LIBERTY PAPER SET

STD. 12 : Biology

Full Solution

Time : 3 Hours **ASSIGNTMENT PAPER 2**

Part A

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

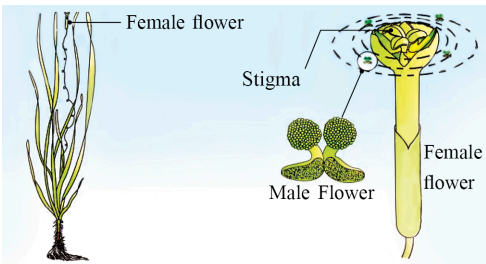
Part B

Section A

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

1.

➥



➥ Some examples of water pollinated plants are *Vallisneria* and *Hydrilla* which grow in fresh water.

➠ In *Vallisneria*, the female flower reach the surface of water by the long stalk and the male flowers or pollen grains are released on to the surface of water.

➠ They are carried passively by water currents. Some of them eventually reach the female flowers and the stigma.

2.

➥ As the anther develops, the cells of the sporogenous tissue undergo meiotic divisions to form microspore tetrads. The ploidy of the cells of the tetrad is haploid

➠ As each cell of the sporogenous tissue is capable of giving rise to a microspore tetrad. Each one is a potential pollen or microspore mother cell.

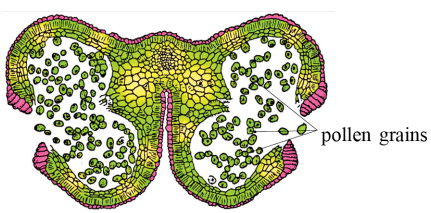
➠ The process of formation of microspores from a pollen mother cell (PMC) through meiosis is called microsporogenesis.

➠ The microspores, as they are formed, are arranged in a cluster of four cells–the microspore tetrad.

➠ As the anthers mature and dehydrate, the microspores dissociate from each other and develop into pollen grains.

➠ Inside each microsporangium several thousands of microspores or pollen grains are formed that are released with the dehiscence of anther.

➥



3.

➥ Natural/Traditional Methods (Calendar Method)

➥ Natural methods work on the principle of avoiding chances of ovum and sperms meeting.

(a) Periodic abstinence :

➥ Periodic abstinence is one such method in which the couples avoid or abstain from coitus from day 10 to 17 of the menstrual cycle when ovulation could be expected.

➥ As chances of fertilisation are very high during this period, it is called the fertile period.

➥ Therefore, by abstaining from coitus during this period, conception could be prevented.

(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, 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.

4.

-

Tubectomy		Vasectomy	
1.	Sterilization Process in Female is called Tubectomy.	1.	Sterilization Process in Male is called Vasectomy.
2.	A small part of fallopian tube is tied up or removed through a small incision in abdomen or through vegina.	2.	vasectomy, a small part of the vas deferens is removed or tied up through a small incision on the scrotum.
3.	it Prevents Transportation of ovum.	3.	It prevents transportation of Sperm.

5.

- Turner's Syndrome : Such a disorder is caused due to the absence of one of the X chromosomes, i. e., 45 with XO, Such females are sterlie as ovaries are rudimentary besides other features including lack of other secondary sexual character.

6.

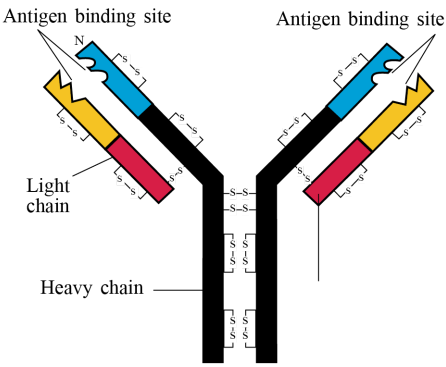
- Genetic material is the hereditary substance in the cell.
- It carries all infomation specific to organism.
- There are two such genetic material DNA and RNA (Nucleic acid)
- DNA acts as the genetic material in most of the organisms.
- RNA though it also acts as a genetic material in some viruses, mostly functions as a messenger. RNA has additional roles as well. It functions as adapter, structural, and in some cases as a catalytic molecule.

7.

- 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.

8.

- Acquired immunity, on the other hand, is pathogen specific. It is characterised by memory.
- This means that our body, when encounters a pathogen for the first time, produces a response called primary response which is of low intensity.
- Subsequent encounter with the same pathogen elicits a highly intensified secondary or anamnestic response.
- The primary and secondary immune responses are carried out with the help of two special types of lymphocytes present in our blood, i.e., B-lymphocytes and T- lymphocytes.



Structure of an antibody molecule

- There are two type of acquired immune response.
- (i) Antibody Mediated Immune response or / Humoral Immune response.
- The B-lymphocytes produce an army of proteins in response to pathogens into our blood to fight with them. These proteins are called antibodies.
- The T-cells themselves do not secrete antibodies but help B cells produce them.
- Each antibody molecule has four peptide chains, two small called light chains and two longer, called heavy chains.
- Hence, an antibody is represented as H_2L_2. Different types of antibodies are produced in our body.
- IgA, IgM, IgE, IgG are some of them. A structure of an antibody is given in Figure 7.4. Because these antibodies are found in the blood, the response is also called humoral immune response.
- (ii) Cell Mediated Immune response
- The second type is called cell-mediated immune response or cell- mediated immunity (CMI). The T-lymphocytes mediate CMI.

9.

- In addition to 'ori', the vector requires a selectable marker.
- It helps in identifying and eliminating non transformants and selectively permitting the growth of the transformants.
- Transformation is a procedure through which a piece of DNA is introduced in a host bacterium.
- 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.

10.

- Parasitism means one organism is dependent on another organism for its food and habitat and harmful to host.

11.

- Primary productivity :
  - Primary production is defined as the amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis.

- Primary productivity depends on the plant species inhabiting a particular area.
- It also depends on a variety of environmental factors, availability of nutrients and photosynthetic capacity of plants.
- Therefore, it varies in different types of ecosystems. The annual net primary productivity of the whole biosphere is approximately 170 billion tons (dry weight) of organic matter.
- Of this, despite occupying about 70 percent of the surface, the productivity of the oceans are only 55 billion tons.

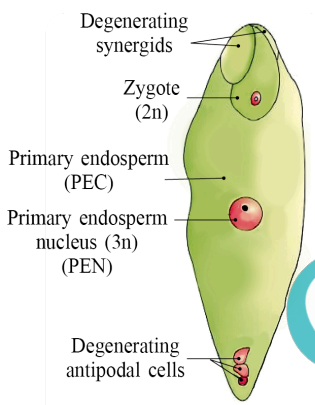
12.

- When alien species are introduced unintentionally or deliberately for whatever purpose, some of them turn invasive, and cause decline or extinction of indigenous species.
- The Nile perch introduced into Lake Victoria in east Africa eventually led to the extinction of an ecologically unique assemblage of more than 200 species of cichlid fish in the lake.
- The environmental damage caused and threat posed to our native species by invasive weed species like carrot grass (Parthenium), Lantana and water hyacinth (Eicchornia).
- The recent illegal introduction of the African catfish Clarias gariepinus for aquaculture purposes is posing a threat to the indigenous catfishes in our rivers.

Section B

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

13.



Fertilised embryo sac showing zygote and Primary Endosperm Nucleus (PEN)

- 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 (PEN).
  - 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, an event unique to flowering plants.
  - The central cell, after triple fusion, becomes the Primary Endosperm Cell (PEC) and develops into the endosperm while the zygote develops into an embryo.

14.

- (i) Menarche - The first menstruation begins at puberty and is called menarche.
- (ii) Menopause - In human beings, menstrual cycles ceases around 50 years of age; that is termed as menopause.

- (iii) Menstrual cycle - In human females, menstruation is repeated at an average interval of about 28/29 days, and the cycle of events starting from one menstruation till the next one is called the menstrual cycle.
- Menstrual cycle: It is the reproductive cycle of female primates (such as monkeys, apes, and humans).
- The menstrual cycle is the sequence of events that begins with one menstruation and ends with the next.
- Menstruation occurs every 28/29 days in human females.
- Menstruation, the follicular phase, ovulation, and the luteal phase are the four phases of the menstrual cycle.
- Hormones that regulate the menstrual cycle are: Follicle-stimulating hormone (FSH), Luteinizing hormone (LH), Estrogen and Progesterone.

15.

- Transforming Principle
- In 1928, Frederick Griffith, in a series of experiments with Streptococcus pneumoniae (bacterium responsible for pneumonia), witnessed a miraculous transformation in the bacteria.
- During the course of his experiment, a living organism (bacteria) had changed in physical form.
- When Streptococcus pneumoniae (pneumococcus) bacteria are grown on a culture plate,

  (I) Some produce smooth shiny colonies (S) while others produce rough colonies (R).

  (II) This is because the S strain bacteria have a mucous (polysaccharide) coat, while R strain does not.
- Mice infected with the S strain (virulent) die from pneumonia infection but mice infected with the R strain do not develop pneumonia.

S strain ⟶ Inject into mice ⟶ Mice die
R strain ⟶ Inject into mice ⟶ Mice live

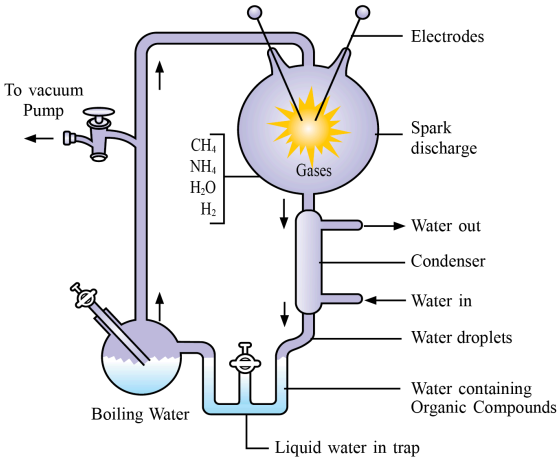
- Griffith was able to kill bacteria by heating them.
- He observed that heat-killed S strain bacteria injected into mice did not kill them.

S strain ⟶ Inject into mice ⟶ Mice live
(heat-killed)

S strain
(heat-killed) ⟶ Inject into mice ⟶ Mice die
+
R strain
(live)

- When he injected a mixture of heat-killed S and live R bacteria, the mice died. Moreover, he recovered living S bacteria from the dead mice.
- He concluded that the R strain bacteria had somehow been transformed by the heat-killed S strain bacteria.
- Some ‘transforming principle’, transferred from the heat-killed S strain, had enabled the R strain to synthesise a smooth polysaccharide coat and become virulent.
- This must be due to the transfer of the genetic material. However, the biochemical nature of genetic material was not defined from his experiments.

16.



Diagrammatic representation of Miller's experiment

- In 1953, an American scientist named S. L. Miller created in the laboratory a condition similar to the Earth's primordial atmosphere.
- He mixed CH_4, H_2, NH_3 and water vapour in a closed flask at a temperature of 800^oC and arranged the electrodes and gave electric shocks. Then the mixture was cooled in the condenser and made a liquid.
- He Collected the liquid in a separate flask.
- After two weeks of the procedure, the fluid was analyzed by chromatography.
- He found that amino acids were formed in it. Besides hydroxy acids (scientific name of H_2O) and aliphatic acids were also present.
- Similarly, other scientists have observed in this type of experiment that sugars, nitrogen bases, pigments and fats were produced.

17.

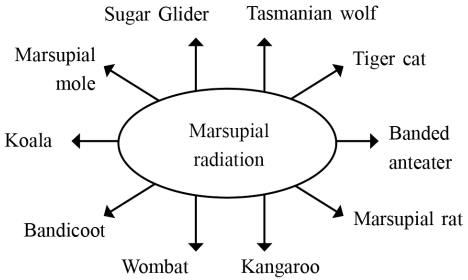
- The process of development of different species starting from one point of a given geographical area to other geographical habitats is called adaptive radiation.

Darwin finch

- Darwin Finch is an excellent example of this type of phenomenon.
- Darwin saw several species of finches across the Galapagos Islands.
- He speculated that all species had evolved on the island by themselves.
- Along with other features of the original finches (seed eating), their beaks may have evolved for other forms that made them insectivorous and herbivorous finches.

Australian marsupials

- Another example is the Australian marsupial.
- Most marsupials were different from each other.
- They evolved from a common set of ancestors, but they all evolved on the Australian island continent.
- When more than one adaptive diffusion occurs in a geographical area (representing different habitats) it is called convergent evolution.
- Mammals of Australia marsupials (E.g.:- the wolf and the Tasmanian wolf) show a similar evolution.



Placental mammals	Australian Marsupials
Mole	Marsupial mole
Ant eater	Numbat (Ant eater)
Mouse	Marsupial mouse
Lemur	Spotted cuscus
Flying squirrel	Flying phalanger
Bobcat	Tasmanian tiger cat
Wolf	Tasmanian wolf

18.

- Large quantities of waste water are generated everyday in cities and towns. A major component of this waste water is human excreta. This municipal waste water is also called sewage.
- It contains large amounts of organic matter and microbes, many of which are pathogenic.
- This cannot be discharged into natural water bodies like rivers and streams directly.
- Before disposal, hence, sewage is treated in Sewage Treatment Plant (STPs) to make it less polluting.
- Treatment of waste water is done by heterotrophic microbes naturally present in the sewage.
- There are two stages of the process:
  - (1) Primary treatment
  - (2) Secondary treatment (biological treatment)
- The following sequential treatment is done in secondary treatment.
- The primary effluent is passed into large aeration tanks, Where it is constantly agitated mechanically and air is pumped into it.
- This allows vigorous growth of useful aerabic microbes into flocs (masses of bacterial associated with fungal filaments to form mesh like structures).
- While growing, these microbes consume the major part of the organic matter in the effluent.
- This results in significant reduction of the BOD (Biochemical Oxygen Demand) of the effluent.
- The greater the BOD of waste water, the more is its polluting potential.
- Once the BOD of sewage or waste water is reduced significantly, the effluent is then passed into a settling tank.
- Where bacterial 'flocs' are allowed to sediment. This sediment is called activated sludge.
- A small part of the activated sludge is pumped back into the aeration tank to serve as the inoculum.
- The remaining major part of the sludge is pumped into large tanks called anaerobic sludge digesters.
- Here, other kinds of bacteria, which grow anaerobically, digest the bacteria and the fungi in the sludge.
- During this digestion, bacteria produce a mixture of gases from biogas such as carbon dioxide, methane and hydrogen. These gases from biogas and can be used as source of energy as it is inflammable.

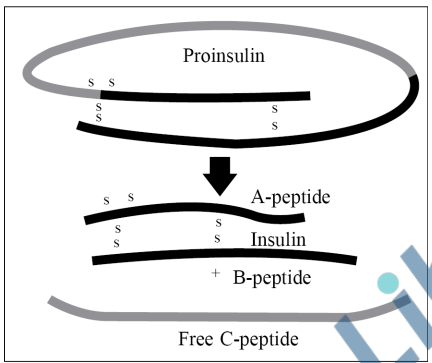
19.

- Due to our present day life styles, environmental pollution is a major cause of concern.
  - The use of chemical fertilizers to meet the *ever-increasing demand* of agricultural produce *has contributed* significantly to this pollution.
  - There are *problems associated* with the overuse of chemical fertilizers and there is a large pressure to switch to organic farming – the use of biofertilizers.
  - Biofertilizers are organisms that enrich the nutrient quality of the soil.
  - The main sources of biofertilizers are bacteria, fungi and cyanobacteria.
  - The nodules on the roots of leguminous *plants are formed* by the symbiotic association of *Rhizobium.*
  - *These bacteria fix atmospheric* nitrogen into organic forms, which is used by the plant *as nutrient.*
  - Other bacteria can fix atmospheric nitrogen while free-living in the soil *Azospirillum* and *Azotobacter,* enriching *the nitrogen* content of the soil.
  - Fungi are also known to form symbiotic associations with plants(mycorrhiza).
  - Many members of the genus Glomus form mycorrhiza.

- The fungal symbiont in these associations absorbs phosphorus from soil and passes it to the plant.
- In paddy fields, *cyanobacteria serve* as an important biofertilizer.
- Currently, in our country, a number of biofertilizers are available commercially in the market and farmers use these regularly in their fields to replenish soil nutrients and to reduce dependence on chemical fertilizers.
- In agriculture, there is a method of controlling pests that relies on natural predation rather than introduced chemicals.
- The use of biocontrol measures will greatly reduce our dependence on toxic chemicals and pesticides.
- A biological control being developed for use in the treatment of *plant disease* is the fungus *Trichoderma*. *Trichoderma* species are free-living fungi.
- *Trichoderma* is a biocontrol agent of several plant pathogens.

20.

- Insulin is produced by beta cells of pancreas.
- Insulin plays important role in a sugar or carbohydrate metabolism.
- Due to lack of insulin diabetes mellitus occurs in humans.
- Insulin used for diabetes was earlier extracted from pancreas of slaughtered cattle and pigs.
- Insulin from an animal source, though caused some patients to develop allergy or other types of reactions to the foreign protein.



- Insulin consists of two short polypeptide chains: chain A and chain B.
- Polypeptide Chain A contains 21 amino acids and chain B contains 30 amino acids that are linked together by disulphide bridges.
- In mammals, including humans, insulin is synthesised as a pro-hormone (like a pro-enzyme, the pro-hormone also needs to be processed before it becomes a fully mature and functional hormone) which contains an extra stretch called the C peptide.
- This C peptide is not present in the mature insulin and is removed during maturation into insulin.
- The main challenge for production of insulin using rDNA techniques was getting insulin assembled into a mature form.
- In 1983, Eli Lilly an American company prepared two DNA sequences corresponding to A and B, chains of human insulin and introduced them in plasmids of E. coli to produce insulin chains.
- Chains A and B were produced separately, extracted and combined by creating disulfide bonds to form human insulin.

21.

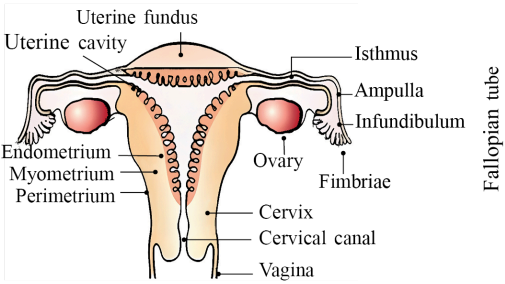
- The most important of them are :
- (i) Genetic diversity :
  - A single species might show high diversity at the genetic level over its distributional range.
  - The genetic variation shown by the medicinal plant *Rauwolfia vomitoria* growing in different Himalayan ranges might be in terms of the potency 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)

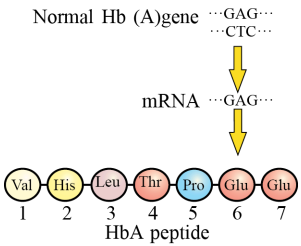
22.

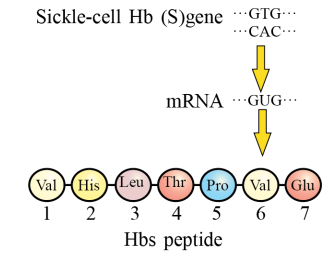


- The oviducts (fallopian tubes), uterus and vagina constitute the female accessory ducts.
- Structure of Oviducts :
  - Each fallopian tube is about 10-12 cm long.
  - It extends from the periphery of each ovary to the uterus.
  - The part closer to the ovary is the funnel-shaped infundibulum.
  - The 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.

23.

- Sickle-cell anaemia : This is an autosome linked recessive trait that can be transmitted from parents to the offspring when both the partners are carrier for the gene (or heterozygous).
- The disease is controlled by a single pair of allele, Hb^A and Hb^S. Out of the three possible genotypes, only homozygous individuals for Hb^S (Hb^SHb^S)show the diseased phenotype.
- Heterozygous (Hb^AHb^S) individuals appear apparently unaffected but they are carrier of the disease as there is 50 per cent probability of transmission of the mutant gene to the progeny, thus exhibiting sickle-cell trait.
- The defect is caused by the substitution of Glutamic acid (Glu) by Valine (Val) at the sixth position of the beta globin chain of the haemoglobin molecule
- The substitution of amino acid in the globin protein results due to the single base substitution at the sixth codon of the beta globin gene from GAG to GUG.

- The mutant haemoglobin molecule undergoes polymerisation under low oxygen tension causing the change in the shape of the RBC from biconcave disc to elongated sickle-like structure.
- 

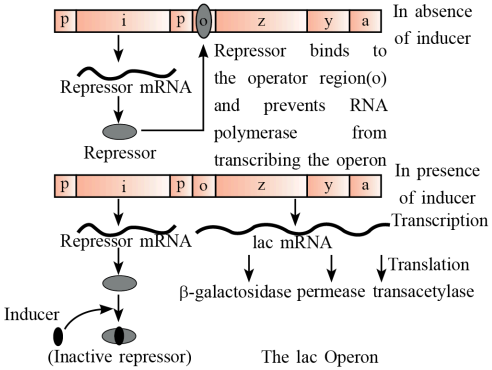
- 

- Micrograph of the red blood cells and the amino acid composition of the relevant portion of β-chain of haemoglobin: (a) From a normal individual; (b) From an individual with sickle-cell anaemia

24.

- The elucidation of the lac operon was also a result of a close association between a geneticist, Francois Jacob and a biochemist, Jacque Monod.
- They were the first to elucidate a transcriptionally regulated system.
- In lac operon (here lac refers to lactose), a polycistronic structural gene is regulated by a common promoter and regulatory genes.
- Such arrangement is very common in bacteria and is referred to as operon.
- The lac operon consists of one regulatory gene (the i gene - here the term i does not refer to inducer, rather it is derived from the word inhibitor) and three structural genes (z, y, and a).
- The i gene codes for the repressor of the lac operon.
- The z gene codes for beta-galactosidase (β-gal), which is primarily responsible for the hydrolysis of the disaccharide, lactose into its monomeric units, galactose and glucose.
- The y gene codes for permease, which increases permeability of the cell to β-galactosides.
- The a gene encodes a transacetylase.
- Hence, all the three gene products in lac operon are required for metabolism of lactose. In most other operons as well, the genes present in the operon are needed together to function in the same or related metabolic pathway.
- Inducer :
- Lactose is the substrate for the enzyme beta-galactosidase and it regulates switching on and off of the operon. Hence, it is termed as inducer.
- In the absence of a perferred carbon source such as glucose, if lactose is provided in the growth medium of the bacteria, the lactose is transported into the cells through the action of permease (Remember, a very low level of expression of lac operon has to be present in the cell all the time, otherwise lactose cannot enter the cells).
- The lactose then induces the operon in the following manner.
- The repressor of the operon is synthesised (all-the-time-constitutively) from the i gene. The repressor protein binds to the operator region of the operon and prevents RNA polymerase from transcribing the operon.
- In the presence of an inducer, such as lactose or allolactose, the repressor is inactivated by interaction with the inducer.
- This allows RNA polymerase access to the promoter and transcription proceeds. Essentially, regulation of lac operon can also be visualised as regulation of enzyme synthesis by its substrate.
- Remember, glucose or galactose cannot act as inducers for lac operon.

- Lac operon would remain expressed untill all the amount of lactose is converted to glucose & Galactose.
- Regulation of lac operon by repressor is referred to as negative regulation. Lac operon is under control of positive regulation as well, but it is beyond the scope of discussion at this level.



25.

- Early detection of cancers is essential as it allows the disease to be treated successfully in many cases.
- 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.

(a) Biopsy

- In biopsy, a piece of the suspected tissue cut into thin sections is stained and examined under microscope (histopathological studies) by a pathologist.

(b) Radiation Diagnosis

- 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.
- Computed tomography uses X-rays to generate a three-dimensional image of the internals of an object.
- MRI uses strong magnetic fields and non-ionising radiations to accurately detect pathological and physiological changes in the living tissue.

(c) Pathological Diagnosis

- Antibodies against cancer-specific antigens are also used for detection of certain cancers.

(d) Molecular Diagnosis

- Techniques of molecular biology can be applied to detect genes in individuals with inherited susceptibility to certain cancers.
- Identification of such genes, which predispose an individual to certain cancers, may be very helpful in prevention of cancers.
- Such individuals may be advised to avoid exposure to particular carcinogens to which they are susceptible (e.g., tobacco smoke in case of lung cancer).

26.

(i) Competent Host

- Since DNA is a hydrophilic molecule, it cannot pass through cell membranes.
- In order to force bacteria to take up the plasmid, the bacterial cells must first be made 'competent' to take up DNA.

(a) Heat Shock :

- This is done by treating them with a specific concentration of a divalent cation, such as calcium, which increases the efficiency with which DNA enters the bacterium through pores in its cell wall.
- Recombinant DNA can then be forced into such cells by incubating the cells with recombinant DNA on ice, followed by placing them briefly at 42° C (heat shock), and then putting them back on ice. This enables the bacteria to take up the recombinant DNA.
- This is not the only way to introduce alien DNA into host cells.
- Foreign gene can also be transfered to host by using following technique

(b) Micro injection :

- In a method known as micro-injection, recombinant DNA is directly injected into the nucleus of an animal cell.

(c) Biolistic or Gene Gun :

- In another method, suitable for plants, cells are bombarded with high velocity micro-particles of gold or tungsten coated with DNA in a method known as biolistics or gene gun.
- And the last method uses 'disarmed pathogen' vectors, which when allowed to infect the cell, transfer the recombinant DNA into the host.
- Now that we have learnt about the tools for constructing recombinant DNA, let us discuss the processes facilitating recombinant DNA technology.

(ii) Isolation of the genetic material (DNA)

- Recall that nucleic acid is the genetic material of all organisms without exception.
- In majority of organisms this is deoxyribonucleic acid or DNA. In order to cut the DNA with restriction enzymes, it needs to be in pure form, free from other macro-molecules.
- Since the DNA is enclosed within the membranes, we have to break the cell open to release DNA along with other macromolecules such as RNA, proteins, polysaccharides and also lipids.
- This can be achieved by treating the bacterial cells / plant or animal tissue with enzymes such as **lysozyme** (bacteria), **cellulase** (plant cells), **chitinase** (fungus).
- You know that genes are located on long molecules of DNA. interwined with proteins such as histones.
- The RNA can be removed by treatment with ribonuclease whereas proteins can be removed by treatment with protease.
- Other molecules can be removed by appropriate treatments and purified DNA ultimately precipitates out after the addition of chilled ethanol.
- This can be seen as collection of fine threads in the suspension. (Figure 9.5)

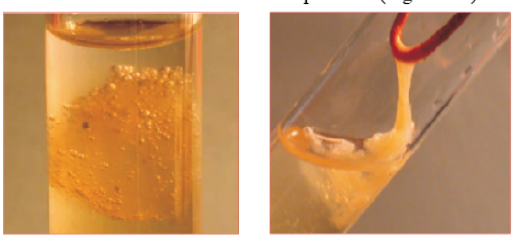


Figure 9.5 : DNA that separates out can be removed by spooling

27.

- No population of any species in nature has at its disposal unlimited resources to permit exponential growth.
- This leads to competition between individuals for limited resources. Eventually, the 'fittest' individual will survive and reproduce.
- The government of many countries have also realised this fact and introduced various restraints with a view to limit human population growth.
- In nature, a given habitat has enough resources to support a maximum possible number, beyond which no further growth is possible. Let us call this limit as nature's **carrying capacity (K)** for that species in that habitat.
- A population growing in a habitat with limited resources show initially a lag phase, followed by phases of acceleration and deceleration and finally an asymptote, when the population density reaches the carrying capacity.
- A plot of N in relation to time (t) results in a sigmoid curve.
- This type of population growth is called Verhulst-Pearl Logistic Growth (Figure 11.3) and is described by the following equation:

$$\boxed{\mathbf{dN/dt = rN\left[\frac{K-N}{K}\right]}}$$

Where N = Population density at time t
r = Intrinsic rate of natural increase
K = Carrying capacity

- Since resources for growth for most animal populations are finite and become limiting sooner or later, the logistic growth model is considered a more realistic one.