LIBERTY PAPER SET

STD. 12 : Biology

Full Solution

Time : 3 Hours **ASSIGNTMENT PAPER 11**

Part A

1. (D) **2.** (A) **3.** (B) **4.** (A) **5.** (C) **6.** (D) **7.** (C) **8.** (A) **9.** (A) **10.** (A) **11.** (D) **12.** (A) **13.** (C) **14.** (B) **15.** (C) **16.** (B) **17.** (A) **18.** (B) **19.** (C) **20.** (C) **21.** (A) **22.** (C) **23.** (C) **24.** (D) **25.** (B) **26.** (B) **27.** (C) **28.** (B) **29.** (D) **30.** (A) **31.** (D) **32.** (C) **33.** (A) **34.** (C) **35.** (D) **36.** (C) **37.** (B) **38.** (A) **39.** (A) **40.** (A) **41.** (A) **42.** (A) **43.** (B) **44.** (C) **45.** (C) **46.** (B) **47.** (C) **48.** (A) **49.** (D) **50.** (C)

Section A

➢ **Write the answer of the following questions : (Each carries 2 Mark)**

1.

➥ Some examples of water pollinated plants are several marine sea-grasses such as *Zostera*.

- In this group, female flowers remain submerged in water and the pollen grains are released inside the water.
- Pollen grains in many such species are long, ribbon like and they are carried passively inside the water.
- Some of them reach the stigma and achieve pollination.
- In most of the water-pollinated species, pollen grains are protected from wetting by a mucilaginous covering.

2.

➥ An ideal contraceptive should be

(i) user-friendly

(ii) easily available

(iii) effective and reversible with no or least side-effects.

(iv) it also should in no way interfere with the sexual drive, desire and/or the sexual act of the user.

3.

➥ Name of Disorder :

(a) Turner's syndrome

(b) Down's syndrome

4.

➥ Ans: If the sequence of one strand of DNA is written as follows:

➥ 5' - ATGCATGCATGCATGCATGCATGCATGC - 3'

➥ The sequence of the complementary strand in 5' -> 3' direction will be :

➥ 5' - GCATGCATGCATGCATGCATGCATGCAT - 3'

5.

➥ The organs of animals which have similar internal structure but different functions are called homologous organs.

➥ For example whales, bats, leopards and humans (all mammals) have similarities in the internal structure of the forelimbs.

➥ In the forelimbs of all these animals there are humerus, metatarsals, posterior metatarsals and ankles.

➥ In these animals, organs with the same structure developed, but they were adapted in different directions and according to their needs. This is the evolution of divergence.

➥ This structure is homologous.

➥ Equivalence indicates common ancestors.

➥ Other examples are the hearts and brains of vertebrates.

➥ Thorn and tendrils of Bougainvillae and cucurbita represents homology.

6.

➥ (i) Females include masculinisation (features like males), increased aggressiveness, mood swings, depression, abnormal menstrual cycles, excessive hair growth on the face and body, enlargement of clitoris, deepening of voice.

(ii) In males it includes acne, increased aggressiveness, mood swings, depression, reduction of size of the testicles, decreased sperm production, potential for kidney and liver dysfunction, breast enlargement, premature baldness, enlargement of the prostate gland.

➥ These effects may be permanent with prolonged use. In the adolescent male or female, severe facial and body acne, and premature closure of the growth centres of the long bones may result in stunted growth.

7.

➥ ***Trichoderma :***

- ➠ *Trichoderma* species are free living fungi that are very common in root ecosystems.
- ➠ This fungi is used as biocontrol agent for the treatment of plant disease.
- ➠ They are effective biocontrol agents of several plant pathogens.

➥ ***Baculoviruses* :**

- ➠ The majority of baculoviruses used as biocontrol agents are in the genus *Nucleopolyhedrovirus*.
- ➠ *Baculoviruses* are pathogens that attack insects and other arthropods.

➥ Various biocontrol agents have shown no negative impacts on plants, mammals, birds, fish or even on non target insects.

➥ Inspite of this, they are desirable when beneficial insects are being conserved to aid in an overall integrated pest management (IPM) programme, or when an ecologically sensitive area is being treated.

8.

➥ **(iii) Immigration** is the number of individuals of the same species that have come into the habitat from elsewhere during the time period under consideration.

➥ **(iv) Emigration** is the number of individuals of the population who left the habitat and gone elsewhere during the time period under consideration.

9.

➥ Endosperm development precedes embryo development.

- ➠ The primary endosperm cell divides repeatedly and forms a triploid endosperm tissue.
- ➠ The cells of this tissue are filled with reserve food materials and are used for the nutrition of the developing embryo.
- ➠ In the most common type of endosperm development, the PEN undergoes successive nuclear divisions to give rise to free nuclei. This stage of endosperm development is called free-nuclear endosperm.
- ➠ Subsequently cell wall formation occurs and the endosperm becomes cellular.
- ➠ The number of free nuclei formed before cellularisation varies greatly.
- ➠ The coconut water from tender coconut that you are familiar with, is nothing but free-nuclear endosperm (made up of thousands of nuclei) and the surrounding white kernel is the cellular endosperm.
- ➠ Endosperm may either be completely consumed by the developing embryo (e.g., pea, groundnut, beans) before seed maturation or it may persist in the mature seed (e.g. castor and coconut) and be used up during seed germination.

10.

➥ **(b) Withdrawal or coitus interruptus :**

- Withdrawal or coitus interruptus is another method in which the male partner withdraws his penis from the vagina just before ejaculation so as to avoid insemination.

➥ **(c) Lactational amenorrhea :**

- Lactational amenorrhea (absence of menstruation) method is based on the fact that ovulation and therefore the cycle do not occur during the period of intense lactation following parturition.
- Therefore, as long as the mother breast-feeds the child fully, chances of conception are almost nil.
- As no medicines or devices are used in these methods, side effects are almost nil. Chances of failure, though, of this method are also high.

11.

➥ Two closely related species competing for the same resources cannot co-exist indefinitely and the competitively inferior one will be eliminated eventually. This may be true if resources are limiting, but not otherwise.

➥ More recent studies do not support such gross generalizations about competition. While they do not rule out the occurrence of interspecific competition in nature, they point out that species facing competition might evolve mechanisms that promote co-existence rather than exclusion. One such mechanism is ‘resource partitioning’.

- If two species compete for the same resource, they could avoid competition by choosing, for instance, different times for feeding or different foraging patterns.
- Mac Arthur showed that five closely related species of warblers living on the same tree were able to avoid competition and co-exist due to behavioral differences in their foraging activities.

12.

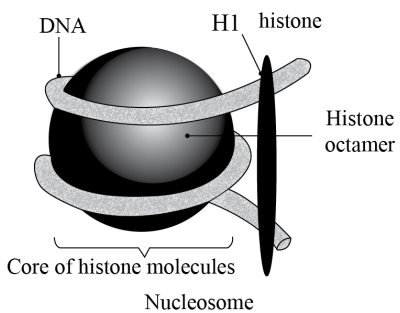
- Ecosystem term is introduced by A. G. Tansly for the first time.
- Ecosystem is a result of interaction between all living and non living factors of environment.
- In an Ecosystem, all biotic and abiotic components are linked by unidirectional energy flow and nutrients cycle.
- Biotic components : plants, animals, microbes.
- Abiotic components : solar energy, water, air and land etc.
- Types of ecosystem : Different types of ecosystems of nature, constitute the giant ecosystem-the biosphere. The ecosystems are categorised in to two as follows :
- (1) Natural ecosystems :
  - They are operated by themselves under natural conditions without any major interference by man.
- (2) Man-made ecosystems crop fields and aquarium
- Based upon the particular kind of habitat, these are further divided as :
  - (i) Terrestrial ecosystems : (a) forest (b) grassland (c) desert.
  - (ii) Aquatic ecosystems : They may be further divided as fresh water and marine water.
- In the double helix model or in double-stranded DNA, the ratio between the adenine and thymine molecule is the same, whereas the ratio between the guanine and cytosine is the same.
- In 100% of DNA, if the percent of cytosine is 20% then the percent of guanine is also equal to 20%.
- By adding the percentage of cytosine and guanine, total of 40% are present and the remaining 60% of DNA is formed by adenine and thymine.
- Thus in DNA, there is 30% of adenine and 30% of thymine.So, the percent of adenine in DNA is 30%.

Section B

➢ **Write the answer of the following questions : (Each carries 3 Mark)**

13.

- Taken the distance between two consecutive base pairs as 0.34 nm (0.34×10^{-9} m), if the length of DNA double helix in a typical mammalian cell is calculated (simply by multiplying the total number of bp with distance between two consecutive bp,
- The length of DNA = Total no. of base pair × Distance between two base pair
- 6.6×10^{9} bp × 0.34×10^{-9} m/bp it comes out to be approximately 2.2 metres.
- A length that is far, greater than the dimension of a typical nucleus (approximately 10^{-6} m).
- In prokaryotes, such as, E. coli, though they do not have a defined nucleus, the DNA is not scattered throughout the cell.
- DNA (being negatively charged) is held with some proteins (that have positive charges) in a region termed as 'nucleoid'.
- The DNA in nucleoid is organised in large loops held by proteins.



- In eukaryotes, this organisation is much more complex. 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.
- Nucleosome :
- 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, thread- like 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.
- Non-histone Chromosomal (NHC) proteins :
- The packaging of chromatin at higher level requires additional set of proteins that collectively are referred to as Non-histone Chromosomal (NHC) proteins.
- Euchromatin :
- In a typical nucleus, some region of chromatin are loosely packed (and stains light) and are referred to as euchromatin.
- Heterochromatin :
- The chromatin that is more densely packed and stains dark are known as heterochromatin. Euchromatin is said to be transcriptionally active chromatin, whereas heterochromatin is inactive.

14.

- The process of formation of a mature female gamete is called oogenesis.
- It is initiated during the embryonic development stage when a couple of million gamete mother cells (oogonia) are formed within each fetal ovary; no more oogonia are formed and added after birth.
- These cells (oogonia) start dividing and enter into prophase-I of the meiotic division and get temporarily arrested at that stage, called primary oocytes.
- Each primary oocyte then gets surrounded by a layer of granulosa cells and is called the primary follicle. A large number of these follicles degenerate during the phase from birth to puberty. Therefore, at puberty only 60,000-80,000 primary follicles are left in each ovary.
- At puberty the primary follicles get surrounded by more layers of granulosa cells and a new theca and are called secondary follicles.
- The secondary follicle soon transforms into a tertiary follicle which is characterised by a fluid filled cavity called antrum. The theca layer is organised into an inner theca interna and an outer theca externa.
- It is at this stage that the primary oocyte within the tertiary follicle grows in size and completes its first meiotic division. It is an unequal division resulting in the formation of a large haploid secondary oocyte and a tiny first polar body.
- The secondary oocyte retains bulk of the nutrient rich cytoplasm of the primary oocyte.
- The tertiary follicle further changes into the mature follicle or Graafian follicle.
- The secondary oocyte forms a new membrane called zona pellucida surrounding it.
- The Graafian follicle now ruptures to release the secondary oocyte (ovum) from the ovary by the process called ovulation.

15.

- The opinion of Russian scientist Operin and English scientist Haldane is as follows :
  - First life must have come from pre-existing non-living organic molecules (RNA, proteins etc.).
  - The structure of life must have been formed after chemical evolution, i.e. organic matter must have come into existence by the aggregation of inorganic molecules.
  - These substances must have been transformed into a colloidal system to produce life.
  - At that time the conditions on earth were very high temperature, volcanic storms, degenerate type of atmosphere which contained water, methane, ammonium etc.

- The next step in molecular evolution was the creation of molecules.

16.

- Maintaining personal and community hygiene is important for the prevention and control of many infectious diseases.
- Personal hygiene includes keeping the body clean, consuming pure water for drinking, food, vegetables etc.
- Disposal of sewage and excreta in public sanitation, periodic cleaning and keeping of reservoirs, cisterns, cesspools, tanks etc.
- Furthermore, it is necessary to follow the norms of cleanliness even in public use.
- Such measures are especially indispensable in places where infectious pathogens are spread through food and water like typhoid, amoebic, asceriasis etc.
- Close contact with the person as well as the use of items used in their mouth should be avoided as a treatment for the mentioned remedies used in air-borne diseases like pneumonia and cold.
- In insect-borne diseases like malaria and filariasis, the control and destruction of vectors and their breeding sites is essential.
- To achieve this purpose, water should not be allowed to accumulate in and around the residential area. Regular cleaning of the cooler used in the house is also a must.
- Use Gambusia fish which eat mosquito eggs.
- Places like pits, drainage, mud should be sprayed with pesticides.

17.

- Antibiotics are chemical substances which is produced by microbes. It kills pathogenic microbes or slow down their growth.
- This chemicals are called antibiotics.
- (anti=opposite, bio= life)
- e.g. Penicillin is the first discovered antibiotic.
- Discovery :
  - Alexander Fleming while working on *staphylococci* bacteria , once observed a mould growing in one of his unwashed culture plated around which staphylococci could not grow.
  - He found out that it was due to a chemical produced by the mould and he named it penicillin after the mould penicillium notatum.
  - This antibiotic was extensively used to treat American soldiers wounded in world war II
  - Fleming, chain and flory were awarded the Nobel prize in 1945, for this discovery.

18.

- In *Bacillus thuringiensis,* there is a bacterial gene which produce toxic crystal protein having insecticidal activity. This crystal protein is called Cry protein.
- Bt toxin is produced by a bacterium called *Bacillus thuringiensis.*
- Bt toxin gene has been cloned from the bacteria and been expressed in plants.
- So plants become resistance to insects without the need for insecticides. This is how a *biopesticide is* created.
- Some strains of *Bacillus thuringiensis* produce proteins that kill certain insects such as *lepidopterans* (tobacco budworm, armyworm), *coleopterans* (beetles) and *dipterans* (flies, mosquitoes).
- *B. thuringiensis* forms protein crystals during a particular phase of their growth.
- These crystals contain a toxic insecticidal protein.
- Actually, the Bt toxin protein exist as inactive protoxins.
- But once an insect ingest the inactive toxin, it is converted into an active form of toxin due to the alkaline pH of the gut which solubilise the crystals.
- The activated toxin binds to the surface of midgut epithelial cells and create pores.
- That cause cell swelling and lysis and eventually cause death of the insect.
- Specific Bt toxin genes were isolated from *Bacillus thuringiensis* and incorporated into the several crop plants such as cotton.
- The proteins encoded by the genes cryIAc and cryIIAb control the cotton bollworms.
- CryIAb controls corn borer.

19.

- For effective treatment of a disease, early diagnosis and understanding its pathophysiology is very important.
- Using conventional methods of diagnosis (serum and urine analysis, etc.) early detection is not possible.
- Recombinant DNA technology, Polymerase Chain Reaction (PCR) and Enzyme Linked Immunosorbent Assay (ELISA) are some of the techniques that serve the purpose of early diagnosis.
- Presence of a pathogen (bacteria, viruses, etc.) is normally suspected only when the pathogen has produced a disease symptom. By this time the concentration of pathogen is already very high in the body.
  - Diagnosis by PCR :
- However,very low concentration of a bacteria or virus at a time when the symptoms of the disease are not yet visible can be detected by amplification of their nucleic acid by PCR.
- 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.
  - Diagnosis by probes :
- 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.
  - Diagnosis by ELISA :
- 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 synthesized against the pathogen.

20.

- Decomposition :
  - Break down complex organic matter into inorganic substances like carbon dioxide, water and nutrients and the process is called decomposition.
  - Dead plant remains such as leaves, bark, flowers and dead remains of animals, including feacal matter, constitute detritus, which is the raw material for decomposition.
- Important steps for decomposition :
  - The important steps in the process of decomposition are fragmentation, leaching, catabolism, humification and mineralisation.
- Fragmentation :
  - Detritivores (e.g., earthworm) break down detritus into smaller particles. This process is called fragmentation.
- Leaching :
  - By the process of leaching, water soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts.
- Catabolism :
  - Bacterial and fungal enzymes degrade detritus into simpler inorganic substances. This process is called as catabolism.
- Humification :
  - Humification leads to accumulation of a dark coloured amorphous substance called humus that is highly resistant to microbial action and undergoes decomposition at an extremely slow rate.
  - Being colloidal in nature it serves as a reservoir of nutrients.
- Mineralisation :
  - The humus is further degraded by some microbes and release of inorganic nutrients occur by the process known as mineralisation.
- Factors affecting decomposition :
  - Decomposition is largely an oxygen-requiring process.
  - The rate of decomposition is controlled by chemical composition of detritus and climatic factors.

- In a particular climatic condition, decomposition rate is slower if detritus is rich in lignin and chitin.
- Decomposition rate is quicker, if detritus is rich in nitrogen and water-soluble substances like sugars.
- Temperature and soil moisture are the most important climatic factors that regulate decomposition through their effects on the activities of soil microbes.
- Warm and moist environment favour decomposition, whereas low temperature and anaerobiosis inhibit decomposition resulting in build up of organic materials.

21.

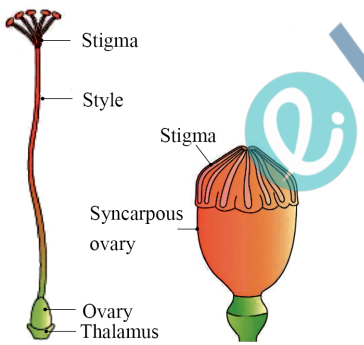
- The most important of them are :
- (i) Genetic diversity :
  - A single species might show high diversity at the genetic level over its distributional range.
  - The genetic variation shown by the medicinal plant *Rauwolfia vomitoria* growing in different Himalayan ranges might be in terms of the potency and concentration of the active chemical (reserpine) that the plant produces.
  - India has more than 50,000 genetically different strains of rice, and 1,000 varieties of mango.
- (ii) Species diversity :
  - The diversity at the species level, for example, the Western Ghats have a greater amphibian species diversity than the Eastern Ghats.
- (iii) Ecological diversity :
  - At the ecosystem level, India, for instance, with its deserts, rain forests, mangroves, coral reefs, wetlands, estuaries, and alpine meadows has a greater ecosystem diversity than a Scandinavian country like Norway.

Section C

➢ **Write the answer of the following questions : (Each carries 4 Mark)**

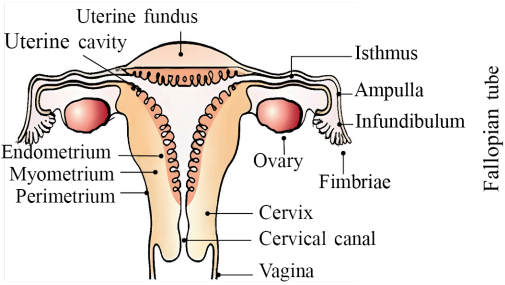
22.

- The gynoecium represents the female reproductive part of the flower.



  - Monocarpellary : When the gynoecium consist of a single pistil.
  - Multicarpellary : When the gynoecium have more than one pistil.
  - When there are more than one :
  - Syncarpous : The pistils fused together.
  - Apocarpous : The pistils are free.
  - Each pistil has three parts - the stigma, the style and the ovary.
- (i) The stigma : It serves as a landing platform for pollen grains.
- (ii) The style : It is the elongated slender part beneath the stigma.
- (iii) The ovary : It is the basal bulged part of the pistil.
  - Inside the ovary is the ovarian cavity (locule).
  - The placenta is located inside the ovarian cavity.
  - Arising from the placenta are the megasporangia, commonly called ovules.
  - The number of ovules in an ovary may be one (wheat, paddy, mango) to many (papaya, watermelon, orchids).

23.

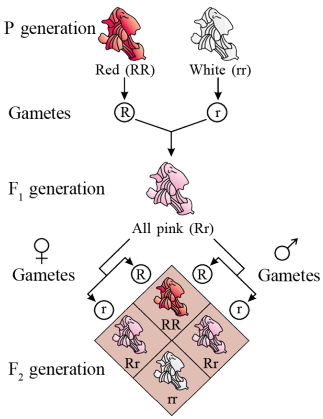


- The oviducts (fallopian tubes), uterus and vagina constitute the female accessory ducts.
- Structure of Oviducts :
  - Each fallopian tube is about 10-12 cm long.
  - It extends from the periphery of each ovary to the uterus.
  - The part closer to the ovary is the funnel-shaped infundibulum.
  - The edges of the infundibulum possess finger-like projections called fimbriae, which help in collection of the ovum after ovulation.
  - The infundibulum leads to a wider part of the oviduct called ampulla.
  - The last part of the oviduct, isthmus has a narrow lumen and it joins the uterus.
- Structure of Uterus :
  - The uterus is single and it is also called womb.
  - The shape of the uterus is like an inverted pear.
  - It is supported by ligaments attached to the pelvic wall.
  - The wall of the uterus has three layers of tissue.
    (i) The external thin membranous perimetrium.
    (ii) middle thick layer of smooth muscle, myometrium.
    (iii) inner glandular layer called endometrium that line the uterine cavity.
  - The endometrium undergoes cyclical changes during menstrual cycle while the myometrium exhibits strong contraction during delivery of the baby.
  - The uterus opens into vagina through a narrow cervix.
  - The cavity of the cervix is called cervical canal which along with vagina forms the birth canal.

24.

- When experiments on peas were repeated using other traits in other plants, it was found that sometimes the F_1 had a phenotype that did not resemble either of the two parents and was in between the two.
- The inheritance of flower colour in the dog flower (snapdragon or Antirrhinum sp.) is a good example to understand incomplete dominance.
- In a cross between true-breeding red-flowered (RR) and true breeding white-flowered plants (rr). the F_1 (Rr) was pink.
- When the F_1 was self-pollinated, the F_2 resulted in the following ratio 1 (RR) Red : 2 (Rr) Pink : 1 (rr) White.
- Here the genotype ratios were exactly as we would expect in any Mendelian monohybrid cross, but the phenotype ratios had changed from the 3 : 1 dominant : recessive ratio. What happened was that R was not completely dominant over r and this made it possible to distinguish Rr as pink from RR (red) and rr (white).
- Obtained Genotypic & Phenotypic Ratio is as follows :

Phenotypic ratio	Red : Pink : White 1 : 2 : 3
Genotypic ratio	RR : Rr : rr 1 : 2 : 1



25.

- A transcription unit in DNA is defined primarily by the three regions in the DNA :

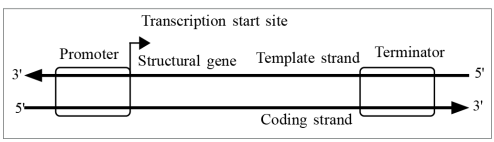
  (i) The Structural gene

  (ii) A Promoter

  (iii) A Terminator

  (i) A structural gene :

- There is a convention in defining the two strands of the DNA in the structural gene of a transcription unit.
- Since the two strands have opposite polarity and the DNA-dependent RNA polymerase also catalyse the polymerisation in only one direction, that is, 5' → 3',
- Template strand :
- The strand that has the polarity 3' → 5' acts as a template, and is also referred to as template strand.
- Coding strand :
- The other strand which has the polarity (5' → 3') and the sequence same as RNA (except thymine at the place of uracil), is displaced during transcription. Strangely, this strand (which does not code for anything) is referred to as coding strand.
- All the reference point while defining a transcription unit is made with coding strand.



Schematic structure of a transcription unit

(ii) A promoter :

- The promoter and terminator flank the structural gene in a transcription unit.
- The promoter is said to be located towards 5'-end (upstream) of the structural gene (the reference is made with respect to the polarity of coding strand).
- It is a DNA sequence that provides binding site for RNA polymerase and it is the presence of a promoter in a transcription unit that also defines the template and coding strands.

(iii) A Terminator :

- By switching its position with terminator, the definition of coding and template strands could be reversed.
- The terminator is located towards 3'-end (downstream) of the coding strand and it usually defines the end of the process of transcription.
- There are additional regulatory sequences that may be present further upstream or downstream to the promoter.

26.

- Innate immunity is non-specific immunity, which is present at the time of birth.
- 1) Physical barrier :
  - Our skin is the main physical barrier that prevents the entry of microorganisms.
  - Mucous membrane lining the respiratory tract, gastrointestinal tract and urinary tract also helps to prevent germs from entering the body.
- 2) Physiological barrier :
  - Acid in the stomach, saliva in the mouth, tears in the eyes etc. inhibit the growth of pathogens.
- 3) Cellular Barrier :
  - Some white blood cells [WBCs] in our body, such as polymorphonuclear leukocytes and natural killer cells, a type of lymphoid cell in the blood, can feed on and destroy microbes.
- 4) Cytokine barrier :
  - Virus-infected cells secrete proteins called interferons, which protect other uninfected cells from virus infection.

27.

- (1) Cyclosporin A :
  - It is derived from *Trichoderma polysporium* fungi.
  - This bioactive molecule is used as immunosuppressive drug in organ transplant patients.
- (2) Statins :
  - It is derived from *Monascus purpurus* a yeast.
  - This drug is used as blood cholesterol lowering agent.
- (3) Streptokinase :
  - This enzyme is derived from *streptococcus* bacterium.
  - This bacterium is modified by using genetic engineering.
  - It is used as “clot bluster” for removing clots from the blood vessels of patients.
  - This drug is used for those patients who have undergone myocardial infraction leading to heart attack.