



Name	:	_____
Date of Exam.	:	_____
Duration	:	<b>3 hours</b>
Max. Marks	:	<b>80</b>
Study Centre	:	_____

# BIOLOGY

Sample Question Paper 2022-23  
CLASS XII BIOLOGY (044)

Maximum Marks: 70

Time: 3 hours

General Instructions:

- All questions are compulsory.
- The question paper has five sections and 33 questions. All questions are compulsory.
- Section–A has 16 questions of 1 mark each; Section–B has 5 questions of 2 marks each; Section–C has 7 questions of 3 marks each; Section–D has 2 case-based questions of 4 marks each; and Section–E has 3 questions of 5 marks each.
- 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.
- Wherever necessary, neat and properly labeled diagrams should be drawn.

Section A		
Q. No.		Marks
1.	The spermatogonia present on the inside wall of the seminiferous tubules multiply by mitotic division and increase in their number. Each spermatogonium is diploid and contains 46 chromosomes. Some spermatogonia called primary spermatocytes periodically undergo meiosis. How many chromosomes are there in the primary spermatocyte? (a) 23 (b) 22 (c) 45 (d) 46	1
2.	Which of the following can be an ideal contraceptive for a female who wants to have space amongst her children? (a) Condom (b) Vasectomy (c) Pills (d) IUD	1
3.	When <i>Streptococcus pneumoniae</i> (pneumococcus) bacteria are grown on a culture plate, why some produce smooth shiny colonies (S) while others produce rough colonies (R)? (a) R strain bacteria have a mucous (polysaccharide) coat, while S strain does not (b) S strain bacteria have a mucous (polysaccharide) coat, while R strain does not (c) Both the strains have a mucous (polysaccharide) coat	1

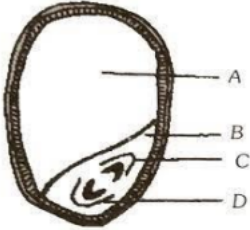
	(d) None of the above	
4.	About 2000 million years ago (mya) the first cellular forms of life appeared on earth. Small sized reptiles of that era still exist today. Imagine, how would be the mammals of that time? (a) Lizards (b) Shrews (c) Frogs (d) Fishes	1
5.	A person is allergic to dust and pollen grains. He starts sneezing and suffers from symptoms like watery eyes, running nose and breathing problem. Which of the following type of antibody will be produced in his body? (a) IgA (b) IgE (c) IgM (d) IgG	1
6.	Which of the following is also called an 'adapter molecule'? (a) mRNA (b) rRNA (c) tRNA (d) snRNA	1
7.	Which of the following is incorrect about BOD? (a) It measures the rate of uptake of oxygen by microorganism in a sample of water. (b) Greater the BOD of waste water, lesser is the pollution potential (c) It also measures the organic matter present in water (d) All of the above	1
8.	An orchid growing as an epiphyte on a mango branch is an example of which of the following? (a) Amensalism (b) Parasitism (c) Commensalism (d) Predation	1
9.	The diversity of plants and animals is not uniform throughout the world but shows a rather uneven distribution. What will be the effect on biodiversity if we move from the equator to the poles? (a) It will increase (b) It will remain the same (c) It will decrease (d) None of the above	1
10.	Trees occupy top layer of a forest, shrubs the second and herbs and the grasses occupy the bottom layers, this vertical distribution of different species occupying different levels is called (a) Leaching (b) Stratification (c) Decomposition (d) All of the above	1
11.	Among animals which of the following make the most species-rich taxonomic group? (a) Molluscs (b) Insects (c) Crustaceans	1



	(d) All of the above	
12.	Tropical environments are. (a) Less seasonal (b) Constant (c) Predictable (d) All of the above	1
<p>Question No. 13 to 16 consist of two statements – Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:                      A. Both A and R are true and R is the correct explanation of A.                      B. Both A and R are true and R is not the correct explanation of A.                      C. A is true but R is false.                      D. A is False but R is true.</p>		
13.	Assertion : The presence of thymine at the place of uracil confers additional stability to DNA. Reason: Both DNA and RNA are able to mutate, but DNA being unstable, mutate at a faster rate.	1
14.	Assertion: the innermost wall layer of a microsporangium is called tapetum. Reason: It's function is to nourish the pollen grains.	1
15.	Assertion: Acquired immunity is pathogen specific. Reason: It is characterised by memory and is non-specific type of defence. This means when our body encounters a pathogen for the first time it produces a response called primary response which is of high intensity.	1
16.	Assertion: DNA fingerprinting involves identifying differences in some specific regions in DNA sequence called repetitive DNA. Reason: Polymorphism RNA sequence is the basis of genetic mapping of human genome as well as RNA fingerprinting.	1
<b>Section B</b>		
17.	Wings of birds and wings of butterflies contribute to locomotion. Explain the type of evolution such organs are a result of.	2
18.	How has genetically modification in crops have enhanced their output?	2
19.	Why does failure of testes to descend into scrotum produce sterility?	
20.	A person is infected with tetanus. What type of antibodies should be given to such an individual. What is such type of immunisation called?	2
21.	Alexander Von Humbolt observed that within a region species richness increased with increasing explored area, but only to a certain limit. On a logarithmic scale, the relation between species richness and a wide variety of taxa is described by an equation. (a) Mention the equation. (b) State the value of regression co-efficient for frugivorous birds and mammals in a tropical forest of different continents.	2
<b>Section C</b>		
22.	Draw a sectional view of the human ovary showing different stages of developing follicles, corpus luteum and ovulation.	3
23.	What are satellite DNAs in a genome? Explain their role in DNA fingerprinting.	3
24.	Alien species are very invasive and are also a threat to the indigenous species. Substantiate this statement with any two examples.	3
25.	A person is suffering from chills and high fever recurring every three to four days. The symptoms are caused in which disease in humans. Name its causal organism. Why is the victim showing symptoms of high fever?	3
26.	(a) What is the difference between a malignant tumor and a benign tumor?	3



	(b) Cellular oncogenes are found in all the human beings. Why is that so that only some of them suffer from cancer? OR How are cancers detected? Mentions any two approaches of their treatment.	
27.	In order to force bacteria to take up the plasmid, the bacterial cells must first be made 'competent' to take up DNA. How can be the bacterial cells made competent in biotechnology?	3
28.	(a) Name the set of positively charged basic proteins present in eukaryotes that along with DNA forms the nucleosome. (b) A typical nucleosome contains how many base pairs of DNA? (c) The packaging of chromatin at higher level requires an additional set of proteins. Name those proteins. Also name the transcriptionally active chromatin.	3
<b>Section D</b>		
Q.no 29 and 30 are case based questions. Each question has subparts with internal choice in one subpart.		
29.	Read the following and answer the questions that follow: DNA replication is a complex multistep process that requires enzymes, protein factors and metal ions. DNA replication in eukaryotes occurs in the nucleus during the S-phase of the cell cycle. It is semi-discontinuous in eukaryotes. In prokaryotes, replication takes place in the cytoplasm. DNA replication in bacteria occurs prior to fission. Nucleoid or viral chromosome is a single molecule of nucleic acid, it may be linear or circular. Nucleic acid in a virus is either DNA or RNA but never both. (a) Name the enzyme that is involved in the replication of DNA and the enzyme that joins the discontinuously synthesised strands of DNA during replication. (b) What is the function of deoxyribonucleoside triphosphates during the replication process. (c) Draw the diagram of a replicating fork. OR (c) Name the enzyme that acts over the ori site and unwinds the two strands of DNA. Which bonds get destroyed during this process?	4
30.	Read the following and answer the questions that follow: Embryo develops at the micropylar end of the embryo sac where the zygote is situated. The zygote divides only after certain amount of endosperm is formed. The early stages of embryo development are similar in both monocotyledons and dicotyledons. The zygote gives rise to the proembryo and subsequently to the globular heart-shaped and mature embryo. A typical dicotyledonous embryo consists of an embryonal axis and two cotyledons. Embryo of monocotyledons possess only one cotyledon. (a) Why is double fertilisation called so? (b) Refer to the given diagram of the embryo of an angiospermous plant with parts labelled B,C and D. Select the correct statement(s) regarding this.	4

	 <p>(i) Part 'B' supplies nutrition to the developing embryo.                  (ii) Part 'C' is the protective sheath of radicle and root cap.                  (iii) Part 'D' is the protective sheath of shoot apex and leaf primordia.                  (c) Draw the diagram of a typical dicot embryo.                  OR                  (d) What is triple fusion?</p>	
<b>Section E</b>		
31.	Describe Meselson and Stahl's experiment that was carried in 1958 on <i>E.coli</i> . Write the conclusion they arrived at after the experiment. OR Describe the process of transcription in prokaryotes with a well labelled diagram.	5
32.	<ul style="list-style-type: none"> <li>● State the law of independent assortment.</li> <li>● With the help of a Punnett square demonstrate the law of independent assortment in a dihybrid cross that are involving two heterozygous parents.</li> </ul> OR Describe the experiment performed by Alfred Hershey and Martha Chase that made them arrive to the conclusion that DNA is the genetic material.	5
33.	(a) State how mature insulin different from proinsulin secreted by pancreas in humans? (b) Explain how was the human functional insulin produced by using recombinant DNA technology. (c) Why is the functional insulin thus produced considered better than the ones used earlier by diabetic patients? OR (a) How has recombinant technology helped in large scale production of vaccines? Support your answer with an example. (b) Name the process involved in the production of nematode resistant tobacco plants, using genetic engineering. Explain the strategy adapted to develop such plants.	5

**Solutions**  
**Section A**

Ans. 1 (d) A primary spermatocyte is a kind of cell that develops from spermatogonium in the mitotic cell division of spermatogenesis. It is diploid in nature. Because of mitotic cell division, they possess 46 chromosomes.

Ans. 2 (d) IUDs are ideal contraceptives for the females who want to delay pregnancy and/or space children. It is one of most widely accepted methods of contraception in India.

Ans3 (b) When *Streptococcus pneumoniae* (pneumococcus) bacteria are grown on a culture plate, some produce smooth shiny colonies (S) while others produce rough colonies (R). This is because the S strain bacteria have a mucous (polysaccharide) coat, while R strain does not.

Ans. 4.(b) The early mammals were like shrews.

Ans. 5. The type of antibodies produced during allergy are IgE type. IgE mediates the immediate hypersensitivity reactions and also acts as a mediator in allergic response.

Ans. 6. (c)The tRNA molecules are called as adaptor molecules because they can bind with both the amino acids as well as RNA.

Ans. 7. (b) The greater the BOD (Biochemical Oxygen Demand) of the water, the more is its polluting potential because the rapidly the oxygen is depleted in the water. This means lesser oxygen is available for higher forms of aquatic life and thus water will be disturbed.

Ans. 8 (c) Commensalism is the interaction in which one species benefits and the other is neither harmed nor benefited, e.g n orchid growing as an epiphyte on a mango branch.

S9.Ans.(c)

Sol. biodiversity is minimum in the Arctic region, moderate in a temperate area and maximum in tropical regions.

10. (b) the vertical distribution is called as stratification.

11. (b) Among animals, insects are the most species-rich taxonomic group, making up more than 70 per cent of the total. That means, out of every 10 animals on this planet, 7 are insects.

12. (d) Tropical environments, unlike temperate ones, are less seasonal, relatively more constant and predictable.

13. (c) the presence of thymine at the place of uracil also confers additional stability to DNA. Both DNA and RNA are able to mutate. In fact, RNA being unstable, mutate at a faster rate. Consequently, viruses having RNA genome and having shorter life span mutate and evolve faster. RNA can directly code for the synthesis of protein.

14. (a) In a transverse section, a typical microsporangium appears near circular in outline. It is generally surrounded by four wall layers the epidermis, endothecium, middle layers and the tapetum. The outer three wall layers perform the function of protection and help in dehiscence of anther to release the pollen. The innermost wall layer is the tapetum. It nourishes the developing pollen grains.

15. (c) Acquired immunity, on the other hand is pathogen specific. It is characterised by memory. This means when our body encounters a pathogen for the first time it produces a response called primary response which is of low intensity. It is innate immunity that is non-specific type of defence.

16. (c) Polymorphism in DNA sequence is the basis of genetic mapping of human genome as well as DNA fingerprinting.

#### Section B

Ans. 17 Birds and bats are very different from evolutionary point of view both anatomically and physiologically. Though their wings contribute to locomotion (flying) but they have a different structural plant as they have different ancestors. The organs of such type are called as analogous organs and are result of convergent evolution a process in which the organism are not related closely but have evolved similar traits due to adaptations to similar ecological niches.

Ans. 18. Genetic modification is not only restricted to organism but it has also been applied to crops for their betterment by the scientist. Genetic modification have made crops stress resistant to cold, heat and drought.



They have also become pest resistant that cuts down the use of pesticides which have made them ecologically and economically beneficial. Genetic modification has increased their mineral usage that maintains their mineral content.

Ans. 19. If the testes fail to descend in the scrotum then this causes sterility as sperm formation does not take place at abdominal temperature. Testis descend in the scrotum because sperm formation requires lower temperature than the body.

Ans. 20. If a person is infected with some deadly microbes to which quick immune response is required just as in tetanus, preformed antibodies, or antitoxin (a preparation containing antibodies to the toxin) should be injected immediately. This type of immunisation is called passive immunisation.

Ans. 21. (a) The equation is as follows:

$$\log S = \log C + Z \log A$$

Where:

S is the species richness

A is the area

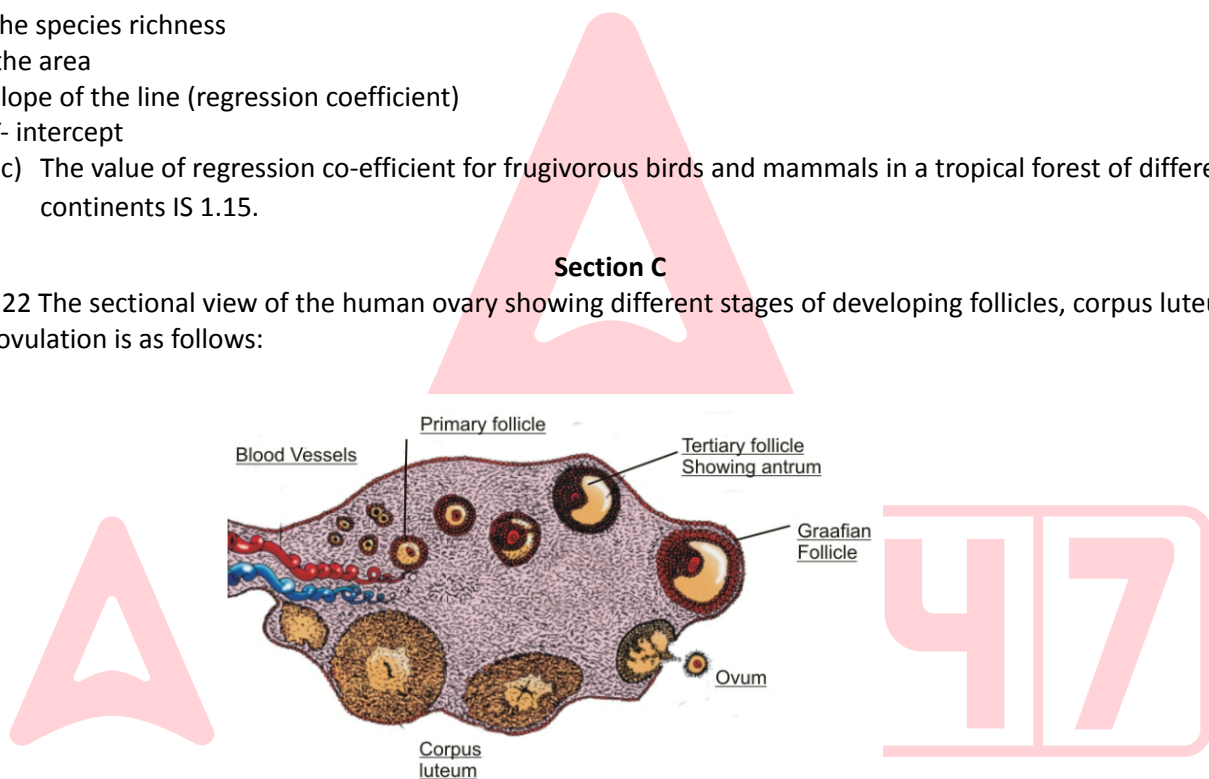
Z is slope of the line (regression coefficient)

C = Y- intercept

(c) The value of regression co-efficient for frugivorous birds and mammals in a tropical forest of different continents is 1.15.

### Section C

Ans. 22 The sectional view of the human ovary showing different stages of developing follicles, corpus luteum and ovulation is as follows:



Ans. 23. The satellite DNA are a part of the genome that contains highly repetitive DNA sequences. Every individual have specific lengths of DNA satellites that forms the basis of DNA fingerprinting. They get inherited from the parents to their offsprings.

Ans. 24. As the alien species get introduced anywhere they turn out to be invasive. They disturb the whole ecological balance of that particular space and become a dominating species of that place. In turn they also lead to decline of the indigenous species of that particular area. E.g Chilchid fish in Lake Victoria led to the extinction of nearly 200 species which introduced Nile Perch in Lake Victoria. And *Parthenium* and *Eichhornia* led to environmental damage of the native species.

Ans. 25. A person is suffering from chills and high fever recurring every three to four days. The symptoms are of malaria. It is caused due to *Plasmodium* that is a tiny protozoan. The parasite requires two hosts to complete its life cycle namely human and the mosquitoes. The victim suffering malaria shows chills and high fever that reoccurs after 3 to 4 days because the rupture of the RBC is associated with release of a toxic substance called haemozoin that is responsible for chills and fever that repeat after 3 to 4 days.

Ans 26. (a) The difference between malignant and benign tumour is as follows:

Malignant tumour	Benign tumour
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1. Cells of malignant tumor can spread to other organs or parts of the body.
2. Malignant tumors usually have a fairly rapid growth rate.
3. They often invade the basal membrane that surrounds an adjacent or nearby healthy tissue.
4. Malignant tumors can spread through the lymphatic system or bloodstream. Furthermore, they may also spread by extending 'fingers' into the adjacent tissue

1. Cells of benign tumor do not spread to other parts or organs of the body from the origin.
2. Most benign tumors have a slow growth rate.
3. They do not invade nearby or adjacent tissue.
4. These tumors do not metastasize or spread to other parts or tissues of the body

(b) Cellular oncogenes are found in all the human beings, in some when they get activated under certain conditions lead to oncogenic transformation of the cells. This activation can be due to physical, chemical or biological agents called carcinogens. E.g The chemical carcinogens present in tobacco smoke have been identified as a major cause of lung cancer.

OR

Cancer detection is based on biopsy and histopathological studies of the tissue and blood and bone marrow tests for increased cell counts in the case of leukemias. However, techniques like radiography (use of X-rays), CT (computed tomography) and MRI (magnetic resonance imaging) are very useful to detect cancers of the internal organs. Cancers can be treated by radiotherapy in which tumor cells are irradiated lethally, taking proper care of the normal tissues surrounding the tumor mass. Other than this, several chemotherapeutic drugs are used to kill cancerous cells. Some of these are specific for particular tumors. Most cancers are treated by combination of surgery, radiotherapy and chemotherapy.

Ans. 27. Cell competence is a cell's ability to take up foreign DNA from the surrounding environment.

Bacterial cells are to be made competent because their cell membrane is selectively permeable and allows only certain molecules to pass through them. To make them competent:

- The cells are treated with a specific concentration of a divalent cation like calcium that increases the efficiency with which the DNA enters the pores through the cell wall.
- Next, the cells are given heat shock by placing them in ice followed by a brief exposure to a temperature of 42 degree and again putting them on ice.

Ans. 28. (a) the set of positively charged basic proteins present in eukaryotes that along with DNA forms the nucleosome is the histone.

(b) A typical nucleosome contains 200 bp of DNA helix.

(c) The packaging of chromatin at higher level requires an additional set of proteins, these proteins are called non-histone chromosomal proteins (NHC). The transcriptionally active chromatin is the euchromatin.

#### Section D

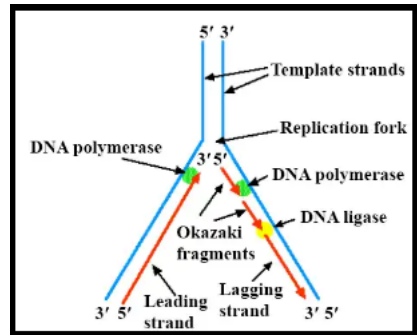
Ans. 29. (a) The enzyme that is involved in the replication of DNA is DNA dependent DNA polymerase and the enzyme that joins the discontinuously synthesised strands during the replication of DNA is ligase.

(b) Energetically replication is very expensive process. Deoxyribonucleosides performs two functions namely they act as substrates in the process and provide energy for polymerisation reaction.

(c) Diagram of a replicating fork is as follows:







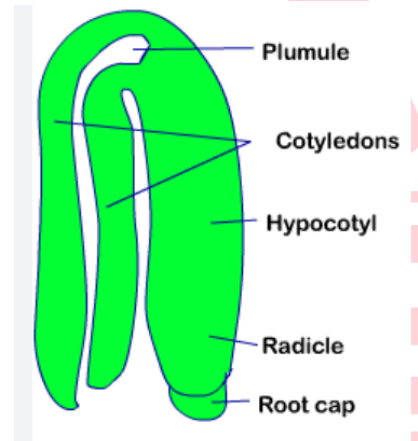
OR

It is the helicase that acts over the ori site and unwinds the two strands of DNA. The bonds that get destroyed during this process is the hydrogen bonds between the nitrogenous base pairs.

Ans. 30. (a) After entering one of the synergids, the pollen tube releases the two male gametes into the cytoplasm of the synergid. One of the male gametes moves towards the egg cell and fuses with its nucleus thus completing the syngamy. This results in the formation of a diploid cell, the zygote. The other male gamete moves towards the two polar nuclei located in the central cell and fuses with them to produce a triploid primary endosperm nucleus. As this involves the fusion of three haploid nuclei it is termed triple fusion. Since two types of fusions, syngamy and triple fusion take place in an embryo sac the phenomenon is termed double fertilisation.

(b) 'B' is the scutellum that supplies nutrition to the developing embryo. The coleorhiza protects the radicle in some plants that is penetrated by the root in germination. Coleoptile assists in the emergence of the shoot apex (first leaf) by safeguarding it while it passes through the soil.

(c) The diagram of a typical dicot embryo is as follows:



(d) During fertilisation one male gamete fuses with the egg cell and the other male gamete moves towards the two polar nuclei located in the central cell and fuses with them to produce a triploid primary endosperm nucleus (PEN). As this involves the fusion of three haploid nuclei it is termed triple fusion.

### Section E

Ans. 31. Meselson and Stahl conducted an experiment to demonstrate the semi-conservative nature of DNA replication. They used two cultures of *E. coli*, one growing in medium with  $N^{14}$  isotope while other growing in medium with  $N^{15}$  isotopes. They were allowed to grow separately for several generations. When these were subjected to density gradient centrifugation the cells growing on  $N^{14}$  medium contained both the strand of  $N^{14}$  while the cells of  $N^{15}$  medium contained both the strands of  $N^{15}$ , which settled down during centrifugation due to higher density.

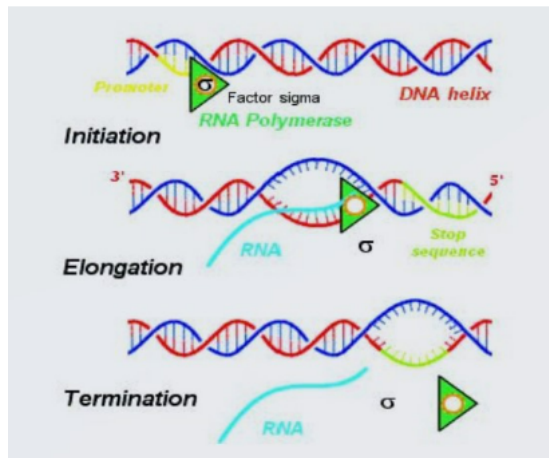
In the second experiment, the  $N^{15}$  culture was transferred to  $N^{14}$  media. The cells were subjected to density gradient centrifugation after one generation. It was found that the daughter cells produced bands of DNA which was located at intermediate position between  $N^{14}$  and  $N^{15}$  which lead to the conclusion that the resultant

daughter DNA contained two strands, one of  $N^{14}$  and the other is of  $N^{15}$ , which act as an evidence for the semi-conservative nature of DNA replication.

OR

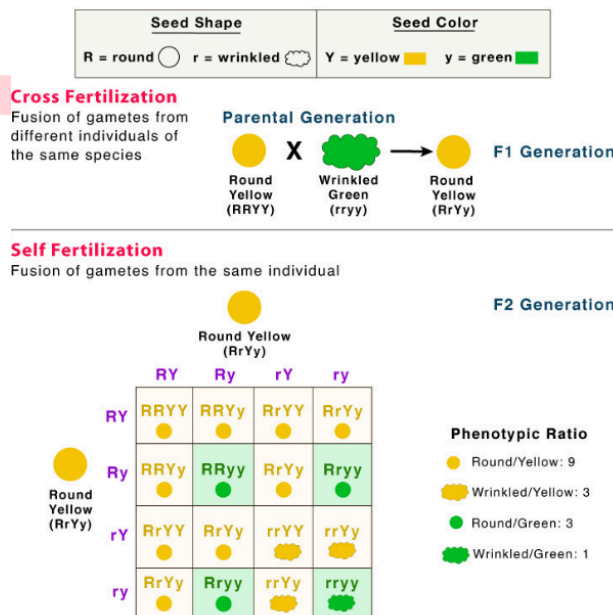
Transcription in prokaryotes is divided into 3 basic steps, initiation, elongation and termination.

1. Initiation: During this step, the DNA is unwound and becomes single-stranded near the initiation site. The RNA polymerase binds to promoter sequence and starts the transcription of the single-stranded DNA. The binding of RNA polymerase to promoter is facilitated and specified by sigma factor.
2. Elongation: After the synthesis of RNA more than 10 bp long, the sigma factor is removed. The enzyme then moves in 5' - 3' direction continuously synthesizing RNA.
3. Termination: This involves termination factor (rho) to stop transcription at specific sites. This factor causes dissociation of RNA polymerase from the DNA.



Ans. 32. (a) According to the law of independent assortment, during the inheritance of two different traits, the alleles of both the traits assort and are inherited independently of one another during gamete formation. This gives both the trait equal chances of being inherited.

(b)



OR

Hershey and Chase grew some viruses on a medium that contained radioactive phosphorus and some others on medium that contained radioactive sulfur. Viruses grown in the presence of radioactive phosphorus contained radioactive DNA but not radioactive protein because DNA contains phosphorus but protein does not. Similarly, viruses grown on radioactive sulfur contained radioactive protein but not radioactive DNA because DNA does not contain sulfur. Radioactive phages were allowed to attach to *E. coli* bacteria. Then, as the infection proceeded, the viral coats were removed from the bacteria by agitating them in a blender. The virus particles were separated from the bacteria by spinning them in a centrifuge. Bacteria which was infected with viruses that had radioactive DNA were radioactive, indicating that DNA was the material that passed from the virus to the bacteria. Bacteria that were infected with viruses that had radioactive proteins were not radioactive. This indicates that proteins did not enter the bacteria from the viruses. DNA is therefore the genetic material that is passed from virus to bacteria

Ans. 33(a) Proinsulin contains an extra stretch called C- peptide. This C- peptide is not present in the mature insulin and is removed during maturation into insulin.

(b) Firstly, we prepare two DNA sequences corresponding to chain A and B of human insulin. It is introduced in plasmid of *Escherichia coli* to produce insulin chains. Chain A and B are produced separately, extracted and combined by creating disulphide bonds to form human insulin.

(c) The functional insulin produced considered better than the ones used earlier by diabetic patients because, it is less expensive, it causes fewer allergic reactions and it is more rapidly absorbed and shows its effectiveness over a short period of time.

OR

Using recombinant DNA technology, scientists have been able to develop three types of recombinant vaccines:

- (1) live genetically modified organisms,
- (2) recombinant inactivated ("killed") vaccines, and
- (3) genetic vaccines.

These vaccines no longer cause disease, but still induce a strong immune response. Paralleling the development of new, more efficacious, stable, and safe recombinant vaccines has been the study of vaccine delivery methods and immune-stimulating adjuvant compounds that enhance the immune response. E.g vaccines like polio that has led to the complete eradication of the disease from the country. Development of the vaccines and its large scale production is possible by downstream processing that has led the vaccines reach every house of the country. Not only polio, the most threatening COVID 19 vaccine has been given to maximum population and continuous research is going to create better ones.

OR

A nematode *Meloidogyne incognita* infects the roots of tobacco plants which reduce the production of tobacco. The infection can be prevented using RNA interference (RNAi) process which is checked by silencing of specific mRNA due to a complementary ds RNA. The ds RNA binds and prevents translation of the mRNA. By using *Agrobacterium* vectors, nematode-specific genes were introduced into the host plants which produce both sense and antisense RNA in the host cells. These two RNAs are complementary to each other and form a double stranded RNA (ds RNA) that initiates RNAi and hence, silences the specific mRNA of the nematode. The parasite cannot survive in transgenic host and so, prevents the plants from pests.

The strategy is:

- ds RNA binds and prevents translation of the mRNA.
- using *Agrobacterium* as vector introduce it into tobacco
- this produce both sense and antisense RNA in the host cells.
- These two RNAs are complementary to each other and form a double stranded RNA
- initiates-RNA interference
- it silences the specific mRNA of the nematode
- The parasite cannot survive in transgenic host



- So, the plant is prevented from pest



