

ISC PAPER–2018

BIOLOGY

Paper 1

(THEORY)

(Maximum Marks : 70)

(Three hours)

(Candidates are allowed additional 15 minutes for **only** reading the paper.

They must **NOT** start writing during this time.)

This paper comprises **TWO PARTS**—Part I and Part II.

Answer **all** questions.

Part I contains **one** question of 20 marks having four subparts.

Part II consists of Sections A, B and C.

Section A contains **seven** questions of **two** marks each

Section B contains **seven** questions of **three** marks each, and

Section C contains **three** questions of **five** marks each.

Internal choices have been provided in two questions in Section A, two questions in Section B and in all three questions of Section C.

PART I (20 Marks)

(Answer **all** questions.)

Question 1.

(a) Answer the following questions briefly and to the point :

[8 × 1]

- (i) Give a significant point of difference between Oestrous and Menstrual cycle.
- (ii) Give the biological name of the organism causing typhoid.
- (iii) If the haploid number of chromosomes in a plant species is 20, how many chromosomes will be present in the cells of the shoot tip ?
- (iv) Name a plant which flowers every twelve years.
- (v) Name the diagnostic test for AIDS.
- (vi) Name the terminal stage of ageing in the life cycle of plants.
- (vii) Which organisms constitute the last trophic level ?
- (viii) What is emasculation ?

(b) Each of the following questions has four choices. Choose the best option in each case :

[4 × 1]

- (i) Length of the DNA with 23 base pairs is :
(A) 78.4 Å (B) 78.2 Å
(C) 78 Å (D) 74.8 Å
- (ii) Opium is obtained from :
(A) *Papaver somniferum* (B) *Cannabis sativa*
(C) *Erythroxylum coca* (D) *Datura metel*
- (iii) According to Abiogenesis, life originated from :
(A) Non-living matter (B) Pre-existing life
(C) Oxygen (D) Extra-terrestrial matter
- (iv) The largest unit in which gene flow is possible is :
(A) Organism (B) Population
(C) Species (D) Genes

- (c) Give one significant contribution of each of the following scientists : [4 × 1]
 (A) P. Maheshwari (B) E. Wilson
 (C) M. S. Swaminathan (D) H. Boyer
- (d) Define the following : [2 × 1]
 (i) Biopotent (ii) Parthenocarpy
- (e) Give a reason for each of the following : [2 × 1]
 (i) Pollen grains of wind pollinated flowers are produced in large quantities.
 (ii) Equilibrium of a forest ecosystem can be disturbed by uncontrolled hunting of big predators.

Answer 1.

- | (a) (i) | Oestrous cycle | Menstrual cycle |
|---------|--|---|
| | The cycle occurs in non-primates. | The cycle occurs in primates. |
| | The cycle consists of short period of oestrous (heat) followed by non-oestrous period. | The cycle consists of three phases' menstrual phase, proliferative phase and secretory phase. |
- (ii) Typhoid is a bacterial infection caused by the bacteria *Salmonella typhi*.
- (iii) Shoot tip cell are diploid, so they will have $2n$ i.e., 40 chromosomes will be present in the cells of the shoot tip.
- (iv) Kurinji or Neelakurinji (*Strobilanthes kunthianus*) is a shrub that blossoms only once in 12 years.
- (v) ELISA, which stands for Enzyme-Linked Immune Sorbent Assay, is used to detect the presence of AIDS.
- (vi) Senescence refers to the process or condition of growing old in the life cycle of plants.
- (vii) Tertiary consumers i.e., carnivores or apex predators constitutes the last trophic level.
- (viii) It is the method of selective breeding. The anthers are removed from a bisexual flower before they release pollen grains. Removal of anther using forceps is termed as emasculation.
- (b) (i) (B) 78.2 Å (ii) (A) *Papaver somniferum*
 (iii) (A) Non-living matter (iv) (C) Species
- (c) (i) **Panchanan Maheshwari** was an Indian botanist known for his invention of the technique of test-tube fertilization of angiosperms. The invention allowed the creation of new hybrid plants that could not crossbreed naturally.
- (ii) **Edward O. Wilson** was an American biologist recognized for his work on ants. Wilson made a series of important discoveries, including the determination that ants communicate primarily through the transmission of chemical substances known as pheromones.
- (iii) **M.S. Swaminathan** is an Indian geneticist who is known for developing short-duration high-yielding varieties of rice including scented Basmati. He is also known for the development of the concept of crop cafeteria, crop scheduling and genetically improving the yield and quality of crops.
- (iv) **Herbert W. Boyer, Stanley N. Cohen, and Paul Berg** together are known for their work on the first artificial Recombinant-DNA. They contributed

significantly to the field of rDNA technology, the way in which genetic material from one organism is artificially introduced into the genome of another organism then replicated and expressed by that other organism.

- (d) (i) **Biopatents** : Patents granted in the field of biology are known as biopatents which allows the patent holder to exclude others from making, using or selling it for a limited period of time.
- (ii) Parthenocarpy refers to development of fruit without fertilization. The fruit produced resembles a normally produced fruit but is seedless. For example, varieties of pineapple, banana, cucumber, grape, orange, exemplify naturally occurring parthenocarpy.
- (e) (i) Pollen grains of wind pollinated flowers are produced in large quantities because the pollen grains are light weight so they fly off in large number, lot of them get wasted during the process of pollination.
- (ii) Hunting creates an imbalance in the natural elements of the environment. If a predator, like wolves or mountain lions, are hunted down, their prey will increase in number. Nature has a delicate balance and human hunting can have an impact on that natural balance. Thus, the equilibrium of a forest ecosystem can be disturbed by uncontrolled hunting of big predators.

PART II

SECTION-A (14 Marks)

(Answer all questions)

Question 2.

- (a) A woman with blood group O married a man with blood group AB. Show the possible blood groups of the progeny. List the alleles involved in this inheritance. [2]

OR

- (b) If the mother is a carrier of colour blindness and the father is normal, show the possible genotype and phenotype of the offspring of the next generation, with the help of a punnet square.

Answer 2.

(a) Blood groups exists as four possible phenotypes : A, B, AB and O. There are 3 alleles for the gene that determines blood type. The alleles are as follows :

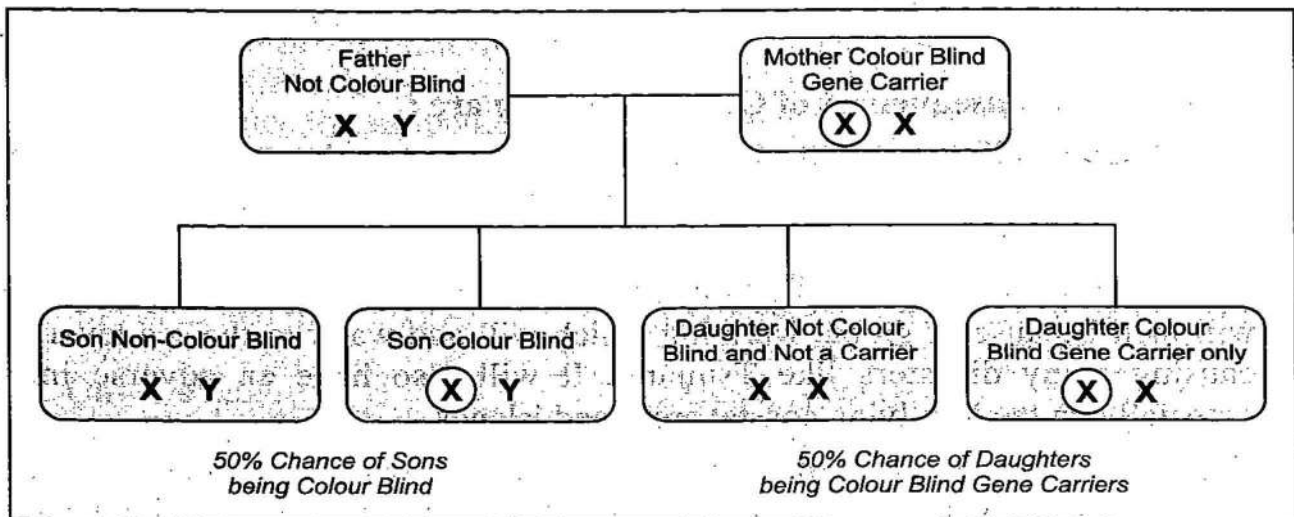
ALLELE	CODES FOR
I^A	Type "A" Blood
I^B	Type "B" Blood
i	Type "O" Blood

Each person possesses any two of the three I gene alleles. I^A and I^B are completely dominant over i, in other words when I^A and i are present only I^A expresses and when I^B and i are present I^B expresses. Blood group O has genotype O/O, blood group AB has genotype A/B. So 50% blood group A, 50% blood group B.

OR

(b) The colour blind 'gene' is carried on one of the X chromosomes. So, for a male to be colour blind the faulty colour blindness 'gene' only has to appear on his X chromosome. For a female to be colour blind it must be present on both of her X chromosomes.

If a woman has only one colour blind 'gene' she is known as a 'carrier' but she won't be colour blind. When she has a child she will give one of her X chromosomes to the child. If she gives the X chromosome with the faulty 'gene' to her son he will be colour blind, but if he receives the 'good' chromosome he won't be colour blind.



	X	Y
X ^C	X X ^C Carrier daughter	X ^C Y Color blind son
X	XX Normal daughter	XY Normal son

Question 3.

Define life span. Give the life span of an elephant.

[2]

Answer 3.

Life span measures the length of time an individual person lives. It refers to the longest period over which the life of any organism or species may extend. Elephants are known for their majestic size and resilience, but also for their long lives. In fact, elephants live longer than any other land mammal, except for man. Elephants can live up to 70 years in the wild.

Question 4.

Give two characteristic features of each of the following :

(a) Ramapithecus

(b) Cro-Magnon man

[2]

Answer 4.

(a) The fossil evidence clearly indicates that Ramapithecus, lived in Africa and Asia (about 10-15 million year ago) were the forerunners of Homonids. These were the first man-like primates. Ramapithecus represented the first step in the evolutionary divergence of humans from the common hominoid stock that produced modern apes and humans. They had Chimpanzee-like feet, flexible wrists and large canines.

(b) Following distinctive features are regarded as common feature of the Cro-Magnon race : Long headed skull, straight forehead, the slightly projecting brow ridges, the cranial vault noticeably flattened, and the occipital bone (at the back of the head) projects backward. The cranial capacity is large, about 100 cubic inches. Although the skull is relatively long and narrow, the face appears quite short and wide.

Question 5.

(a) List any four effects of global warming.

OR

(b) State any four measures to control noise pollution.

[2]

Answer 5.

(a) **The various consequences of Global warming are :**

(i) **Warmer climate :** Global warming on an average, has resulted in increase of the Earth's temperature. The earth will become warmer than earlier, some places will get warm while others may not.

(ii) **The rise of sea level :** The glaciers and ice sheets of Greenland and Atlantic will melt because of global warming which will add water to the sea level, thus causing many disasters like Tsunami. It will also have an adverse impact especially on the low-lying coastal areas and islands.

(iii) Rise in temperature leads to harmful effects in environment example El Niño effect (Climate cycle in the Pacific Ocean with global impact on weather patterns)

(iv) Increased level of carbon dioxide will result in serious health problems such as asthma and bronchitis.

OR

(b) **Measures to control noise pollution :**

(i) Using silencers to control noise from automobiles, ducts, exhausts etc.

(ii) Minimum use of loudspeakers and amplifiers especially near silence zones.

(iii) Proper oiling will reduce noise from the machine.

(iv) **Transmission path intervention :** This includes containing the source inside a sound insulating enclosure, constructing a noise barrier or provision of sound absorbing materials along the path.

Question 6.

Define BOD. What is its significance in an aquatic ecosystem ?

[2]

Answer 6.

Biochemical oxygen demand (BOD) refers to the amount of dissolved oxygen needed by aerobic biological organisms required to break down organic material present in a given water sample at certain temperature over a specific period of time. It is commonly expressed in milligrams of oxygen consumed per litre of sample during 5 days of incubation at 20 °C and is often used as a "surrogate of the degree of organic pollution of water".

Oxygen consumed in the decomposition process robs other aquatic organisms of the oxygen they need to live. Organisms that are more tolerant to lower dissolved oxygen levels may replace a diversity of natural water systems bacteria, which need oxygen (aerobic) to survive. BOD is an important water quality parameter because it provides an index to assess the effect of discharged wastewater on the environment. The higher the BOD value, the greater the amount of organic matter or "food" available for oxygen consuming bacteria.

Question 7.

Give one significant difference between each of the following pairs :

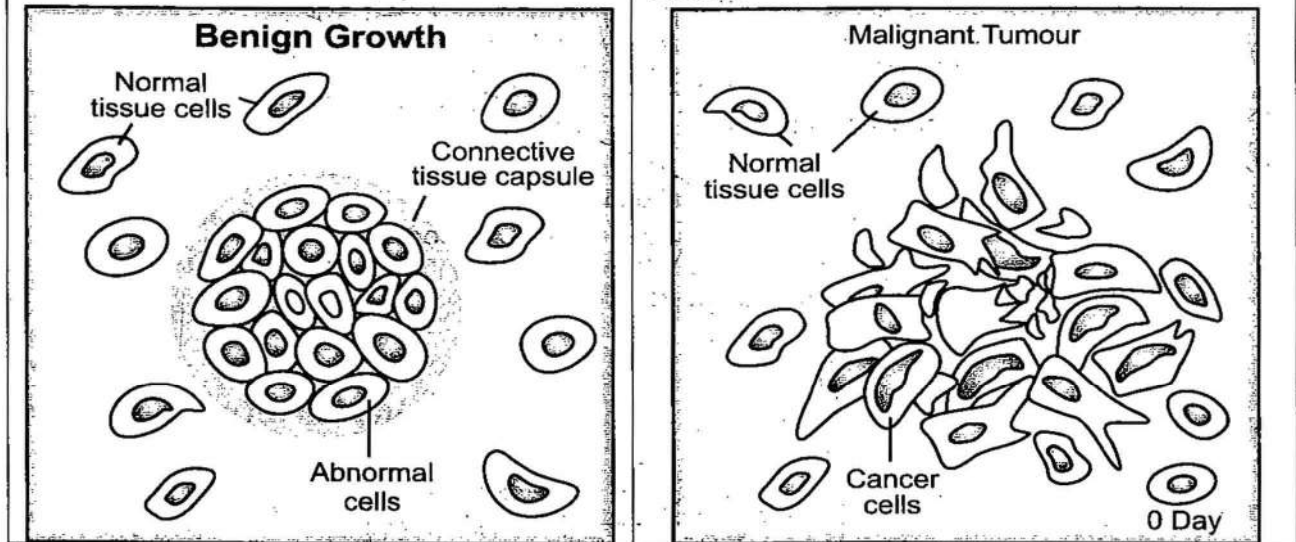
- (a) Humoral immunity and cell mediated immunity.
- (b) Benign tumour and malignant tumour.

[2]

Answer 7.

(a) Humoral Immunity	Cell mediated Immunity
Mainly involves B-lymphocytes which produce the antibodies.	Consists of T-lymphocytes.
Generation and maturation occurs in bone marrow.	Originates in bone marrow and complete development occurs in thymus.
Defends body against extracellular microbes and their toxins.	Defends body against intracellular microbes, viruses, parasites (leishmania), bacteria and tumour cells.
Onset is rapid.	Onset is delayed.
Cells involved in antibody synthesis are t-lymphocytes, b-lymphocytes and macrophage.	Cells involved in cell mediated immunity are Macrophage, helper T cells, natural killer T cells and cytotoxic T cells.

(b) Benign tumour	Malignant tumour
It is non-cancerous.	It is cancerous.
It occurs by expansive growth.	It occurs by invasive growth.
Mitotic activity of cells is not high.	Mitotic activity of cells is frequently high.
There are no or few symptoms.	Symptoms are associated with pain and disability.
No metastasis .	Frequent metastasis.
Example : Pappiloma, Adenoma.	Example : Liposarcoma, Adenocarcinoma.



Question 8.

Give four causes of infertility in males.

[2]

Answer 8.

(i) Male infertility is due to low sperm production, abnormal sperm function or blockages that prevent the delivery of sperm. Illnesses, injuries, chronic health problems, lifestyle choices and other factors can play a role in causing male infertility.

(ii) Cancers and non-malignant tumours can affect the male reproductive organs directly, through the glands that release hormones related to reproduction, such as the pituitary gland, or through unknown causes.

(iii) In some males, during fetal development one or both testicles fail to descend from the abdomen into the sac that normally contains the testicles (scrotum). Decreased fertility is more likely in men who have had this condition.

(iv) Infertility can result from disorders of the testicles themselves or an abnormality affecting other hormonal systems including the hypothalamus, pituitary, thyroid and adrenal glands.

SECTION-B (21 Marks)

(Answer all questions)

Question 9.

(a) Draw a labelled diagram of L.S. of human testis.

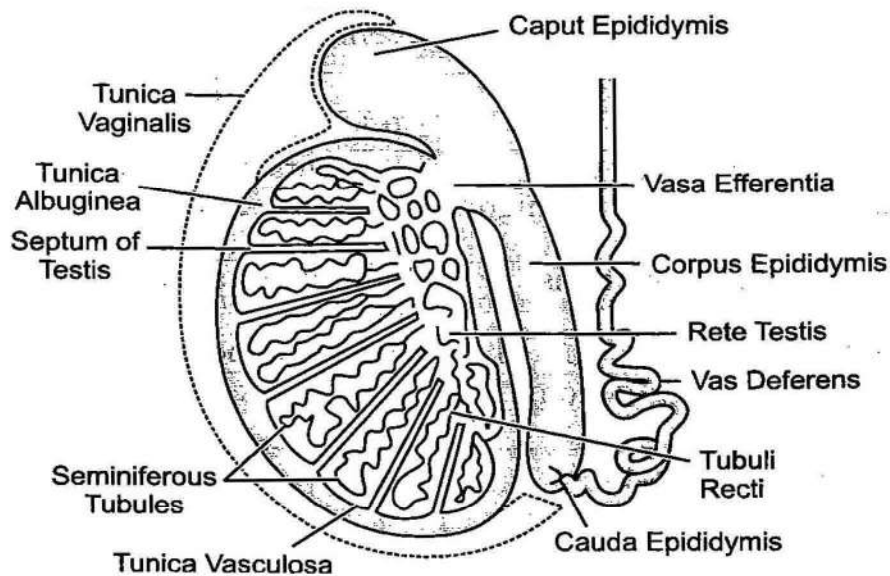
[3]

OR

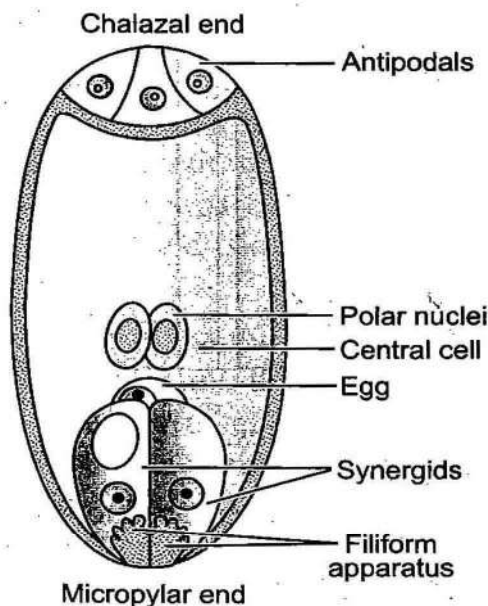
(b) Draw a labelled diagram of the mature embryo sac of angiosperms.

Answer 9.

(a)



(b)



Question 10.

Explain gene therapy, with reference to treatment of SCID.

[3]

Answer 10.

Gene therapy is an experimental technique in which gene are introduced into individuals cells or tissues, to cure some hereditary diseases in which a defective allele of a gene is replaced with normal one. The technique of gene therapy was initiated in 1972.

Severe Combined Immune Deficiency (SCID) is a potentially fatal primary immuno deficiency in which there is combined absence of T-lymphocyte and B-lymphocyte function. There are at least 13 different genetic defects that can cause SCID. These defects lead to extreme susceptibility to very serious infections. This condition is generally considered to be the most serious of the primary immune deficiencies. Fortunately, effective treatments, such as stem cell transplantation, exist that can cure the disorder. The future holds the promise of gene therapy for several more types of SCID.

Another type of SCID is caused by mutations in a gene that encodes an enzyme called adenosine deaminase (ADA). ADA is essential for the metabolic function of a variety of body cells but especially T-cells. The absence of this enzyme leads to an accumulation of toxic metabolic by-products within lymphocytes that cause the cells to die. For patients with SCID due to ADA deficiency, replacement therapy with a modified form of the enzyme (from a cow, called PEG-ADA) has been used with some success.

Question 11.

Study the table given below. Do not copy the table, but write the answers in the correct order.

[3]

<i>Scientific Name</i>	<i>Commercial Product</i>	<i>Use</i>
(a)	<i>Streptokinase</i>	(b).....
<i>Monascus purpureus</i>	(c).....	(d).....
(e).....	<i>Lactic acid</i>	(f).....

Answer 11.

- (a) group C (beta)-hemolytic streptococci. (b) to dissolve blood clots.
 (c) Red yeast rice.
 (d) production of certain fermented foods. (e) Lactic acid bacteria (LAB).
 (f) Food fermentation.

Question 12.

Explain industrial melanism.

[3]

Answer 12.

Industrial melanism was responsible for increase in the population of dark-coloured moths along with the loss of lichens during industrialization in England.

The tree trunks became darker (after industrialization) with deposits of soot and smoke; hence the number of dark moths increased as they were not easily visible to their predators while the white-winged ones were easily picked up by the predators. Thus, dark ones were selected by nature (natural selection) and light ones fail to survive.

Question 13.

Describe the tissue culture technique in plants.

[3]

Answer 13.

Plant tissue culture is an advanced technique of plant breeding that developed around the 1950s. Plant tissue culture makes use of parts of a plant to generate multiple copies of the plant in a very short duration. The technique is based on the property of totipotency of plant cell which means that any cell from any part of the plant can be used to generate a whole new plant.

Types of Plant tissue culture :

- | | |
|------------------------|---------------------|
| (i) Seed Culture | (ii) Embryo Culture |
| (iii) Callus Culture | (iv) Organ Culture |
| (v) Protoplast Culture | (vi) Anther Culture |

An example of use of plant tissue culture in the lab :

Step 1: A new gene of interest is introduced into tissue of a plant. Thus altering its genotype.

Step 2 : The transformed plant cells are then isolated and placed into sterile nutrient agar.

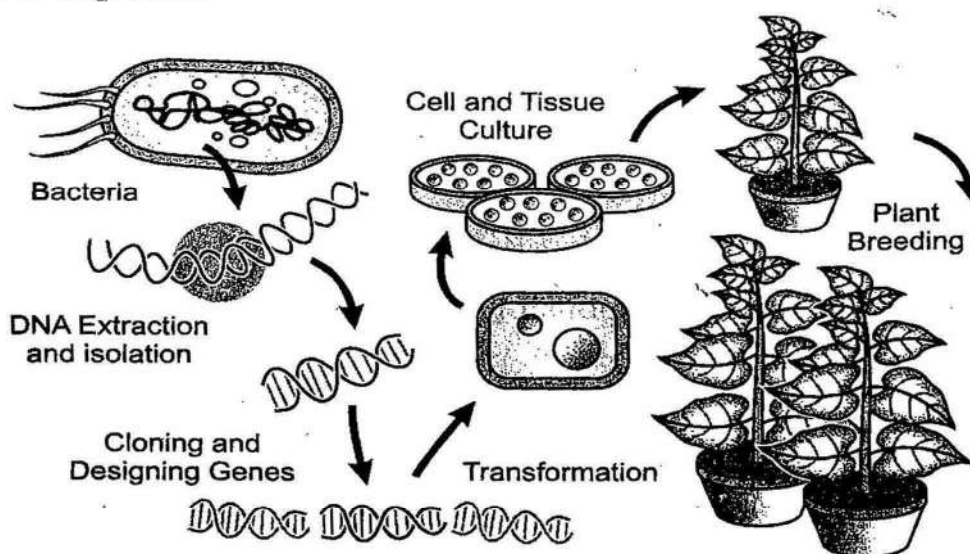
Step 3 : Each cell grows into a cluster of cells called a callus.

Step 4 : Calluses are separated and a plant hormone called cytokinin is added which stimulates growth of small leaf shoots.

Step 5 : Shoots are separated and the addition of another plant hormone called auxin stimulates the growth of roots.

Step 6 : New plants are transferred to soil and grown to observe how the alteration of its genotype has affected its phenotype under extreme environmental conditions such as high salt, increased CO₂ and drought.

Tissue culture is used to develop thousands of genetically identical plants from one single parent plant known as soma clones, and this process is known as micro-propagation. The method offers an advantage over other methods as it can be used to develop disease free plants from disease-ridden plants by using their meristems (apical and axillary) as explants.



Question 14.

Define the following :

- (a) Spermiogenesis
- (b) Reproductive health
- (c) Amenorrhea

[3]

Answer 14.

(a) Spermiogenesis is the final stage of spermatogenesis, which sees the maturation of spermatids into mature, motile spermatozoa. The spermatid is a more or less circular cell containing a nucleus, Golgi apparatus, centriole and mitochondria.

(b) Reproductive health is a state of complete physical, mental and social well-being in all matters relating to the reproductive system.

(c) Lactational amenorrhea is the temporary postnatal infertility that occurs when the female is amenorrheic (not menstruating) and fully breastfeeding. Breastfeeding prevents the resumption of normal ovarian cycles by disrupting the pattern of pulsatile release of GnRH from the hypothalamus and hence LH from the pituitary.

Question 15.

(a) Define the following :

- (i) Hotspots
- (ii) Ramsar Sites
- (iii) Red data book

[3]

OR

(b) Define the following :

- (i) Biodiversity
- (ii) Eutrophication
- (iii) PAR

Answer 15.

(a) (i) A biodiversity hotspot is a biogeographic region with significant levels of biodiversity that is threatened with destruction.

(ii) Ramsar site is a wetland site designated of international importance under the Ramsar Convention. The Convention on Wetlands, known as the Ramsar Convention, is an intergovernmental environmental treaty established in 1971 by UNESCO, and coming into force in 1975. Ramsar sites are designated because they meet the criteria for identifying Wetlands of International importance.

(iii) Red Data Book is a state document established for documenting rare and endangered species of animals, plants and fungi, as well as some local subspecies. The IUCN Red List of Threatened Species is the world's most comprehensive inventory of the global conservation status of biological species.

(b) (i) 'Biological diversity' refers to variation among living organisms from all sources like, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes; this comprise of diversity within species, between species and of ecosystems.

(ii) Eutrophication or more precisely hypertrophication, refers to enrichment of a water body with nutrients, usually with an excess amount of nutrients. This process induces growth of plants and algae and, due to the biomass load, may result in oxygen depletion of the water body. For example algal bloom.

(iii) Photosynthetically Active Radiation (PAR) is the amount of light available for photosynthesis with wavelengths between 400 and 700 nm. PAR changes seasonally and varies depending on the latitude and time of day.

SECTION-C (15 Marks)

(Answer all questions)

Question 16.

(a) Describe post transcriptional processing of RNA in eukaryotes. [5]

OR

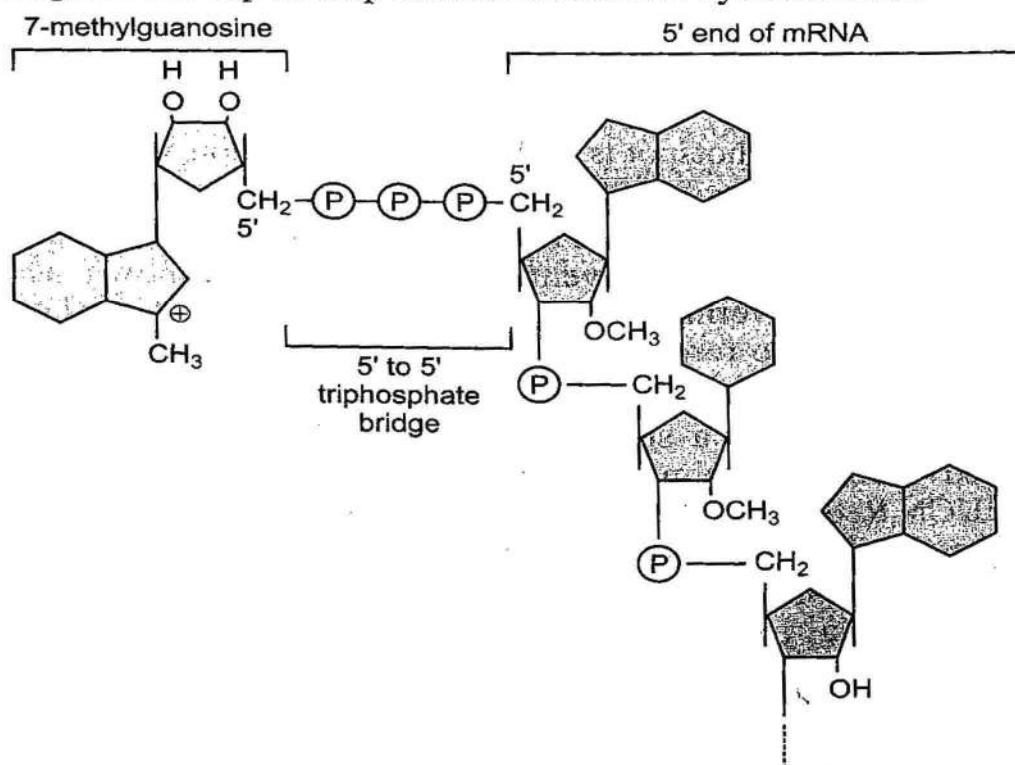
(b) Describe Avery, McLeod and McCarty's experiment. State its significance.

Answer 16.

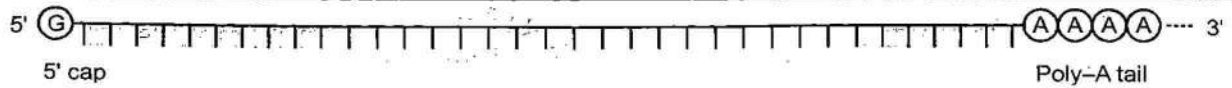
(a) Messenger RNA production requires synthesis of a pre-mRNA by RNA Pol II and processing of the nascent precursor by 5' capping, splicing of introns, and 3' cleavage or polyadenylation to make mature mRNA.

(i) **Splicing** : In molecular biology, splicing refers to editing of the precursor messenger RNA (pre-mRNA) transcript into a mature messenger RNA (mRNA) wherein introns are removed and exons are joined together *i.e.*, they are ligated. Splicing occurs within the nucleus after transcription.

(ii) **Capping** : While the pre-mRNA is synthesized, a 7-methylguanosine cap is added to the 5' end of the growing transcript by a 5'-to-5' phosphate linkage. In molecular biology, the five-prime cap (5' cap) is a specially altered nucleotide on the 5' end of some primary transcripts, this process is known as mRNA capping. This is a highly regulated and vital process for forming stable and mature messenger RNA able to undergo translation during protein synthesis. The cap protects the nascent mRNA from degradation. Moreover, initiation factors involved in protein synthesis recognize the cap to help initiate translation by ribosomes.



(iii) **Tailing** : An enzyme called poly (A) polymerase (PAP) is apart of the protein complex that cleaves the pre-mRNA and it immediately adds a string of approximately 200 A nucleotides, called the poly (A) tail, to the 3' end of the just-cleaved pre-mRNA. The poly (A) tail protects the mRNA from degradation, aids in the export of the mature mRNA to the cytoplasm, and is involved in binding proteins involved in initiating translation.








OR

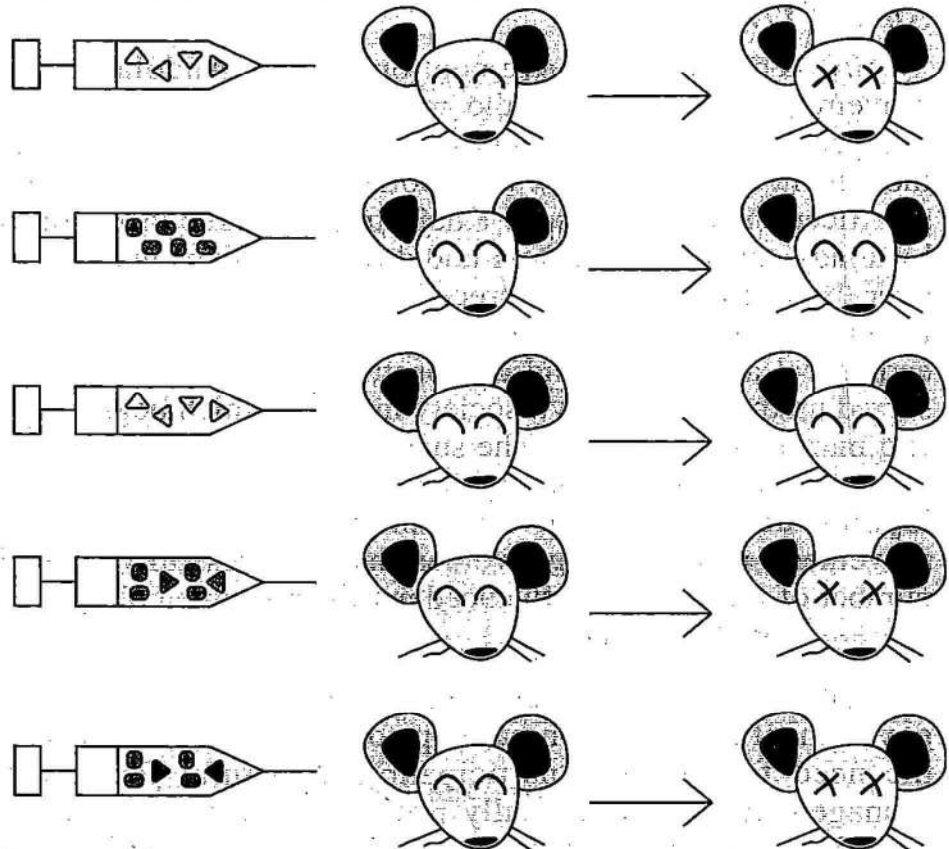
(b) In 1944 Oswald Avery, Colin MacLeod and Maclyn McCarty, gave an experimental demonstration, that DNA is the substance that causes bacterial transformation, when it had been widely believed that it was proteins that served the function of carrying genetic information. The experiment was conducted at Rockefeller Institute for Medical Research. This was done to determine if rough bacteria could be transformed into smooth bacteria, hence passing along the genetic information causing the transformation. By isolating and purifying this chemical component, they could deduce if it had characteristics of a protein or DNA molecule

Procedures:

1. The encapsulated, virulent bacteria is injected into the mouse. The mouse dies.
2. The non-encapsulated, avirulent bacteria is injected into the mouse. The mouse lives.
3. The heat-killed, virulent bacteria is injected into the mouse. The mouse lives.
4. The heat-killed, virulent bacteria is mixed with the non-encapsulated avirulent bacteria and injected into the mouse. The mouse dies.
5. The DNA extracted from the heat-killed, virulent bacteria is mixed with the non-encapsulated avirulent bacteria and injected into the mouse. The mouse dies.

Legend:

-  encapsulated, virulent bacteria
-  heat-killed, virulent bacteria
-  DNA extracted from 
-  non-encapsulated, avirulent bacteria



Two sets of bacteria were taken one smooth (virulent) and one rough (non-virulent).

(i) They first injected deadly encapsulated bacteria into the mouse – the mouse dies at the end.

(ii) They then injected non-encapsulated, non-virulent bacteria into the mouse – the mouse lives.

(iii) Next, they heated the virulent bacteria at a temperature that kills them and injected these bacteria into the mouse – the mouse lives.

(iv) After that, they then have the denatured fatal bacteria mix into the living non-encapsulated, non-fatal bacteria. The mixture was then injected into the mouse – the mouse dies.

(v) Finally, they mix the live, non-encapsulated harmless bacteria with the DNA that was extracted from the heated, lethal bacteria. These “harmless” bacteria injected to the mouse after being mixed – the mouse dies.

This showed that non-virulent bacteria become deadly after mixing with the DNA of the virulent bacteria. Such a demonstration shows that non-virulent bacteria became virulent because of the genetic information that originally came from the virulent bacteria. The protein from the virulent bacteria was already denatured during step 3.

Thus, it was DNA and not protein that transferred the genetic information to the non-virulent bacteria.

Question 17.

(a) *Write a short note on Chipko Movement.*

[5]

OR

(b) *Write a short note on Joint Forest Management.*

Answer 17.

(a) The Chipko movement or Chipko Andolan was a forest conservation movement. The name of the movement comes from the word 'embrace', as the villagers hugged the trees, and prevented the contractors from felling them. During the movement that dates back to 1730 AD, 363 people of Khejarli village of Rajasthan, sacrificed their lives to save Khejri trees. A large group of them from 84 villages led by a lady called Amrita Devi laid down their lives in an effort to protect the trees. All over the world it created a precedent for starting of non-violent protest in India. This inspired to slow down the rapid deforestation, expose vested interests, increase ecological awareness, and demonstrate the viability of people power. Above all, it stirred up the existing civil society in India, which began to address the issues of tribal and marginalized people. The success achieved by this protest led to similar protests in other parts of the country. From their origins as a spontaneous protest against logging abuses in Uttar Pradesh in the Himalayas, supporters of the Chipko movement, mainly village women, have successfully banned the felling of trees in a number of regions and influenced natural resource policy in India.

OR

(b) The Indian Forest Policy of 1988 (MoEF, 1988) and the subsequent government resolution on participatory forest management (MoEF, 1990) emphasize the need for people's participation in natural forest management. Joint Forest Management (JFM) officially refers to partnerships in forest movement involving both the state forest departments and local communities. The policies and objectives are detailed in the Indian comprehensive National Forest Policy of 1988 and the Joint Forest Management Guidelines of 1990 of the Government of India.

Although schemes vary from state to state and are known by different names in different Indian languages, usually a village committee known as the Forest Protection Committee (FPC) and the Forest Department enter into a JFM agreement. Under joint forest management (JFM), village communities are entrusted with the protection and management of nearby forests. The areas concerned are usually degraded or even deforested areas. Villagers agree to assist in the safeguarding of forest resources through protection from fire, grazing, and illegal harvesting in exchange for which they receive non-timber forest products and a share of the revenue from the sale of timber products. The communities are required to organize forest protection committees, village forest committees, village forest conservation and development societies, etc. Each of these bodies has an executive committee that manages its day-to-day affairs.

Question 18.

(a) What does PCR stand for? Describe the different steps of PCR.

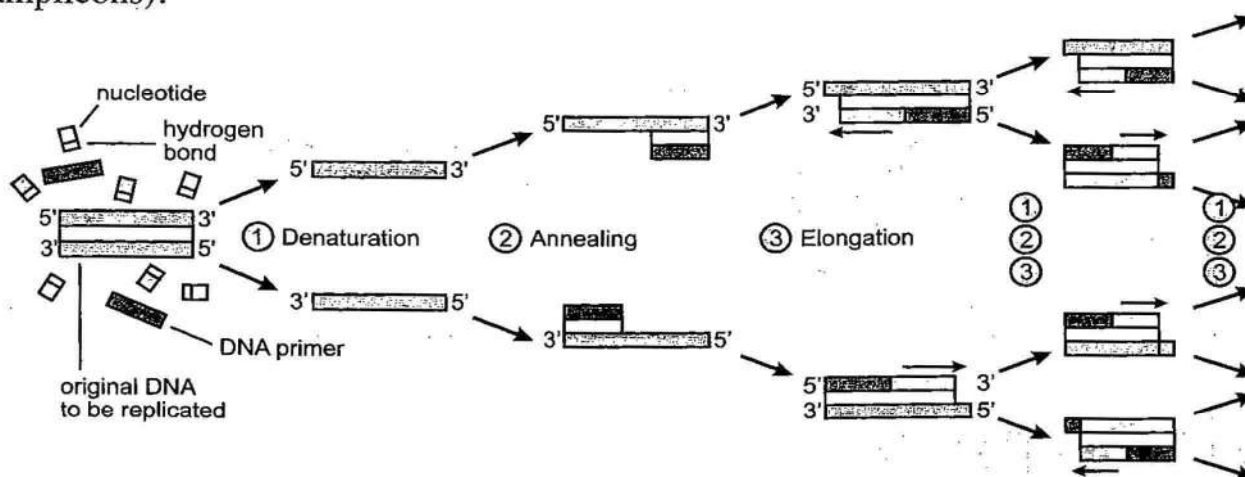
[5]

OR

(b) Give an account of the Blue-White Method of selection of recombinants.

Answer 18.

(a) PCR (Polymerase Chain Reaction) method for synthesis of new DNA strands was developed by **Kary Mullis** in the 1980s. The technique of PCR is ability of DNA polymerase enzyme to synthesize new strand of DNA complementary to the template strand. DNA polymerase can add a nucleotide only onto a pre-existing 3'-OH group, so it needs a primer to which it can add the first nucleotide. At the end of the PCR reaction, the specific sequence will be accumulated in billions of copies (amplicons).



Process : There are three main steps in the process Denaturation, Annealing and Extending.

(i) **Denaturation :** The double stranded template of DNA is heated at a temperature of 94-95°C to separate them into two different strands.

(ii) **Annealing :** During this step the temperature is cooled to 50-54°C and the primers are annealed to single stranded DNA.

(iii) **Extending :** This step is final step and the temperature is increased to 72°C and the DNA is elongated with the help of heat stable enzyme Taq-DNA polymerase.

The process is repeated 20-40 times to get the desired amount of DNA.

OR

(b) Blue-white method of selection is a powerful method of screening for the presence of recombinant plasmid. This method is based upon the insertional inactivation of the lac Z gene present on the vector (*e.g.*, PUC19). This gene expresses the enzyme β -galactosidase whose activity can cleave a colourless substrate called X-gal into blue coloured product. Isopropyl β -D-1-thiogalactopyranoside (IPTG) is used along with X-gal for blue-white screening. IPTG is a non-metabolizable analog of galactose that induces the expression of lac Z gene. It should be noted that IPTG is not a substrate for β -galactosidase but only an inducer. If the lac Z gene is inactivated due to the presence of the insert (express active enzyme), then the enzymes is not expressed. Hence, if after a transformation experiment the *E. coli* host cells are plated on an ampicillin and X-gal containing solid media plate then colonies which appears blue are those which have transformed cells (antibiotic resistant) but do not have the insert (express active enzyme). Colonies which appear white are both ampicillin resistant and have the insert rDNA and thus are the cells to be used for future experiment.

