozygous genotype and represents the frequency of the homozygous recessive.

ii. Genetic equilibrium states the status of evolution. If there is some fluctuation or disturbance in genetic equilibrium or Hardy–Weinberg equilibrium, *i.e.*, change of frequencies of alleles in a population then it can predicted that evolution is in progress.

b. Factors that affect Hardy–Weinberg equilibrium:

i. Gene migration or gene flow
ii. Genetic drift

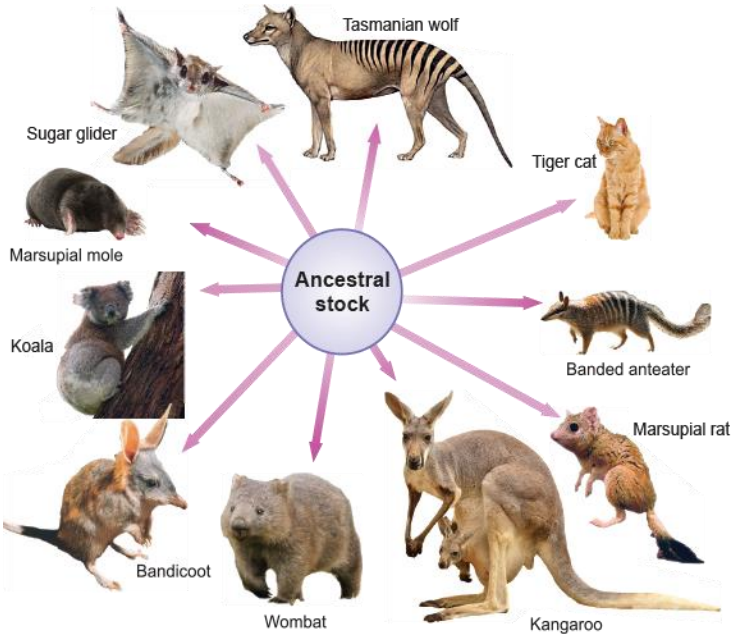
iii. Mutation

Q.15. What is disturbance in Hardy-Weinberg genetic equilibrium indicative of? Explain how it is caused.

Ans. Disturbance in Hardy-Weinberg equilibrium is an indicator of change of frequency of allele in a population, resulting in evolution.
It is caused by any of the following factors:

i. Genetic drift
ii. Gene flow or gene migration
iii. Mutation
iv. Genetic recombinations
v. Natural selection

Q.16. Name and explain the evolutionary concept represented in the illustration given below:



Ans.

The illustration represents adaptive radiation.
For explanation, refer to Basic Concepts Point 6(*iii*).

Q.17. Evolution is a change in gene frequencies in a population in response to changes in the environment in a time scale of years and not centuries. Justify this statement with reference to DDT. How does the theory of Hugo de Vries support this?

Ans.

When 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 resistant within a time span of few years.
According to Hugo de Vries, evolution is caused by sudden large differences in the population and not minor variations.

Q.18. Rearrange *Ramapithecus, Australopithecus* and *Homo habilis* in the order of their evolution on the Earth. Comment on their evolutionary characteristics.

Ans. The order of evolution on the earth is:

Ramapithecus → Australopithecus → Homo habilis

Ramapithecus were hairy and walked–like gorilla and chimpanzees. They were more man like.
Australopithecus hunted with stone weapons and ate fruit.
Homo habilis had a brain capacity 650-800 cc and probably did not eat meat.

Q.19. Write the characteristics of *Ramapithecus, Dryopithecus*, and Neanderthal man.

Ans.

Ramapithecus: hairy, walked–like gorillas and chimpanzees, more man like.
Dryopithecus: hairy, walked–like gorillas and chimpanzees, more ape-like.
Neanderthal man: brain size is 1400c, used hides to protect their body, buried their dead.

Q.20. Answer the following questions.

Q. State Oparin–Haldane's hypothesis.

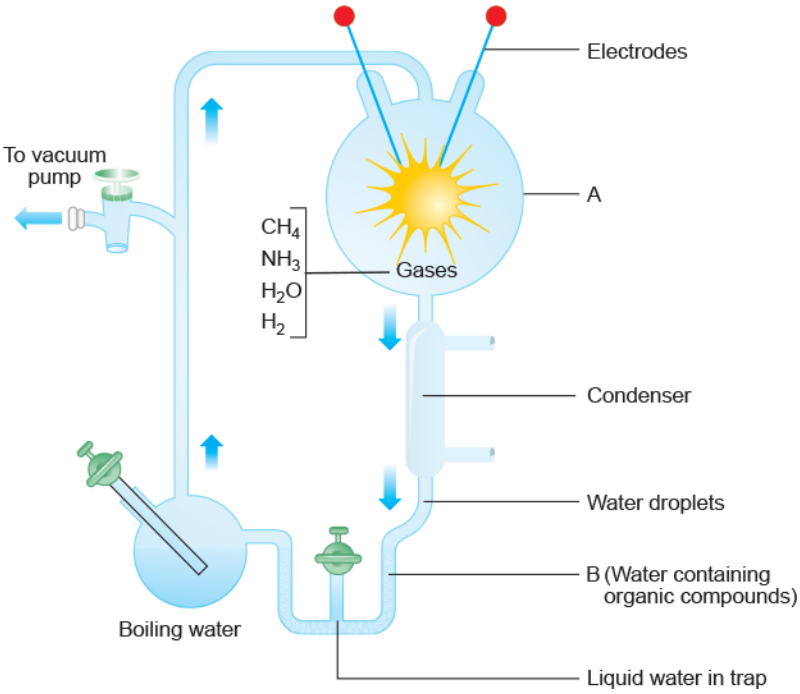
Ans. Oparin-Haldane's hypothesis states that life could have come from pre-existing non-living organic molecules and that formation of life was preceded by chemical evolution.

Q. How does S.L. Miller's experiment supports it?

Ans.

i. It provides experimental evidence for the theory of chemical origin.
ii. It showed that the first non-cellular form of life was created about 3 billion years ago.
iii. It showed that non-cellular biomolecules exist in the form of DNA, RNA, polysaccharides and protein.

Q.21. Given below is a diagrammatic representation of the experimental set-up used by S.L. Miller for his experiment:

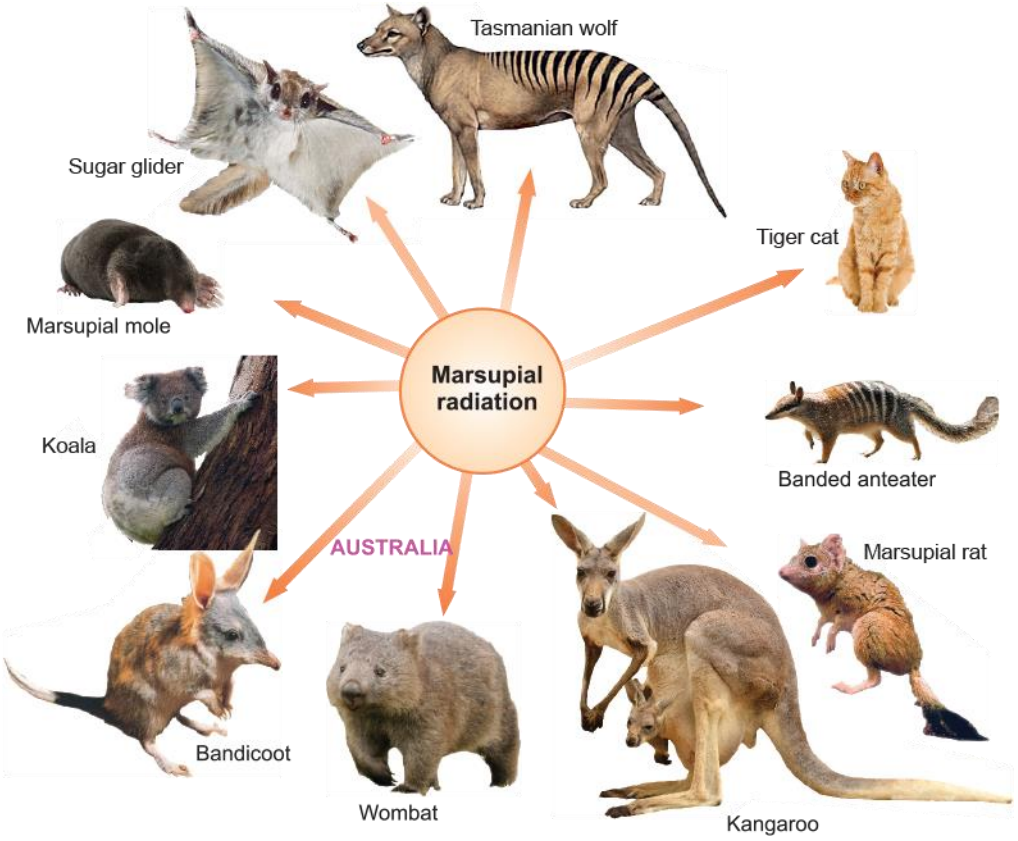


a. Write the names of different gases contained and the conditions set for the reaction in the flask 'A'.
b. State the type of organic molecule he collected in the water at 'B'.
c. Write the conclusion he arrived at.

Ans.

a. The gases obtained are CH_4, H_2, NH_3 and water vapour. The closed flask, electric discharge was created at 800°C.
b. Amino acids were collected in the water at 'B'.
c. He arrived at the conclusion that life came from pre-existing non-living organic molecules and that formation of life was preceded by chemical evolution.

Q.22.



a. Mention the specific geographical region where these organisms are found.
b. Name and explain the phenomenon that has resulted in the evolution of such diverse species in the region.
c. Explain giving reasons the existence of placental wolf and Tasmanian wolf sharing the same habitat.

Ans.

a. Australia.
b. Adaptive radiation (Divergent evolution) has resulted in this evolution. The process of evolution of different species in a given geographical area starting from a point and radiating to other areas of geography (habitats) is called adaptive radiation. It is the development of different functional structures from a common ancestral form.
c. Placental wolf and Tasmanian wolf share similar habitat due to convergent evolution and evolved into unrelated group of organisms.

Q.23. Since the origin of life on Earth, there were five episodes of mass extinction of species.

i. How is the 'Sixth Extinction', presently in progress, different from the previous episodes?
ii. Who is mainly responsible for the 'Sixth Extinction'?

iii. List any four points that can help to overcome this disaster.

Ans.

i. The current species extinction rate are estimated to be 100-1000 times faster than in the pre-human times.
ii. Human activities.
iii.
    a. Preventing habitat loss and fragmentation
    b. Checking overexploitation
    c. Preventing alien species invasion
    d. Preventing co-extinction
    e. Conservation/Preservation of species.

Short Answer Questions-II (OIQ)

[3 Marks]

Q.1. Whose theory was put to test by Miller and Urey and what was the theory? How did their experiment give due to abiotic origin of life on earth?

Ans. Urey and Miller tested the theory of Oparin and Haldane, which states that life originated on the earth through physiochemical processes of atoms combining to form molecules which in turn react to produce inorganic and organic compounds. Miller and Urey created the similar environment as described by Oparin and Haldane in laboratory using glass apparatus and tubes. They took CH_4, NH_3, H_2O, H_2 and water vapour for their experiment and supplied electric discharge using cathode in a closed flask at 800°C. After a week, it was observed that a number of complex organic molecules have originated, *e.g.*, some sugars, nitrogen bases, amino acids and lipids. 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.2. What are fossils? Mention any two ways in which the study of fossils support biological evolution of an organism.

Ans. Fossils are the remains or impressions of pre-historic organisms preserved in sedimentary rocks or other media.

Two ways in which study of fossils support biological evolution:

i. The study of *Archaeopteryx* reveals that birds have evolved from reptiles. This shows fossils provide evidence for evolution.
ii. Phylogeny can be constructed from fossils.
iii. The habitat and behaviour of extinct organisms can be inferred from well-preserved fossils.

Q.3. What is natural selection? How is artificial selection different from natural selection? Give one example each from plants and animals where artificial selection has operated.

Ans. The nature builds some pressure on the population of a species and as a result few individuals are eliminated and few adapt to adjust with changes and become fit. This biological phenomenon is called natural selection.

S. No.	Natural selection	Artificial selection
(*i*)	It is a natural phenomenon.	It is the practice done by man.
(*ii*)	As a result only fit individual increases in a population.	As a result commercially high yielding and disease resistance varieties increase.

Artificial selection have been operated in the followings cases:
Plants: Cabbage, wheat.
Animals: High milk yielding varieties of cows.

Q.4. Write in what context did Darwin use the terms 'fitness', 'survival' and 'selection' while elaborating on the mechanism of evolution.

Ans. According to Darwin, fitness refers to reproductive fitness. A fit species will leave more progenies. This will result in greater chances of survival.
Greater the number of progenies which will survive, more they will be selected by nature to continue the species. This is called natural selection.

Q.5. What type of organs eye of an Octopus and that of a human called? Give another example from the animal group and one from the plants of such organs. Name and explain the evolutionary process they exhibit.

Ans. These organs are called analogous organs. Another example from animal group is flippers of penguins and dolphins or eye of octopus and mammals
In plants, these organs can be seen in sweet potato (root modification) and potato (stem modification).
They are anatomically dissimilar structure though they perform similar function. This type of evolution is called convergent evolution.

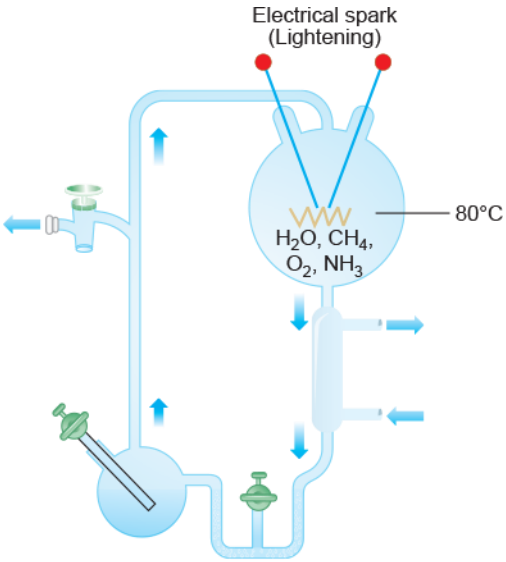
Q.6.

a. **Name the ancestors of progymnosperm.**
b. **Name the ancestors of herbaceous and arborescent lycopod.**
c. **Name the ancestors of cycads.**

Ans.

a. *Psilophyton*
b. *Zosterophyllum*
c. Progymnosperm.

Q.7. A student was simulating Urey and Millers experiment to prove the origin of life. The set up used by the student is given



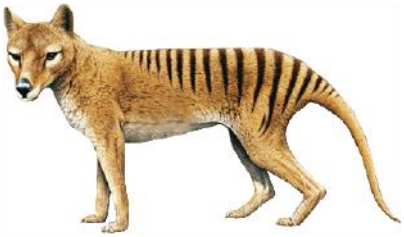
a. Find out the reasons why he could not get desired results.
b. What conclusion was drawn by Urey and Miller through this experiment?
c. Compare the conclusion drawn with the theory of spontaneous generation.

Ans.

a. He could not get desired results because:
   i. O_2 was used instead of H_2.
   ii. Temperature maintained was 80°C instead of 800°C.
b. It was concluded that life could have come from pre-existing non-living organic molecules and their formation was preceded by chemical evolution.
c. Urey and Miller observed formation of amino acids when in a closed flask CH_4, H_2, NH_3 and water vapour were heated at 800°C in presence of electric discharge. Analysis of meteorite content also reveals similar compounds indicating that similar process are occurring elsewhere in space (Chemical evolution). Urey and Miller proved that life originated abiogenetically whereas theory of spontaneous generation emphasised that units of life called spores were transferred to different planets including Earth.

Q.8. Refer to the figure given below and answer the questions that follow:

Wolf



Tasmanian wolf

a. Recognize and explain the process by which Tasmanian wolf evolved.
b. Give one example of an animal that has evolved along with Tasmanian wolf.
c. Compare and contrast the two animals shown?

Ans.

a. Adaptive radiation: It is 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).
b. Tiger cat/banded ant eater/Marsupial rat
c. Wolf is a placental mammal, whereas Tasmanian wolf is a marsupial mammal.