

*(Questions-Answers)**

BIOLOGY

*A Highly Simulated Practice Question Paper for
CBSE Class XII Examination*

Time : 3 hrs

Max. Marks : 70

General Instructions

1. All questions are compulsory.
2. The question paper has four sections: Section A, Section B, Section C and Section D. There are 33 questions in the question paper.
3. Section-A has 14 questions of 1 mark each and 2 case-based questions. Section-B has 9 questions of 2 marks each. Section-C has 5 questions of 3 marks each and Section-D has 3 questions of 5 marks each.
4. There is no overall choice. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.
5. Wherever necessary, neat and properly labelled diagrams should be drawn.

SECTION A

(1 Mark)

1. What are the responsibilities of GEAC setup by the Indian government?
2. Why a small part of the activated sludge is pumped back into aeration tank during secondary treatment of sewage?
3. Give an example of innate immunity.
4. How does the body compensate for low oxygen availability during altitude sickness?
5. Write down some impacts of loss of biodiversity on the environment.
6. Mention the type of allele that expresses itself only in homozygous state in organism.
7. What is the significance of cryopreservation technique for conservation of biodiversity?
8. Name three protozoan diseases in humans.
9. Why Western ghats in India have been declared as biological hotspot?
10. Why are cancer cells able to divide continuously and produce tumours?

Direction (Q. Nos. 11-14)

In each of the following questions, a statement of Assertion (A) is given followed by corresponding statement of Reason (R). Of the statements, mark the correct answer as

- (a) If both A and R are true and R is the correct explanation of A
- (b) If both A and R are true, but R is not the correct explanation of A
- (c) If A is true, but R is false
- (d) If both A and R are false

11. **Assertion** (A) Although geitonogamy is functionally cross-pollination involving a pollinating agent, genetically it is similar to autogamy.

Reason (R) In geitonogamy, pollen grains from the anthers of one flower are transferred to the stigma of another flower borne on the same plant.

12. **Assertion** (A) If the sequence of bases of one DNA strand is known then the sequence of other strand can be predicted.

Reason (R) Both the strands of DNA are complementary to each other.

13. **Assertion** (A) Each antibody is represented by H_2L_2 .

Reason (R) Each antibody molecule has four nucleotide chains, two small called light chains and two longer called heavy chains.

14. **Assertion** (A) Nicotine, caffeine, quinine, strychnine and opium are produced by plants as defences against grazers and browsers.

Reason (R) Thorns of *Acacia* and cactus are most common physiological means of defence.

Or

Assertion (A) All the biodiversity hotspots if put together, cover less than 2% of the earth's land area.

Reason (R) The strict protection of the hotspots could reduce the ongoing mass extinction by almost 2%.

15. **Direction** Read the following and answer any **four** questions from 15(i) to 15(v) given below

Biotechnology deals with techniques of using live organisms to produce products useful to humans. But this manipulation of living organisms is going without regulation. Therefore, some ethical standards are required to evaluate the morality of human activities. In India, Government has setup organisation such as GEAC, which make decisions regarding the validity of GM research and patent issues.

- (i) Biopatent means
 - (a) right to use an invention
 - (b) right to use biological resources
 - (c) right to use applications or processes
 - (d) All of the above
- (ii) A new variety of rice was patented by a foreign company, though such varieties have been present in India for a long time. This is related to
 - (a) Lerma Roja (b) Sharbati Sonora
 - (c) Co-667 (d) Basmati
- (iii) Biopiracy is related to
 - (a) traditional knowledge exploitation
 - (b) biomolecules and regarding bioresources exploitation
 - (c) stealing of bioresources
 - (d) All of the above
- (iv) Which Indian plants have either been patented or attempts have been made to patent them by Western nations for their use?
 - (a) Basmati rice (b) Turmeric
 - (c) Neem (d) All of these
- (v) **Assertion** (A) *Bacillus anthracis* exemplifies how biotechnology can be used for destructive purposes.

Reason (R) The spores of anthrax bacterium were spread via letters in the form of powder.

 - (a) If both A and R are true and R is the correct explanation of A
 - (b) If both A and R are true, but R is not the correct explanation of A
 - (c) If A is true, but R is false
 - (d) If both A and R are false

16. **Direction** Read the following and answer any **four** questions from 16(i) to 16(v) given below

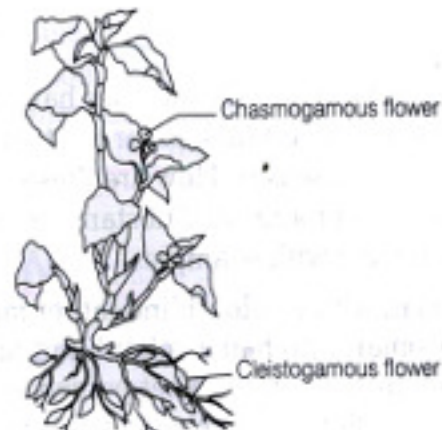
Pollination is the act of transferring pollen grains from male anther of a flower to the female stigma.

The goal of every living organism including plants is to create offspring for the next generation. One of the ways that plants can produce offspring is by making seeds which then germinate to produce new plants. Two types of flowers with their pollination seen in plants are chasmogamy and cleistogamy. Chasmogamous flowers have strikingly coloured petals and nectar guides/nectaries in contrast to cleistogamous flowers which are minute bud-like.

- (i) Cleistogamous flowers are strictly autogamous because, they remain
 (a) always open (b) always close
 (c) always fragraned (d) brightly coloured
- (ii) In chasmogamy, pollination takes place in
 (a) open flower
 (b) closed flower
 (c) large flower
 (d) geitonogamy flower
- (iii) Advantage of cleistogamy is
 (a) higher genetic variability
 (b) more vigorous offspring



- (c) no dependence on pollinators
 (d) vivipary
- (iv) Even in the absence of pollinating agents, seed-setting is assured in
 (a) *Commelina* (b) *Zostera*
 (c) *Salvia* (d) Fig
- (v) Identify the features of the type of flower given below.



Choose the correct conclusions drawn from this figure.

- I. Cleistogamous flowers are not dependent on pollinators.
 II. Chasmogamous flowers are bisexual.
 III. Chasmogamous flowers do not show cross-pollination.
 (a) I and II (b) I and III
 (c) II and III (d) Only I

SECTION B

(2 Marks)

17. A plasmid DNA and a linear DNA (both of the same size) have one site for a restriction endonuclease. When cut and separated on agarose gel-electrophoresis, plasmid shows one DNA band while, linear DNA shows two fragments. Explain.
18. Why all hydrophytes are not pollinated by water?

Or

Name any two hormones and their source organs which are produced only during pregnancy.

19. Analyse the adaptation which is helpful in the survival of Antarctic fish (*Trematomus*) which can remain active even in extremely cold sea water.
20. Which kind of rice is better to be purchased, organically grown or conventionally grown? Give reason.
21. How is the incorporation of cry genes beneficial to several crop plants?
22. 'In a sewage treatment, plant setup to treat the wastewater, a vigorous growth of flocs are seen'. Justify the given statement and also give definition of flocs.

23. Explain the two factors responsible for conferring stability to double helix structure of DNA.

Or

Why did TH Morgan selected *Drosophila melanogaster* to study sex-linked genes for his lab experiments?

24. Explain various methods by which cancer is diagnosed in humans.
25. State the role of local people to control reproduction and other related issues in our country.

SECTION C

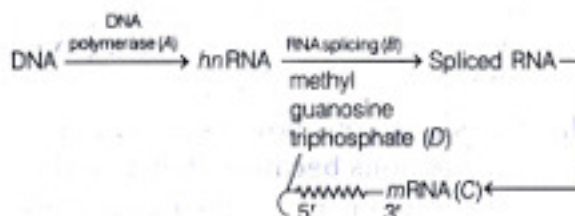
(3 Marks)

26. Recombinant DNA vaccines have proved to be an important tool for the treatment of many diseases. How are these vaccines produced? Substantiate the given fact with examples.
27. A man with a colourblind father marries a woman who had a colourblind mother and normal father. What percentage of male children conceived by this couple will be colourblind?

Or In an organism, genome consisted of double-stranded DNA, where 17% of the bases were confirmed as cytosine. Calculate the expected percentage of the other three nitrogenous bases present in the given DNA.

28. What is meant by organic farming? How does it work as a holistic environment friendly approach?

29. Given below is the sequence of steps of transcription in a eukaryotic cell. Define transcription.



What would be the result if step (D) does not occur during this process?

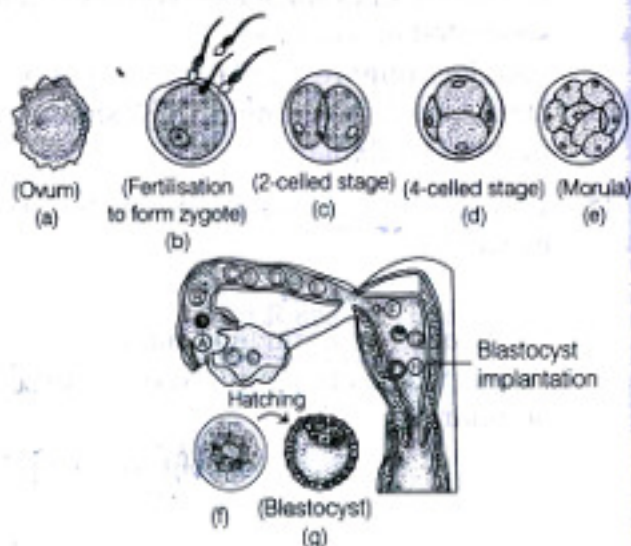
30. Give reason for the following.
(i) Single Nucleotide Polymorphisms (SNPs) identified in human genome can bring out revolutionary changes in biological and medical sciences.
(ii) RNA was the first genetic material.

SECTION D

(5 Marks)

31. Draw and explain a logistic curve for a population of density (N) at time (t) whose intrinsic rate of natural increase is (r) and carrying capacity is (K).
Or Describe the importance of species diversity to the ecosystem as explained by David Tilman and Paul Ehrlich.
32. What are the problems our country will face if its high population growth rate is not controlled? Also write the steps that could be taken by our government to control this problem.
Or The figure given below shows the transport of ovum, fertilisation and

passage of growing embryo through Fallopian tube.

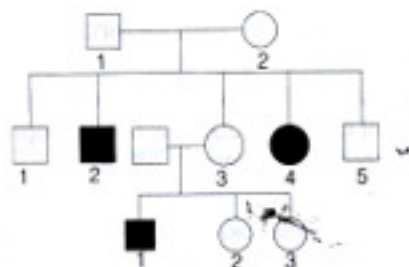


Integrate the stages given in above diagram and compile a report in your own words to describe the process occurring here.

33. Meselson and Stahl performed experiment to prove that DNA replicates semiconservatively. Elaborate their experiment with the help of diagram.

Or

Study the given pedigree chart showing inheritance of sickle-cell anaemia and answer the questions that follows.



- Is the trait recessive or dominant?
- Is the trait sex-linked or autosomal?
- Give the genotype of the parents.
- If both parents are carriers of sickle-cell anaemia what are the chances of pregnancy resulting in an affected child?

EXPLANATIONS

- The GEAC has following responsibilities
 - To make decisions regarding GM research validity.
 - To make decisions regarding the safety of introducing GM organisms for public services. (1)
- A small part of the activated sludge is pumped back into the aeration tank during secondary treatment of sewage, so that it can serve as the inoculum. (1)
- An example of innate immunity is PMNL-neutrophils. (1)
- In altitude sickness, the body compensates low oxygen availability by increasing red blood cell formation and breathing rate. In contrast, oxygen binding capacity of Hb decreases. (1)
- Impacts of loss of biodiversity may lead to destruction in plant production, lowered resistance to environmental perturbation and increased variability in ecosystem processes like water use, disease cycle, etc. (1)
- Recessive allele expresses itself only in homozygous state in organisms. (1)
- Cryopreservation is *ex situ* conservation technique in which tissue organs, embryos, seeds, etc., are stored at very low temperature of -196°C . (1)
- Kala-azar, sleeping sickness, ascariasis, etc., are protozoan diseases in humans. (1)
- Western ghats have been declared biological hotspots because along with their biodiversity, they also support a rich flora and fauna which are found nowhere else in the world. (1)
- Normal cells show a property called contact inhibition by virtue of which contact with other cells stops their uncontrolled growth. Cancer cells appear

to have lost this property and they continue to divide and form a mass of cells called tumour. (1)

- (a) Geitonogamy is functionally cross-pollination as it involves the pollinating agent to carry out pollination, but genetically it is similar to autogamy (self-pollination) since the pollen grains of one flower are transferred to the stigma of another flower belonging to either the same plant or genetically similar plant having monoecious condition. Thus, both A and R are correct and R is the correct explanation of A. (1)
 - (a) In polynucleotide chains like DNA base pairings are said to be complementary to each other. Therefore, if the base sequence of one strand is known then the sequence of other strand can be predicted. Thus, both A and R are correct and R is the correct explanation of A. (1)
 - (c) Each antibody is represented as H_2L_2 , because it has four peptide chains, two small called light chains and two longer called heavy chains. Thus, A is true, but R is false. (1)
 - (c) Nicotine, caffeine, quinine, strychnine and opium are produced by plants as defences against grazers and browsers. Thorns of *Acacia* and cactus are most common morphological means of defence. Thus, A is true, but R is false. (1)
- Or
- (c) All the biodiversity hotspots if put together, cover less than 2% of the earth's land area. The strict protection of the hotspots could reduce the ongoing mass extinction by almost 30%. Thus, A is true, but R is false. (1)
 - (i) (d) A biopatent means a government protection granted for biological entities and their products.

- It gives right to use an invention, biological resources or use of application or processes. (1)
- (ii) (d) In 1997, an American company got patent right on Indian Basmati rice through the US patent and trademark office. (1)
- (iii) (d) Biopiracy is related to traditional knowledge exploitations, biomolecules and regarding bioresources exploitation and stealing of bioresources. (1)
- (iv) (d) In the past patent attempts have been made on basmati rice, turmeric and neem by Western nations. (1)
- (v) (c) Anthrax is a disease caused by the bacterium, *Bacillus anthracis* is caused by its spores and can enter the intestines of human body through their lungs or through the skin. It was first seen to occur in farm animals. It was later used as bioweapon.
Thus, A is true, but R is false. (1)
16. (i) (b) Cleistogamous flowers are strictly autogamous because they remain always close. (1)
- (ii) (a) In chasmogamy, pollination takes place in open flower. (1)
- (iii) (c) Advantage of cleistogamy is no dependence on pollinators. (1)
- (iv) (a) *Commelina* has cleistogamous flowers thus no pollinating agents are required for pollination. (1)
- (v) (d) Cleistogamous flowers are not dependent on pollinators. These are bisexual flowers which never open thus always remain closed. Therefore, there is no change of cross-pollination in them. (1)
17. A single DNA band is observed in plasmid, while two DNA bands are observed in linear DNA in agarose gel because plasmid is a circular DNA molecule and when cut with enzyme, it becomes linear, but does not get fragmented.
Whereas, a linear DNA molecule gets cut into two fragments. (2)
18. It is true that all hydrophytes are not pollinated by water. The hydrophytes whose flowers emerge above the surface of water are pollinated by insects or wind, e.g. water hyacinth and water lily are pollinated by insects. (2)
- Or The hormones that are produced only during pregnancy are
- (i) **Human Chorionic Gonadotropin (hCG)** It is secreted by the placenta. The primary role of hCG is to keep the corpus luteum functioning, so that it continues to produce oestrogen and progesterone.
- (ii) **Relaxin** It is secreted by the ovary. It relaxes the pelvic ligaments of pregnant woman, so as to prepare it for the childbirth during parturition. (1 + 1)
19. The Antarctic fish (*Trematomus*) remains active even in extremely cold sea water due to the presence of special ice nucleating proteins called Anti-Freeze Proteins (AFPs). The AFPs can bind to ice and subsequently inhibit the growth of the ice crystals in the body. Thus, these fishes are adapted to tolerate very low temperatures. These fishes can inhabit ice laden or cold water below freezing point (-0.7°C) of their blood serum by virtue of AFPs. (2)
20. It is better to purchase organically grown rice because in organic farming, biopesticides and biofertilisers are used which are natural and are not harmful. They do not cause health hazard. On the other hand, in conventional farming, excessive chemical pesticides and insecticides are used which affect human health adversely. (2)
21. *cry* genes code for *Bt* toxins which are lethal to bollworms. Specific *Bt* toxin genes are isolated from the bacterium *Bacillus thuringiensis* and incorporated into several crops like cotton. The choice of the gene depends on the crop and the targeted pest, as most *Bt* toxins are insect group specific. Gene *cry IAc* and *cry IIAb* control cotton bollworms while *cry IAb* controls corn borer. (2)
22. In a sewage treatment plant, during the secondary treatment of the wastewater, the primary effluent is passed through large aeration tanks, where it is constantly agitated and air is pumped through it. This allows vigorous growth of useful aerobic microbes into flocs.
Flocs are masses of bacteria associated with fungal filaments to form mesh-like structures. They degrade organic matter in sewage water aerobically and thus reduces BOD value. (1+1)
23. Two factors responsible for conferring stability to double helix structure of DNA are
- (a) Stacking of one base pair over other (1)
- (b) H-bond between nitrogenous bases (1)
- Or The scientific name of fruitfly is *Drosophila melanogaster*.
TH morgan preferred this organism for his study because of the following reason
- (i) It has fast and short life cycle.
- (ii) It has only four pairs of chromosomes.
- (iii) It reproduces quickly. (2)
24. Cancer can be easily detected by the following methods
- Performing biopsy by taking out a piece of suspected tissue and studying it by cutting it into thin sections, staining and examining them under the microscope.
 - WBC counting in leukemia.
 - Radiography (X-rays) and CT (Computed Tomography) scan to detect the cancers of internal organs.

- Magnetic Resonance Imaging (MRI) to detect the pathological and physiological changes in the living tissues. (2)

25. Roles of local people in reproductive child healthcare related issues are as follows

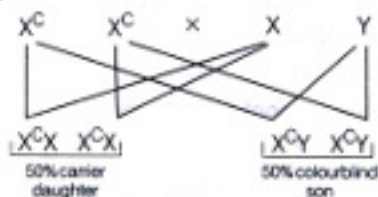
- Parents should provide proper information about reproductive organs, adolescence, safe and hygienic sexual practices, etc., to their children.
- Problems like uncontrolled population growth, sex abuse and sex related crimes should be addressed without any hesitation.
- Fertile couples and people of marriageable age group should have proper information about various birth control measures, STDs, etc. (2)

26. Recombinant DNA vaccines are known as second and third generation vaccines. These are the purest and highly potent vaccines. These are produced by using genetically engineered plasmids.

These plasmids have gene inserts for the surface proteins of a pathogen that can elicit immunity, but do not result in infection. After that plasmids are inserted in bacteria or yeast cells where they express the viral proteins. These proteins are injected into the human host as vaccine, where they are recognised as foreign elements and an immune response is elicited. Recombinant DNA vaccine is used for treating diseases such as hepatitis-B, polio, etc. (3)

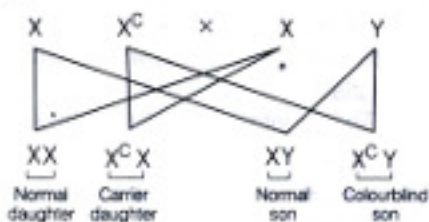
27. Colour blindness is sex-linked recessive genetic disorder, as gene for it is present on X-chromosome. According to the situation given in the question, a man whose father was colourblind will be, XY normal.

A woman whose mother was colourblind and father was normal will be a carrier ($X^C X$) as shown in the figure.



(1½)

When marriage happens between a normal man and a carrier woman there is a probability that 25% of their male children would be colourblind. This can be easily observed from the cross given below



(1½)

Or

According to the Chargaff's rule, in a *dsDNA*, the purine and pyrimidine base pairs are present in equal amount,

i.e. $A = T, G = C$

Here, $\frac{A+T}{G+C} = 1$

If the amount of cytosine is 17%,

Then, $A + G + C + T = 100$ and $G = C, A = T$

Thus, $A + 17 + 17 + T = 100$

$A + T + 34 = 100$

$A + T = 100 - 34 = 66$

$A = T = \frac{66}{2} = 33\%$

Hence, if cytosine is 17%, then $G = 17\%$ and A and T will be 33% each. (3)

28. Organic farming is an alternative form of agricultural system in which there is use of biofertilisers and biopesticides. Biofertilisers are organisms (mainly bacteria, fungi and cyanobacteria) that enrich the nutrient quality of soil. Organic farming is a holistic approach which seeks to develop an understanding of various interactions among the flora and fauna of the field. A system is created where soil fertility is enhanced naturally and the insect pests are kept at manageable level by a complex system of checks and balances within a living and vibrant ecosystem.

Such use of biocontrol measures thus, reduces the use of chemical pesticides and fertilisers thereby, decreasing the pollution. (3)

29. Transcription is the process of copying genetic information from one strand of DNA into RNA. The step D represents capping of pre *mRNA* (or *hnRNA*).

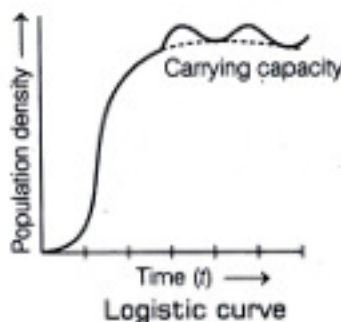
The 7-methyl guanosine cap is added to the 5' end of pre-*mRNA*, while elongation is still in progress. This moiety protects the nascent *mRNA* from degradation. In its absence, the transcript will become prone to degradation or damage by proteins or enzymes present in hosts.

The cap also assists in translation. The initiation factor involved in protein synthesis recognises the cap and helps to initiate the translation by ribosomes. Thus, protein synthesis will be affected if the cap would not present in transcript. (3)

30. (i) Scientists have identified about 1.4 million locations, where single base DNA differences, (Single Nucleotide Polymorphisms or SNPs) occur in humans. This information can bring out revolutionary changes in biological and medical science in following ways
- By tracing human history.
 - By finding chromosome location of disease associated sequences. (2)

- (ii) RNA is the first genetic material because
- Essential life processes such as metabolism, translation, etc., have evolved around RNA.
 - It acts both as catalyst and genetic material. (1)

31.



- In this curve, population initially shows a lag phase and then shows a phase of acceleration or exponential growth followed by the phase of deceleration. (1/2)
- Population can grow exponentially for a certain period of time and then assumes a steady state, as the resource availability becomes limited at some point of time. (1/2)
- Every environment has resources to support a particular maximum number of individuals, called its carrying capacity (K). Beyond that, there is no increase in the size/density of a population. (1/2)
- A population showing logistic growth shows a sigmoid curve, when the number of individuals is plotted as a function of time. (1/2)
- Equation can be described as

$$\frac{dN}{dt} = rN \left(\frac{K - N}{K} \right)$$

Where, N = Population density at time t

r , = Intrinsic rate of natural increase

K = Carrying capacity. (1/2)

- The model is more realistic in nature, because no population can sustain the exponential growth indefinitely. (1/2)

Or

According to ecologists, communities with more species tend to be more stable than those with less species.

- David Tilman's** longterm experiments on ecosystem found that plots with more species showed less year-to-year variation in total biomass. He also showed that increased diversity contributed to higher productivity.
- Paul Ehrlich** through his rivet popper hypothesis tried to explain the importance of biodiversity for the survival of species.
 - The hypothesis assumes the ecosystem to be an airplane and the species to be the rivets joining all parts together.

- If every passenger pops a rivet to take home (resulting in species extinction), it may not affect the flight safety initially (proper ecosystem functioning) but with time as more and more rivets are removed, the plane becomes dangerously weak.
- Loss of rivet on the wings (key species that drives major ecosystem functions) is a more serious threat to flight safety than loss of a few rivets on the seats or windows of the plane. (5)

32. At present, there is an increased demand for food, shelter, jobs, etc., in our country. The increasing population creates lot of pressure on natural resources and our environment.

If the population growth rate is not controlled, we can face following problems in the future.

- Shortage of Food Supply** The production of food cannot increase in a similar proportion as the population, thus, resulting in shortage of food.
- Unemployment** As number of people will increase, the need for jobs will increase radically. But when sufficient number of jobs are not available, this would lead to unemployment.
- Education** With increasing population, more people need to be educated. This creates difficulties for the government in order to provide proper education to all.
- Poverty** Family tends to become poor, if there are more persons in it and the income is less. Steps that can be undertaken by government to control population growth are
 - Statutory raising of marriageable age of girls to 18 years and 21 years in case of boys.
 - By giving incentives to the couples with small families.
 - Motivate smaller families through media like advertisements, posters, etc., to use various contraceptive methods. (5)

Or

The development of an embryo from a fertilised ovum involves the following events

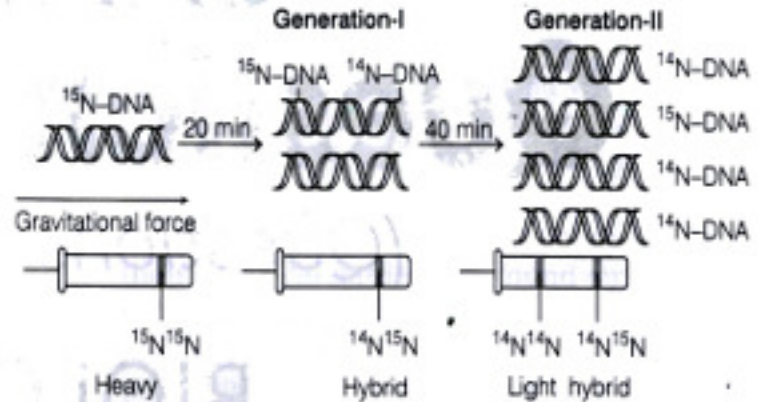
- The fusion of the haploid nuclei of the sperms and ovum in the ampullary region of Fallopian tube form a diploid zygote.
- The zygote moves through the isthmus of the oviduct towards the uterus, forming 2, 4, 8, 16 daughter cells (i.e. blastomeres) by mitotic divisions called cleavage.
- The zygote slowly moves down the Fallopian tube towards the uterus where following events take place
 - The zygote with 8-16 blastomeres called morula is formed.
 - The morula continues to divide and transforms into blastocyst, while moving further into the uterus. This process is called blastulation.

- (c) The blastomeres in the blastocyst get arranged into an outer layer, i.e. trophoblast and an inner group of cells attached to trophoblast called the inner cell mass.
- (d) The trophoblast layer then gets attached to the endometrium and the inner cell mass differentiates into the embryo. Later, the uterine cells divide rapidly and cover the blastocyst.
- (e) The blastocyst gets embedded in the endometrium of the uterus. This is called implantation and it leads to pregnancy. (5)

33. Meselson and Stahl in 1958 proved that DNA replicates in a semiconservative way. This semiconservative DNA replication suggests that after the completion of replication, each DNA molecule will have one parental and one newly-synthesised strand. Steps of the experiment conducted by them are as follows

- They grew *E. coli* in a medium containing $^{15}\text{NH}_4\text{Cl}$ (^{15}N is the heavy isotope of nitrogen) for many generations. As a result, ^{15}N got incorporated into the newly synthesised DNA. This heavy DNA was differentiated from normal DNA by centrifugation in cesium chloride (CsCl) density gradient.
- Then, they transferred the cells into the medium containing $^{14}\text{NH}_4\text{Cl}$ and took the samples at various definite time intervals.
- The extracted DNAs were centrifuged and measured to get their densities. The parent bacteria had labelled DNA only ($^{15}\text{N}^{15}\text{N}$). The first generation of bacteria, contained intermediate ($^{15}\text{N}^{14}\text{N}$) DNA. The second generation had intermediate and light DNA in equal amounts and so on.

- It was possible only if DNA replicates in a semiconservative mode.

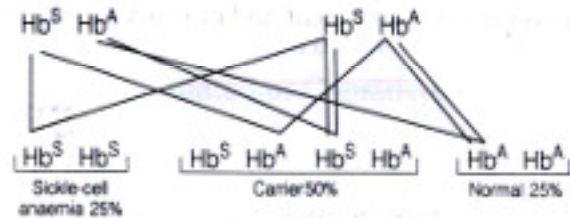


Meselson and Stahl's experiment (5)

Or

This disease is controlled by a single pair of allele Hb^A and Hb^S . Only homozygous individuals for Hb^S , i.e. Hb^SHb^S show the diseased phenotype, while the heterozygous individuals are carriers (Hb^AHb^S). Thus,

- it is a recessive trait.
- the gene for this trait is present on autosomes. The disease can be transmitted from the parents to the offspring only if both the parents are heterozygous (i.e. carrier for the gene).
- the parents are heterozygous for the trait as two of their offspring have diseased phenotype. The genotype of the parents would be Hb^AHb^S and Hb^AHb^S .
- the chances would be 25% because both parents are carriers, i.e. (1 x 4)



(1)

*** ***** ***