



All India 2023 Solved Paper

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11 Years CBSE Class 12 Biology

Previous Year-wise Solved Papers

(2013 - 2023) Powered with Concept Notes

3rd Edition

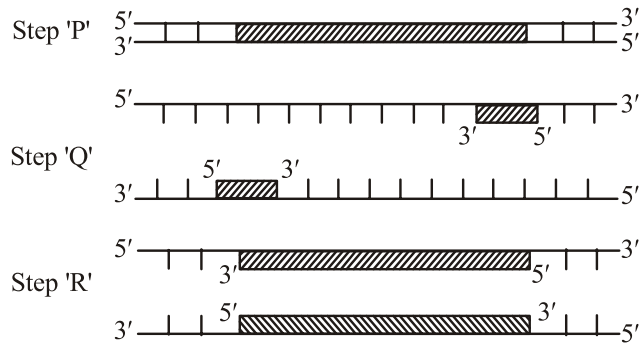
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- (a) Individual 1 and 3
 (b) Individual 1 and 2
 (c) Individual 2 and 3
 (d) Individual 1 is the only parent of the child amongst 1, 2 and 3

7. The given schematic illustration shows three steps 'P', 'Q' and 'R' of the polymerase chain reaction.



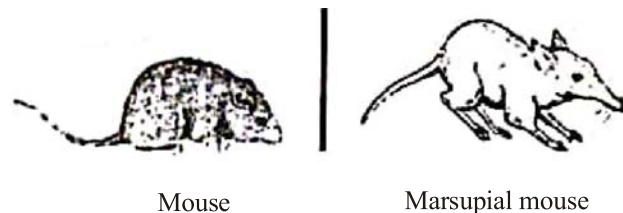
Which of the following statements are correct with reference to the illustration given above?

- (i) Step 'P' is showing denaturation at low temperature.
 (ii) Step 'Q' is a denaturation of DNA strand at high temperature, followed by annealing.
 (iii) Step 'R' is the extension of DNA in presence of thermostable DNA polymerase.
 (iv) Step 'Q' is extension with two sets of primers.
- (a) (i) and (iii) only (b) (ii) and (iii) only
 (c) (ii) only (d) (i) only
8. Identify the fungus that ripens the famous 'Roquefort' cheese:
- (a) *Saccharomyces cerevisiae*
 (b) *Propionibacterium sharmanii*
 (c) *Monascus purpureus*
 (d) *Penicillium notatum*
9. Select the options which is/are incorrect statement(s) with respect to T-lymphocytes in the human body.
- (i) They are a type of white blood cells.
 (ii) They are produced in bone marrow.
 (iii) They remain active at all times in the body.
 (iv) They mature in the bone marrow.
- (a) (i) and (iv) only (b) (iii) only
 (c) (iv) only (d) (iii) and (iv) only

10. Which one among the following regions is not a hotspot

of biodiversity?

- (a) The Indo-Burma Region
 (b) Jaintia Hills in Meghalaya
 (c) The Western Ghats and Sri Lanka
 (d) The Himalayas
11. Human settlement often leads to habitat loss which leads to fragmentation, forming smaller patches of habitats. Select the statements that describe how a small patch differs from a large patch of the same habitat.
- (i) Invasive species will never be seen here.
 (ii) Population of large animals decreases.
 (iii) Biodiversity decreases.
 (iv) Competition from surrounding habitats increases.
- (a) (ii), (iii) and (iv) only (b) (ii) and (iv) only
 (c) (i) and (iii) only (d) (i), (ii) and (iii) only
12. Identify the option that gives the correct type of evolution exhibited by the two animals shown, living in the same habitat in Australia.



- (a) Convergent Evolution
 (b) Disruptive Selection
 (c) Divergent Evolution
 (d) Homologous Ancestry

For Questions number 13 to 16, two statements are given-one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

- (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
 (b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
 (c) Assertion (A) is true, but Reason (R) is false.
 (d) Assertion (A) is false, but Reason (R) is true.

13. **Assertion (A):** The Covid-19 virus has a shorter life-span and evolves into new strains at a fast speed.

Reason (R): RNA being unstable, mutates at a faster rate.

14. **Assertion (A):** For DNA sequencing, the total DNA from a cell is isolated and converted into random fragments of relatively smaller sizes.

Reason (R): Human genome is said to have approximately 3×10^9 bp and the total estimated cost for sequencing is very high.

15. **Assertion (A):** Biologists are sure about how many prokaryotic species are living now.

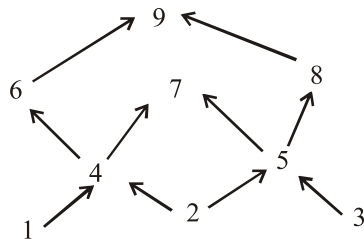
Reason (R): The conventional taxonomic methods are not suitable for identifying microbial species.

16. **Assertion (A):** Mary Mallon continued to spread typhoid for many years.

Reason (R): Salmonella typhi generally enters the small intestine through food and water contaminated with it.

SECTION - B

17. (a) Explain the process of the development of a male gametophyte in an angiosperm. 2
- (b) Why is it called a male gametophyte? 2
18. (a) Name the two institutes which developed the technology of biogas production in India. 2
- (b) Explain the main principle used in this technology. 2
19. Given below is a food web that involves nine organisms.



- (a) Identify two producers and two carnivores shown in the food web. 2
- (b) Is it possible to make an ecological pyramid depicting this food web? Give reason in support of your answer. 2
20. (a) 'Insertional inactivation' is a method to detect recombinant DNA. Explain the method. 2

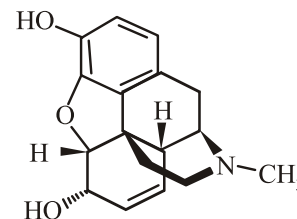
OR

- (b) Explain how recombinant DNA technology is used to detect a disease even before any clinical symptom appears. 2
21. On August 22 in the year 2022, 3358 fires were detected in the rainforests. Write one short-term and one long-term effect of this event on the biotic and abiotic components of the environment. 3

SECTION - C

22. Explain the following population interactions with the help of one example each: 3
- (a) Brood Parasitism
- (b) Co-evolution of mutualists
23. (a) Write the scientific name of the nematode that infests the tobacco plants and the part that it infests. 3
- (b) How is *Agrobacterium* used to protect tobacco plant from this attack? 3

24.



- (a) Name the category of drugs represented by the chemical structure given above. 3
- (b) If the methyl group is substituted by acetyl group we get a bitter crystalline compound. Name the compound. 3
- (c) Name the natural source of these compounds. 3
- (d) State the harmful effects of this class of drugs on the human body. 3
25. (a) Darwin's theory of Natural Selection is widely accepted but some limitations have been identified by modern biologists. Mention the limitations identified. 3
- (b) Name and state the most accepted theory of evolution in modern times. 3
- (c) Mention any two ways the limitations identified in Darwin's theory of evolution are explained in modern biology. 3

26. (a) (i) How many types of RNA polymerases are there in a eukaryote cell? Mention which one of them transcribes hnRNA. 3
- (ii) Write the changes that hnRNA undergoes before it leaves the nucleus as mRNA. 3

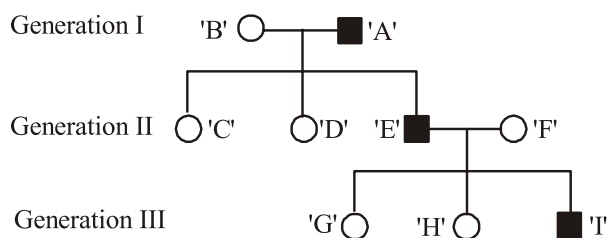
OR

- (b) The length of DNA in any cell is far greater than the dimension of its nucleus. Explain how this enormous DNA is packaged in a eukaryotic cell. 3
27. Expand and explain the following techniques used in the Test Tube Baby' programme: 3
- (a) GIFT (b) ZIFT
- (c) IUI
28. Trace the journey of a zygote from the isthmus of the fallopian tube up to its implantation in the uterus of a human female. Highlight the changes the zygote undergoes during the course of its journey up to implantation. 3

SECTION - D

The following questions are case-based questions. Read the cases carefully and answer the questions that follow.

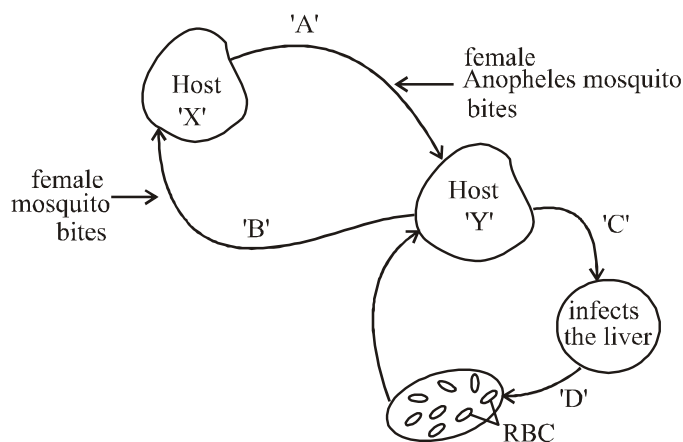
29. The following pedigree chart shows the inheritance of a genetic disorder up to three generations of a family. Observe the chart and answer the questions that follow.



- (i) Is the disease sex-linked or autosomal as per the chart? Give reasons in support of your answer. 1
- (ii) Is it a recessive or a dominant disorder? 1
- (iii) Write the genotypes of the individuals 'C', 'D' and 'H'. 1
- (iv) (a) If the female 'D' marries a normal man, what will be the probability of their daughter being a sufferer of this disease? 1

OR

- (iv) (b) If the mother 'B' is a carrier of the disease, what will be the probability of their daughter being a sufferer of this disease? 1
30. The diagram shows the life cycle of a pathogenic protozoan.



- (i) Name the parasitic stage that is being transferred from host 'X' to host 'Y'. 1
- (ii) Write the changes the parasite undergoes in the liver. 1
- (iii) Write the changes the parasite undergoes when it enters the RBC. 1
- (iv) (a) Trace the changes the parasite undergoes when the host 'X' takes its blood meal from infected host 'Y'. 1

OR

- (iv) (b) At which stage during the life cycle of the pathogen does the host 'Y' experience the symptoms of the disease? Name the disease and the toxic substance responsible for these symptoms. 1

SECTION - E

31. (a) Protein synthesis requires the services of all three types of RNAs, namely t-RNA, m-RNA and r-RNA. Explain the role of each of them during the process of protein synthesis in prokaryotes. 5

OR

- (b) A homozygous tall pea plant with green seeds is crossed with a homozygous dwarf pea plant with yellow seeds.

- (i) Write the possible phenotype and genotype of F_1 generation.
- (ii) State the laws of Mendel that are proved true by the F_1 generation.
- (iii) Mention the F_2 phenotypic ratio along with their possible phenotypes.
- (iv) Write the genotypes of the male and female gametes produced by F_1 progeny. **5**
- 32. (a)** Answer the following questions with respect to recombinant DNA technology: **5**
- (i) Why is plasmid considered to be an important tool in rDNA technology? From where can plasmids be isolated? (Any two sources)
- (ii) Explain the role of 'ori' and selectable marker in a cloning vector.
- (iii) "r-DNA technology cannot proceed without restriction endonuclease." Justify.
- OR**
- (b) Answer the following questions based on Bt-crops: **5**
- (i) Why do farmers prefer to grow Bt cotton crop than genetically unmodified cotton crops?
- (ii) Name any two insects that are killed by Bt toxin.
- (iii) Explain the mechanism by which Bt toxin kills the insects but not the bacterium which possesses the toxin.
- 33. (a)** (i) Describe the arrangement of nuclei and cells in a mature embryo sac of a typical angiosperm.
- (ii) Explain the devices the flowering plants have developed to prevent the following types of pollination: **5**
- (1) Prevents both autogamy and geitonogamy
- (2) Prevents autogamy, but not geitonogamy
- OR**
- (b) (i) Write the specific location of the following in the testis in humans:
- (1) Sertoli cells
- (2) Leydig cells
- (ii) Explain the coordination between Gonadotropins, Leydig cells and Sertoli cells and their role in spermatogenesis. **5**

Solutions

SECTION - A

1. (c) Point Q is vas deferens which is cut and tied during surgical method called vasectomy. **(1 mark)**



Note

Vasectomy is a form of male birth control that cuts the supply of sperm to your semen.

2. (a) Perisperm can be defined as the persistent part of nucellus that remain after the embryonic development. It persists in the mature seed of black pepper. **(1 mark)**

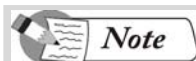
3. (b) 10-17 day of menstrual cycle are most fertile days, because ovulation occurs in which the ovary releases an egg for fertilisation to occur but when this egg does not get fertilised, the endometrium lining sheds causing the release of the egg along with mucus, this occurs in the form of menstruation cycle. This occurs during 21-28 days and the female is in the least fertile stage during 21-28 days. **(1 mark)**

4. (d) Bryophytes were the part of cenozoic era. **(1 mark)**

5. (c) Hershey and Chase wanted to check if it was the DNA or the protein of the bacteriophage that was injected as genetic material into the bacterial cells. For this, they cultured bacteriophage in two different media - One containing radioactive sulphur (sulphur being a constituent of certain amino acids) to label the protein coat of the bacteriophage, and another containing radioactive phosphorus to label their DNA core. **(1 mark)**

6. (d) Individual 1 exhibit largest number of common bands with the child X that are band 1, 3, 6 and 8 are common so individual 1 is expected to be the parent of child X. **(1 mark)**

7. (b) In the given polymerase chain reaction, in option (b) there is correct explanation of steps Q and R. Moreover, step P is not showing the denaturation process, it is a single stranded DNA molecule and in step Q only annealing process is occurring but no extension.



Note

PCR is a laboratory technique for rapidly producing million to billion copies of a specific segment of DNA.

8. (b) Propionobacterium sharmanii is responsible for ripening of chosse. **(1 mark)**

9. (d) Fully matured T lymphocytes circulate in all tissues and organs of the lymphatic system including the tonsils, spleen and lymph nodes. They can also circulate in the bloodstream. These cells do not remain active all time during life span but get activated during pathogenic invasion in the body. These cells are produced in the bone marrow but get matured in the thymus. **(1 mark)**

10. (b) The sacred grooves are the trees which are considered as culturally, socially, medicinally or religiously important. Jaintia Hills in Meghalaya is an example of sacred grove. Three of the hotspots – Western Ghats and Sri Lanka, Indo-Burma and Himalaya – cover our country's exceptionally high biodiversity regions. **(1 mark)**

11. (a) Due to habitat loss and fragmentation, following changes are expected to happen as a result of transformation from large population to small population:

1. Population of large animals decreases: This occurs because the large animals require larger territory to survive which is not possible at small patch. The population of large animals like herbivores or predators is likely to reduce.
2. Biodiversity decreases: Due to habitat loss and fragmentation of large patch into small patch the number of species is likely to reduce.
3. Competition from surrounding habitats increases: As the small patch developed after habitat loss and fragmentation there will be limited number of resources available so the population of small patch is likely to compete with members of the other neighboring patches for resources like food, water and shelter.

Invasive species will never be seen here is an incorrect option because small patch of population will be more prone to the attack of invasive species. The invasive species will be able to outcompete the population of small patch for resources. **(1 mark)**

12. (a) The changes in characteristics occur in consequence to adapt to a new environment. It can be in structures that serve the same function. Adaptive radiation is a convergent pattern of evolution and results in the formation of analogous structures like the fins of whales and fishes. The given figure is showing the transformation of mouse to marsupial mouse resulting into convergent evolution due to adaptive radiation. **(1 mark)**

13. (a) The Covid-19 virus is a RNA virus has a short life span and mutate at a faster pace. RNA being a catalyst was reactive and hence unstable, it mutates at a faster rate. Consequently, viruses having RNA genome and shorter lifespan, mutate and evolve faster. **(1 mark)**
14. (b) For sequencing, the total DNA from a cell is isolated and converted into random fragments of relatively smaller sizes this is due to the fact that there are technical limitations in sequencing very long strands of DNA in a single attempt. The entire human genome is said to have approximately 3×10^9 base pairs. If the cost of sequencing is estimated to be about US \$ 3 for each base pair, then the estimated cost of the entire project turns out to be 9 billion US dollars. **(1 mark)**
15. (d) Biologists are not sure about how many prokaryotic species there might be. This is because of the fact that conventional taxonomic methods are not sufficient for identifying microbial species and many prokaryotic species are not culturable under laboratory conditions. **(1 mark)**
16. (b) Mary Mallon, also called Typhoid Mary, was identified as a carrier of the typhoid bacterium and was the source of multiple outbreaks of typhoid fever in New York City and Long Island during 1900-1907. After eating food or drinking water contaminated with the Salmonella typhi bacteria, the bacteria moves down into the digestive system, where it will multiply quickly. **(1 mark)**
18. (a) The technology of biogas production was developed in India mainly due to the efforts of Indian Agricultural Research Institute (IARI) and Khadi and Village Industries Commission (KVIC). **(2 marks)**
- (b) Principle of Biogas: Biogas is produced by decomposition of organic matter. Biogas is mainly composed of methane.
- A mixture of farm waste is fed into the biogas plant. This waste is mixed to make a slurry.
 - Slurry is then fed into the digester. Digester is an air-tight chamber and oxygen is not present in it.
 - Anaerobic bacteria in digester carry out decomposition process of slurry. This results in production of biogas. **(1 mark)**
 - Biogas is sent out through an outlet so that it can be suitably used.
 - Decomposed matter is taken out and it can be used as manure. **(1 mark)**
19. (a) According to the given food web, the producers are 1 and 2 whereas the two carnivores are 6 and 7. **(1 mark)**
- (b) Yes, it is possible to make an ecological pyramid using the food web provided as it includes organisms at the producer, primary consumer, secondary consumer and tertiary consumer trophic levels. So, there will be transfer of energy from lower to higher trophic level leading to the formation of an upright ecological pyramid. **(1 mark)**
20. (a) Insertional inactivation technique of recombinant DNA technology used to select bacteria that carry recombinant plasmids; a fragment of foreign DNA is inserted into a restriction site within a gene for antibiotic resistance, thus causing that gene to become nonfunctional. It is often used to identify recombinant vectors in gene cloning and in turn to distinguish a recombinant vector from a non-recombinant vector. For example, insertion of a piece of foreign DNA into a cloning site which is located on an antibiotic-resistant gene on the vector can lead to loss of the antibiotic resistance phenotype by insertional inactivation. The recombinant vector will, therefore, specify antibiotic sensitivity, whilst the non-recombinant vector will specify antibiotic resistance. **(2 marks)**

SECTION - B

17. (a) In angiosperms, the pollen grain is the male gametophyte. Maturation of the male gametophyte or pollen grain includes two mitotic divisions. First divisions form vegetative and generative cell and in the second mitotic division the generative cell forms basically two male gametes and their release occurs from a mature anther. Therefore, it has two male gametes and one vegetative cell. **(2 marks)**
- (b) In angiosperms, microspores indicate the male gametophyte. Microspores divide mitotically, resulting in two unequal type of cells that are bigger vegetative cell and a small generative cell. The generative cell splits once again resulting in two male gametes or sperms. Microspore in angiosperms is also known as pollen grains. **(2 marks)**



Note

For fertilization to occur in angiosperms, pollen has to be transferred to stigma of a flower.

OR

- (b) PCR, ELISA and autoradiography are some of the recombinant DNA technologies that can be used for the detection of disease even before any clinical symptom appears. PCR is now routinely used to detect HIV in suspected AIDS patients. It is being used to detect mutations

in genes in suspected cancer patients too. It is a powerful technique to identify many other genetic disorders. **(2 marks)**

A single stranded DNA or RNA, tagged with a radioactive molecule (probe) is allowed to hybridise to its complementary DNA in a clone of cells followed by detection using autoradiography. The clone having the mutated gene will hence not appear on the photographic film, because the probe will not have complementarity with the mutated gene. This can be help in detection of mutated gene responsible for causing disease. ELISA is based on the principle of antigen-antibody interaction. Infection by pathogen can be detected by the presence of antigens (proteins, glycoproteins, etc.) or by detecting the antibodies synthesised against the pathogen.

21. One short term impact of forest fire:

On biotic component of the environment is mortality of large number of species causing biodiversity loss.

On abiotic component of the environment is the deterioration of the quality of air and water.

One long term impact of forest fire:

On biotic component of the environment is co-extinction of species.

On abiotic component of the environment will not support the survival of future species. **(2 marks)**

SECTION - C

22. (a) Brood parasitism: in birds is a fascinating example of parasitism in which the parasitic bird lays its eggs in the nest of its host and lets the host incubate them. During the course of evolution, the eggs of the parasitic bird have evolved to resemble the host's egg in size and colour to reduce the chances of the host bird detecting the foreign eggs and ejecting them from the nest. **(3 marks)**

(b) Co-evolution of mutualists: The most spectacular and evolutionarily fascinating examples of mutualism are found in plant-animal relationships. Plants need the help of animals for pollinating their flowers and dispersing their seeds. Animals obviously have to be paid 'fees' for the services that plants expect from them. Plants offer rewards or fees in the form of pollen and nectar for pollinators and juicy and nutritious fruits for seed dispersers. But the mutually beneficial system should also be safeguarded against 'cheaters', for example, animals that try to steal nectar without aiding in pollination. Plant-animal interactions often involve co-evolution of the mutualists, that is, the evolutions of the flower and

its pollinator species are tightly linked with one another. In many species of fig trees, there is a tight one-to-one relationship with the pollinator species of wasp. It means that a given fig species can be pollinated only by its 'partner' wasp species and no other species. The female wasp uses the fruit not only as an oviposition (egg-laying) site but uses the developing seeds within the fruit for nourishing its larvae. The wasp pollinates the fig inflorescence while searching for suitable egg-laying sites. In return for the favour of pollination the fig offers the wasp some of its developing seeds, as food for the developing wasp larvae. **(3 marks)**

23. (a) A nematode *Meloidogyne incognita* infects the roots of tobacco plants and causes a great reduction in yield. **(1½ marks)**

(b) Using *Agrobacterium* vectors, nematode-specific genes were introduced into the host plant. The introduction of DNA was such that it produced both sense and anti-sense RNA in the host cells. These two RNA's being complementary to each other formed a double stranded (dsRNA) that initiated RNAi and thus, silenced the specific mRNA of the nematode. The consequence was that the parasite could not survive in a transgenic host expressing specific interfering RNA. The transgenic plant therefore got itself protected from the parasite. **(1½ marks)**

24. (a) The given drug is morphine that belongs to the category of opioids. Opioids are the drugs, which bind to specific opioid receptors present in our central nervous system and gastrointestinal tract. **(½ mark)**



Note

Morphine are used as analgesics.

(b) Heroin, commonly called smack is chemically diacetylmorphine which is a white, odourless, bitter crystalline compound. This is obtained by acetylation of morphine, which is extracted from the latex of poppy plant *Papaver somniferum*. Generally taken by snorting and injection, heroin is a depressant and slows down body functions. **(1 mark)**

(c) *Papaver somniferum* is the natural source of these compounds. **(½ mark)**

(d) The harmful effects of opioids include drowsiness, constipation, euphoria, nausea, vomiting and slowed breathing. A person using opioids over time can develop tolerance, physical dependence and opioid used disorder, with the risk of overdose and death. **(1 mark)**

25. (a) (i) The theory of evolution could not explain how and where variations have arisen.
 (ii) It also could not explain how the variations are inherited. **(1 mark)**
- (b) Theory given by Hugo de Vries is the most accepted theory of evolution in modern times. In the first decade of twentieth century, Hugo de Vries based on his work on evening primrose brought forth the idea of mutations – large difference arising suddenly in a population. He believed that it is mutation which causes evolution and not the minor variations (heritable) that Darwin talked about. Mutations are random and directionless while Darwinian variations are small and directional. Evolution for Darwin was gradual while de Vries believed mutation caused speciation and hence called it saltation (single step large mutation). **(1 mark)**
- (c) The two ways the limitations identified in Darwin's theory of evolution are explained in modern biology are as follows:
1. According to Darwin evolution is a gradual process caused by minor variation this was contradicted by de Vries who proposed that evolution is an outcome of mutations that appear suddenly. He called it saltation (single step large mutation).
 2. According to Darwin evolution is a slow directional process whereas according to de Vries evolution is caused by random chance events or mutations resulting in sudden evolution of characters in a single or few generation. **(1 mark)**
26. (a) (i) Eukaryotes have three RNA polymerases which are structurally distinct complexes, though share certain subunits in common, and have a specific function and specific promoter sequence. RNA polymerase I synthesize preribosomal RNA (pre-rRNA), which contains the precursor for the 18S, 5.8S, and 28S rRNAs. RNA polymerase II is synthesized mRNAs and some specialized RNAs. RNA polymerase III makes tRNAs, the 5S rRNA, and some other small specialized RNAs. The enzyme RNA Polymerase II is responsible for the transcription of eukaryotic hnRNA. **(1½ marks)**
- (ii) hnRNA is required to undergo splicing process before becoming functional mRNA in eukaryotes. hnRNA have both coding and non coding sequences and thus it undergoes splicing where all the non coding (introns) are removed and all the coding (exons) are bind together and forms functional mRNA. **(1½ marks)**

OR

- (b) In eukaryotes, the length of the chromatin material is large so it is required to be packed in a manner so that it can be condensed in a single nucleus. There is a set of positively charged, basic proteins called histones. A protein acquires charge depending upon the abundance of amino acids residues with charged side chains. Histones are rich in the basic amino acid residues lysine and arginine. Both the amino acid residues carry positive charges in their side chains. Histones are organised to form a unit of eight molecules called histone octamer. The negatively charged DNA is wrapped around the positively charged histone octamer to form a structure called nucleosome. A typical nucleosome contains 200 bp of DNA helix. Nucleosomes constitute the repeating unit of a structure in nucleus called chromatin, threadlike stained (coloured) bodies seen in nucleus. The nucleosomes in chromatin are seen as 'beads-on-string' structure when viewed under electron microscope (EM). The beads-on-string structure in chromatin is packaged to form chromatin fibers that are further coiled and condensed at metaphase stage of cell division to form chromosomes. The packaging of chromatin at higher level requires additional set of proteins that collectively are referred to as Non-histone Chromosomal (NHC) proteins. In a typical nucleus, some region of chromatin are loosely packed (and stains light) and are referred to as euchromatin. The chromatin that is more densely packed and stains dark are called as Heterochromatin. Euchromatin is said to be transcriptionally active chromatin, whereas heterochromatin is inactive. **(3 marks)**
27. (a) GIFT: In this assisted reproductive technologies (ART) the transfer of an ovum collected from a donor into the fallopian tube (GIFT – gamete intra fallopian transfer) of another female who cannot produce one, but can provide suitable environment for fertilisation and further development is another method attempted. **(1 mark)**
- (b) ZIFT: In this assisted reproductive technologies (ART) the zygote or early embryos (with upto 8 blastomeres) could be transferred into the fallopian tube (ZIFT – zygote intra fallopian transfer). **(1 mark)**
- (c) IUT: In this assisted reproductive technologies (ART) embryos with more than 8 blastomeres, into the uterus (IUT – intra uterine transfer), to complete its further development. **(1 mark)**



Assisted reproductive technology is used to treat infertility.

28. (a) The ovaries produce the female egg cells, called the ova or oocytes. The oocytes are then transported to the fallopian tube where fertilisation by a sperm may occur. Then the zygote travels down the fallopian tube, where it becomes a morula. **(1½ marks)**
- (b) The fertilised egg then moves to the uterus, where the uterine lining has thickened in response to the normal hormones of the reproductive cycle. **(1 mark)**
- (c) Once fertilised in the ampullary region of the fallopian tube, the embryo the uterine cavity at the blastocyst stage after 5 days of fertilisation. **(1 mark)**
- (d) During implantation the embryo adheres to the wall of the uterus. At this step of prenatal development, the conceptus is termed as blastocyst. **(½ mark)**

SECTION - D

29. (i) According to the given pedigree chart, among the parents in the generation I A is affected which is according to pedigree symbol is a male. The disease is passed from the male to the progeny (male children) in generation II and III so the disease is Y-linked or sex linked. **(1 mark)**
- (ii) A condition is considered Y-linked if the altered gene that causes the disorder is located on the Y chromosome, one of the two sex chromosomes in each of a male's cells. Because only males have a Y chromosome, in Y-linked inheritance, a variant can only be passed from father to son. Therefore, the given case is an example of Y-linked dominant disorder. **(1 mark)**
- (iii) According to the given pedigree chart, the genotypes of individuals 'C', 'D' and 'H' are XX, XX and XX respectively because these are females and mother is not the carrier of the disease in the generation I. **(1 mark)**
- (iv) (a) XX (female D) X XY (normal man) then the probability of a daughter being a sufferer of the disease is zero. This is because of the fact that the given pedigree chart is indicative of Y linked disorder so male progeny is likely to be affected by it and also the mother is not the carrier of the disorder so the female progeny will not be the carrier or affected by the disease. **(1 mark)**

OR

- (iv) (b) If X (mother B) is the carrier of the disease then the probability of their daughter being the sufferer of the disease is zero. In this case one of the daughter can be the carrier of the disease but will remain unaffected from the disease because the given

disease is Y linked dominant trait which will not be transferred in females.

30. (i) Sporozoite is the parasitic stage that is being transferred from host X (mosquito) to host Y (human). **(1 mark)**
- (ii) The parasite reproduce asexually in the liver cells of the human host. It leads to bursting of cells and the parasite spreads into the bloodstream. **(1 mark)**
- (iii) Parasite when enters in to the red blood cells reproduces asexually causing bursting of the red blood cells. Further causing the cycle of fever and other symptoms. Released parasites from ruptured red blood cells infect new red blood cells. **(1 mark)**
- (iv) (a) Host X is mosquito which will feed on host Y to obtain its blood meal and the host Y is already been infected by the parasite which is at the sexual stage (gametocytes) develop in red blood cells of the host Y. The host X will take up gametocytes with blood meal. **(1 mark)**

OR

- (iv) (b) When the parasite enters into the red blood cells of the host it reproduces asexually, when the red blood cells get burst this causes cycles of fever and other symptoms. The disease is malaria and the rupture of RBCs is associated with release of a toxic substance, haemozoin, which is responsible for the chill and high fever recurring every three to four days. **(1 mark)**

SECTION - E

31. (a) The role of t-RNA, m-RNA and r-RNA during the process of protein synthesis in prokaryotes is as follows:
- t-RNA:** tRNA functions as an adapter molecule during the translation process. It was earlier known as soluble RNA or sRNA. As an adapter, it links the amino acids to nucleic acids. It carries the amino acid to be added in the peptide chain and also deciphers the codon for the same in the mRNA molecule.
- m-RNA:** Messenger RNAs are required for converting the genetic information in the DNA into functional proteins. More than one protein can be encoded in a single mRNA. In prokaryotes mRNAs must have a ribosome binding site in order to be translated. **(2½ marks)**
- r-RNA:** Ribosomal RNA (rRNA) is the RNA component of a ribosome and helps in protein synthesis. These structures physically move along an mRNA molecule and catalyse the assembling of amino acids into protein chains. They also bind tRNAs and various accessory molecules needed for the synthesis of protein. **(2½ marks)**

OR



There are many types of RNA found in eukaryotic and prokaryotic cells. Three main type of RNA are mRNA, tRNA, rRNA.

- (b) (i) According to the cross:
TTGG (tall green) X ttgg (dwarf yellow)
F₁ generation progeny will have tall green (TtGg) genotype and tall green phenotype.
- (ii) The law of dominance can be applied in the F₁ generation. The one which is expressed in the F₁ generation is called the dominant trait and the one which is suppressed is called a recessive trait. In simple words, the law of dominance states that recessive traits are always dominated or masked by the dominant trait. **(2½ marks)**
- (iii) Phenotypic ratio in the F₂ generation will be tall green: tall yellow: dwarf green: dwarf yellow and the genotypic ratio will be 9:3:3:1. **(1½ marks)**
- (iv) The genotypes of the male and female gametes produced by F₁ progeny will 1:2:2:4:1:2:1:2:1. **(1 mark)**

32. (a) (i) Plasmids used in genetic engineering are called vectors. They are used to transfer genes from one organism to another. Plasmid helps in linking of foreign DNA and selection of recombinants from non-recombinants. Some plasmids may have only one or two copies per cell whereas others may have 15-100 copies per cell. Their numbers can go even higher. The two sources of plasmid are E.coli and Agrobacterium tumefaciens. **(1 mark)**
- (ii) Origin of replication (ori) : This is a sequence from where replication starts and any piece of DNA when linked to this sequence can be made to replicate within the host cells. This sequence is also responsible for controlling the copy number of the linked DNA. So, if one wants to recover many copies of the target DNA it should be cloned in a vector whose origin support high copy number. **(2½ marks)**
- Selectable marker** : In addition to 'ori', the vector requires a selectable marker, which helps in identifying and eliminating nontransformants and selectively permitting the growth of the transformants. Transformation is a procedure through which a piece of DNA is introduced in a host bacterium (you will study the process in subsequent section). Normally, the genes encoding resistance to antibiotics such as ampicillin, chloramphenicol, tetracycline or kanamycin, etc., are considered useful

selectable markers for E. coli. The normal E. coli cells do not carry resistance against any of these antibiotics.

(iii) The r-DNA technology cannot proceed without restriction endonuclease because this enzyme cuts the DNA very precisely and thus eliminates the infecting organisms. It cuts double stranded DNA at specific recognition sites. It was used to restrict the growth of viruses when it was discovered in bacteria.

(1½ marks)

OR

- (b) (i) Specific Bt toxin genes were isolated from Bacillus thuringiensis and incorporated into the several crop plants such as cotton. The choice of genes depends upon the crop and the targeted pest, as most Bt toxins are insect-group specific. The toxin is coded by a gene cryIAC named cry. There are a number of them, for example, the proteins encoded by the genes cryIAC and cryIIAB control the cotton bollworms, that of cryIAB controls the growth of corn borer infecting the healthy cotton plants. The genetically unmodified cotton crops will remain unprotected with the corn borer and this will negatively affect the cotton crops. **(2½ marks)**
- (ii) Cotton bollworm and corn borer are the two insects that are killed by Bt toxin. **(1 mark)**
- (iii) Bt toxin is produced by bacteria Bacillus thuringiensis. During sporulation, these bacteria forms intracellular crystalline proteins. Bt toxin does not kill the bacterium that produces it, but kills the insect that ingests it because the endotoxin that accumulates in the bacterium is an inactive precursor. It gets activated only in the alkaline gut of insect. When insect ingests it, then protoxin is cleaved by proteases (alkaline conditions in gut), resulting is shorter versions of the protein that display the toxic activity, by binding to the inside of the insects mid gut and damages the surface epithelium by creating pores that cause swelling and lysis. So, that insect is unable to feed and consequently starves to death. **(1½ marks)**
33. (a) (i) In a typical embryo sac of an angiosperm there are seven cells- one central cell, two synergids, one egg cell, and three antipodals. The egg apparatus comprising a group of three cells (two synergids and one egg cell) is found at the micropylar end. Three antipodal cells are located at the chalazal end. Six of the eight nuclei are enclosed by cell walls, whereas, the remaining two nuclei (polar nuclei) are located in the central cell. Hence, a typical angiosperm embryo sac at maturity is 8-nucleate and 7-celled. **(2½ marks)**

(ii)

(1) Autogamy is a type of pollination is achieved within the same flower. Transfer of pollen grains from the anther to the stigma of the same flower. Geitonogamy involves the transfer of pollen grains from the anther to the stigma of another flower of the same plant. In several species such as papaya, male and female flowers are present on different plants, that is each plant is either male or female (dioecy). This condition prevents both autogamy and geitonogamy. **(1 mark)**

(2) In some species, pollen release and stigma receptivity are not synchronised. Either the pollen is released before the stigma becomes receptive or stigma becomes receptive much before the release of pollen. In some other species, the anther and stigma are placed at different positions so that the pollen cannot come in contact with the stigma of the same flower. Both these devices prevent autogamy but not geitonogamy. **(1½ marks)**

**Note**

Geitonogamy is a functionally cross pollination involving a pollinating agent.

(b) (i)

(1) Sertoli cells are present in the seminiferous tubules of the male gonads in the testes. **(1 mark)**

(2) Leydig cells are present in the intertubular/interstitial space. **(1 mark)**

(ii) The increased levels of GnRH then acts at the anterior pituitary gland and stimulates secretion of two gonadotropins – luteinising hormone (LH) and follicle stimulating hormone (FSH). LH acts at the Leydig cells and stimulates synthesis and secretion of androgens. Androgens, in turn, stimulate the process of spermatogenesis. FSH acts on the Sertoli cells and stimulates secretion of some factors which help in the process of spermiogenesis. Sertoli cells are located within the seminiferous tubules of the testes. **(3 marks)**

They provide nutrition to the developing sperms.

The Leydig cells are located in the interstitial spaces between the seminiferous tubules.

They synthesise and secrete androgen hormones (like testosterone).