

XII - ISC Board

Date: 21.03.2018

Biology Paper 1 - Solutions

PART - I (20 Marks)

Answer *all* questions.

Question 1

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

(i) Give a significant point of difference between *Oestrous* and *Menstrual cycle*.

Ans. Oestrous cycle takes place in Non-primate females (which occurs during the Breeding season).
Menstrual cycle takes place in primates, which occurs monthly.

(ii) Give the biological name of the organism causing typhoid.

Ans. The organism causing typhoid is *salmonella typhi*.

(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?

Ans. The number of chromosomes in the cells of shoot tip will be 40 as shoot tip cells are meristematic cells which are diploid cells ($2n$).

(iv) Name a plant which flowers every twelve years.

Ans. *Strobilanthes kunthianus* or *Neelakurinji* is a plant which flowers every twelve years.

(v) Name the diagnostic test for AIDS.

Ans. The diagnostic test for AIDS is ELISA (Enzyme linked Immunosorbant Assay).

(vi) Name the terminal stage of ageing in the life cycle of plants.

Ans. Maturation is the terminal stage of ageing in the life cycle of plants.

(vii) Which organisms constitute the last trophic level?

Ans. Tertiary consumers (Decomposers) are the organisms which constitute the last trophic level.

(viii) What is *emasculation* ?

Ans. Removal of anthers of a flower in order to prevent self pollination is called *emasculation*.

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

(i) Length of DNA with 23 base pairs is :

- (1) 78.4 Å (2) 78.2 Å (3) 78 Å (4) 74.8 Å

Ans. (2) 78.2 Å

(ii) Opium is obtained from :

- (1) *Papaver somniferum* (2) *Cannabis sativa*
(3) *Erythroxyllum coca* (4) *Datura metel*

Ans. (1) *Papaver somniferum*

(iii) According to Abiogenesis, life originated from :

- (1) Non-living matter (2) Pre-existing life
(3) Oxygen (4) Extra-terrestrial matter

Ans. (1) Non-living matter

(iv) The largest unit in which gene flow is possible is :

- (1) Organism (2) Population (3) Species (4) Genes

Ans. (2) Population

(c) Give one significant contribution of each of the following scientists :

(i) P. Maheshwari

(ii) E. Wilson

(iii) M. S. Swaminathan

(iv) H. Boyer

Ans. (i) P. Maheshwari : Significant contribution in plant tissue culture.

(ii) E. Wilson : Father of biodiversity

(iii) M. S. Swaminathan : Father of green revolution in India

(iv) H. Boyer : Discovered restriction enzymes

(d) Define the following :

- (i) Biopatent
- (ii) Parthenocarpy

Ans. (i) Biopatent : A biopatent is a right granted by a government to an inventor to prevent others from commercial use of his invention. A patent is granted for

- (a) An invention (including product)
- (b) An improvement in an earlier invention
- (c) The process of generating products
- (d) A concept or design

(ii) Parthenocarpy

It is the natural or artificially induced production of fruit without fertilization of ovules, which makes the fruit seedless.

(e) Give a reason for each of the following :

- (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.

Ans. (i) Pollen grains of wind pollinated flowers are produced in large quantities as it is an abiotic agent of cross pollination destruction rate is more.

- (ii) Equilibrium of a forest ecosystem can be disturbed by uncontrolled hunting of big predators as big predator acts as consumers which may be primary consumer, secondary consumers or tertiary consumers which may significantly decrease due to hunting. And if these predators decreases in number it will result in imbalance in ecosystem.

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 shows the possible blood groups of the progeny. List the alleles involved in this inheritance.

Ans. Women with Blood group O married a man with Blood group AB

Hence the genotype of parents are

Mother – $I^O I^O$

Father – $I^A I^B$

Using the punnet square method, the possible blood groups in the progeny are as follows:

	I^O	I^O
I^A	$I^A I^O$	$I^A I^O$
I^B	$I^B I^O$	$I^B I^O$

Hence the possible genotype are – $I^A I^O$ and $I^B I^O$

possible phenotype are – Blood group A and Blood group B.

OR

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

Ans. Color blindness is a X-linked recessive disorder.

- Mother is carrier for colorblindness and Hence, the genotype of Mother must be $X^C X$.
- Fahter is normal, hence the genotype of father must be XY.

By using punnet square, the possible genotypes and phenotypes in next generation will be

	X	Y
X^C	$X^C X$	$X^C Y$
X	XX	XY

Possible Genotypes – $X^C X, X^C Y, XX$ and XY .

Possible Phenotypes – $X^C X$ = Carrier daughter

$X^C Y$ = Affected son

XX = Normal daughter

XY = Normal son

Question 3: Define *life span*. Give the life span of an elephant.

Ans. Life Span definition: The period from birth to the natural death of the organism represents it's life span.

Asian elephant – 48 years

African elephant – 60 to 70 years.

Question 4

Give two characteristic features of each of the following :

(a) *Ramapithecus*

(b) *Cro-Magnon man*

Ans. Two characteristics of Ramapithecus and Cro-magnon man are:

(a) Ramapithecus : It was an ape-man like primate. The teeth and jaw bones of them were found in the rocks of Siwalik hills. They walked erect on their Hind limbs.

(b) Cromagnon man: The cro-magnon man was the extinct modern man.

The cro-magnon were about 180 cm in height with large skull, rounded forehead, distinct chin, narrow nose.

The cranial capacity was about 1600 cc.

They lived in caves with families.

They were expert in hunting and painting.

They made weapons and ornaments.

They buried their dead according to their customs.

Question 5

(a) List *any four* effects of global warming.

Ans. Effect of global warming :

(i) Due to global warming, earth's temperature increases. This results in melting of glaciers and ice caps of polar regions and consequently floods in rivers, rise in sea level.

(ii) Due to increased CO₂ concentration, the rate of photosynthesis will increase. This is called CO₂ fertilisation effect.

(iii) Depletion of ozone layer leads to increase in temperature.

(iv) Changes in the cycle of rain i.e., Uneven rainfall.

OR

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

Ans. (i) Sound absorbents must be used to minimize the sound.

(ii) Growing of more plants can also minimize the noise pollution, by muffling.

(iii) Strict following of laws like delimitation of horn free zones around hospitals, schools etc.

(iv) Proper timings after which loud speakers cannot be played.

Question 6

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

Ans. BOD - Biochemical Oxygen Demand

The water pollution by organic wastes is measured in term of BOD. It is the amount of dissolved oxygen needed by bacteria in decomposing the organic wastes present in water.

Significance in an Aquatic Ecosystem :

BOD \propto input of organic wastes

If BOD is increased dissolved oxygen is decreased in water. Higher amount of organic waste increases the rate of decomposition in water. O₂ is rapidly consumed by microbes, thereby causing drop in dissolved oxygen content in water.

Question 7

Give one significant difference between each of the following

pairs : (a) *Humoral immunity and cell mediated immunity.*

Ans.

Human Immunity	Cell Medicated Immunity
Provided by T-lymphocyte that involves, T-Helper, T-Suppressor, T-memory and Cytotoxic T-cells	Provided by B-lymphocytes The B-lymphocytes differentiate to plasma cells which forms antibodies against antigens.

(b) *Benign tumour and malignant tumour*

Ans.

Benign Tumor	Malignant Tumor
<ul style="list-style-type: none"> • Capsulated • Slower rate of growth • Do not invade the surrounding tissue and structure • Do not Metastasize • Prognosis is good 	<ul style="list-style-type: none"> • Non-capsulated • Rapid growth • Shows Invasion • Shows Distant Metastasis • Prognosis is poor

Question 8

Give four causes of infertility in males.

Ans. Causes of Infertility in Males:

- (i) Cryptorchidism - Failure of descend of testis from abdomen in the scrotum.
- (ii) Oligospermia - Low sperm count
- (iii) Asthenospermia - Decreased motility of sperm
- (iv) Hormone Imbalance - Decrease testosterone and excessive estradiol secretion (from adrenal glands) leading to virilism.
- (v) Infection - like orchiditis (Inflammation of testis)
- (vi) Impotency - Failure of erection.

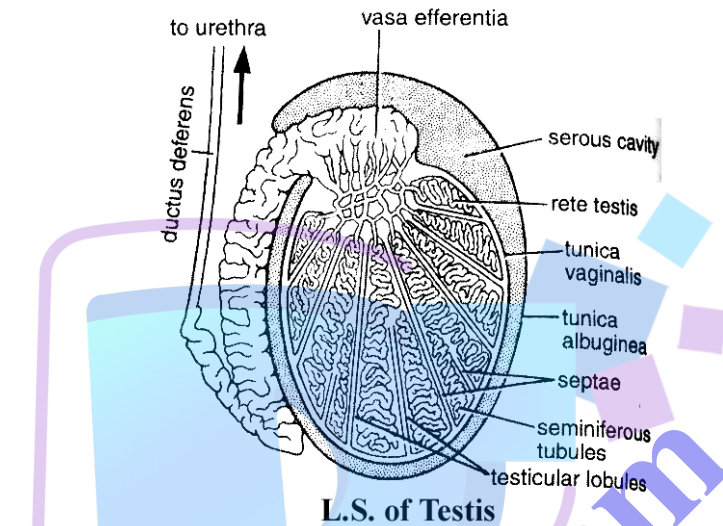
Section B (21 Marks)

Answer *all* questions.

Question 9

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

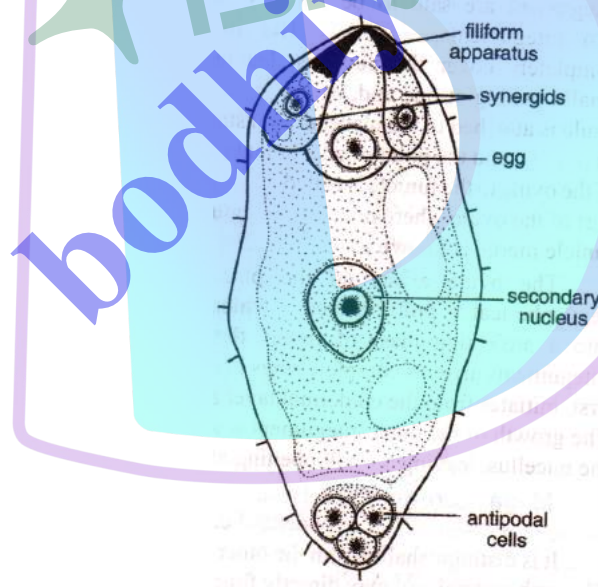
Ans.



OR

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

Ans.



Question 10

Explain gene therapy, with reference to treatment of SCID.

Ans. Gene therapy with respect to SCID: Gene therapy is the insertion of desired genes into an individual's cells and tissue to treat genetic diseases.

SCID is severe combined immunodeficiency due to the deficiency of enzyme adenosine deaminase (ADA). This disorder is caused due to the deletion of gene for adenosine deaminase.

The enzyme is crucial for immune system to work properly. The deficiency leads the individual susceptible to many infections due to impaired immune system.

The first clinical gene therapy was given in 1990 to a 4 year old girl with ADA deficiency.

During this procedure, the lymphocytes from the blood of the patient are grown in a culture outside the body.

- A functional ADA, cDNA (using a retroviral vector) is then introduced into these lymphocytes, which are subsequently returned to the patient.
- However, as these cells are not immortal, the patient requires periodic infusion of such genetically engineered lymphocytes.
- However if the gene isolated from marrow cells producing ADA is introduced into cells at early embryonic stages, it could be a permanent cure.

Question 11

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

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

Ans.

Scientific Name	Commercial Product	Use
(a) Haemolytic Strepto cocci	Streptokinase	(b) Anticoagulant
<i>Monascus purpureus</i>	(c) Statins	(d) Blood-cholesterol lowering agent
(e) Lactobacillus Bulgaricus	Lactic acid	(f) Curdling of Milk

Question 12

Explain *industrial melanism*.

Ans. **Industrial Melanism:** Industrial melanism is an example for natural selection. It illustrates the development of dark colored peppered moths in response to air pollution during the industrial revolution in Great Britain.

Before the industrial revolution (1845) light colored peppered moths called *Biston Betularia* were prevalent in very high numbers. The peppered moths are nocturnal in habit. During day time they rest on the tree trunk. Their pale body colour camouflaged well with the lichen covered trees that helped

them to escape from the predatory birds. On the contrary, the black coloured moth called *Biston carbonaria*, resting on lichen covered tree trunks were very conspicuous and were easy victims for the predatory birds hence they were rare.

During the industrial revolution, large number of industries came up in Great Britain. The industries released black sooty smoke that killed the lichens growing on trees and turned the trees black due to the sooty deposit. This change became an advantage to the black tree trunks and their population increased, while the pale coloured moths became easy victims to predatory birds and their population drastically reduced.

Thus, natural selection has resulted in the establishment of a phenotypic trait in changing the environmental conditions.

Question 13

Describe the tissue culture technique in plants.

Ans.

(i) Explant culture :

Proper explant is excised from the plant which may be a cell, tissue or a piece of plant organ. Generally parenchyma tissue or meristem is used as explants. It is sterilized properly and placed on solid nutrient medium. The cells from explant absorb nutrients and start multiplying.

(ii) Callus formation and its culture :

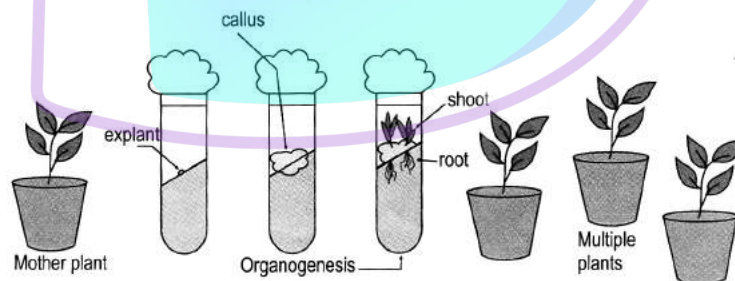
The callus is unorganized mass of cells produced due to growth of the explant. Generally it has thin walled living parenchyma cells. It develops due to proliferation of cells from explants. All the cells of callus are identical because they are produced by mitosis only.

(iii) Organogenesis :

Now the growth hormones like auxins and cytokinins in proper proportion are provided to the callus to induce formation of organs. If auxins are more, roots are formed (rhizogenesis) and if the cytokinins are in the more quantity then the shoot system begins to develop (caulogenesis).

(iv) Formation of cell or suspension culture :

For formation of cell or suspension culture the callus can be transferred to liquid nutrient medium and it is agitated. Due to this the cells from callus get separated. This cell culture is to be agitated constantly at 100-250 rpm. The agitation serves the purpose of aeration, mixing of medium and prevents the aggregation of cells. By the callus and suspension culture we can achieve cell biomass production which can be utilized for biochemical isolation, regeneration of new plantlets, formation of transgenic plants and protoplast culture.



Question 14

Define the following :

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

- Ans. (a) **Spermiogenesis** : The process of conversion of immature spermatids into mature spermatazoa or sperm.
- (b) **Reproductive health**: (WHO) Reproductive health means a total well-being in all aspect of reproduction, i.e., physical, emotional, behavioural and social.
- (c) **Amenorrhea**: Absence of menstrual cycle in female of reproductive age.

Question 15

- (a) Define the following :
 - (i) Hotspots
 - (ii) Ramsar Sites
 - (iii) Red data book

- Ans. (i) **Hotspots** :

Hotspot is a biodegradable region that is both a significant reservoir of biodiversity and is threatened with destruction.

- (ii) **Ramsar Sites** :

It is a wetland site designed of international importance under the Ramsar convention. It is an inter-governmental environmental treaty established in 1971 by UNESCO and coming into force in 1975.

- (iii) **Red data book** :

The Red data book is the state document established for documenting rare and endangered species of animals, plants and fungi as well as some local sub-species that exist within the territory of the state or country.

OR

- (b) Define the following :
 - (i) Biodiversity
 - (ii) Eutrophication
 - (iii) PAR

- Ans. (i) **Biodiversity**

It is defined as the variety of plant and animal life in the world or in a particular habitat, a high level of which is usually considered to be important and desirable.

(ii) Eutrophication

The process by which a body of water enriched in dissolved nutrients (such as phosphates) that stimulates the growth of aquatic algae usually resulting in the depletion of dissolved oxygen.

(iii) PAR

PAR is photosynthetically active radiation. The part of visible spectrum of light that contributes most to the process of photosynthesis.

PAR sensors are used by many biologists, which induces optimum exposure to desired radiation to the plants.

Section C (15 Marks)

Answer all questions.

Question 16

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

Ans. DNA to RNA- Transcription. During this process, a complementary mRNA strand is formed from a DNA strand.

Post transcription processing of RNA in eukaryotes takes place as follows:

- (1) RNA to protein- Translation. In the translation process, the coded information coming originally from DNA, contained in mRNA, programmes ribosomes for the synthesis of protein molecules.
- (2) Chain initiation and chain termination codons: AUG (methionine) and GUG (valine) triplets are designated as chain initiation codons, while UAA, UAG (tyrosine) and UGA (tryptophan) triplets, as chain termination codons.
- (3) Activation of amino acids and transfer of activated amino acid to -tRNA. First, an amino acid molecule is activated by ATP in the presence of a specific activating enzyme (called amino acyl-tRNA synthetases). This results in the formation of amino acyl-adenylic acid compound (amino acyl-AMP-E) and release of pyrophosphate (PP). Therefore the amino acyl-AMP-enzyme complex, formed during the first step reacts with a particular -tRNA and transfers the amino acid to the -tRNA. The specific amino acid is attached to the 3'-end of specific -tRNA molecules.
- (4) Role of ribosome in protein synthesis: Once the amino acids have become attached to their respective -tRNA, they diffuse to ribosomes where protein synthesis actually occurs. Ribosomes have two sites for binding amino acyl-tRNA-(i) amino acyl (or A site), and (ii) peptidyl (or P site). The initiating formyl methionine -tRNA can bind only with P site, whereas all other newly coming aminoacyl -tRNA bind to A site.
- (5) The initiation of polypeptide chain; It is always brought about by the amino acid methionine and, therefore, methionyl t-RNA, charged with methionine binds to the initiator codon on the mRNA of the P site.
- (6) Elongation of polypeptide chain; A second tRNA charged with an appropriate amino acid forms hydrogen bonds with the second codon on mRNA at the A-site of the ribosome. While the two tRNA molecules are held, a peptide bond forms between the last amino acid in the polypeptide chain and the amino acid held by the tRNA at the A-site. The tRNA at the P-site then releases the polypeptide chain and leaves the ribosome. At this point, the ribosome shifts so that the remaining tRNA (formerly at the A-site) is moved to the P-site, which leaves the A-site free to bind with the tRNA carrying the next amino acid for the chain. This process is known as translocation. It results in the third codon coming into the A-site and an appropriate tRNA charged with a third amino acid would bind at the A-site. The process of peptide bond formation and translocation is repeated.

- (7) Termination and release of polypeptide chain: A termination codon (UUA, UAG and UGA) is not recognised by the anticodons of any of the normally occurring aminoacyl-t RNAs, and its presence in the decoding or aminocyl site precludes the addition of any further amino acids to the chain and this protein synthesis is stopped. The terminating codons are recognised by some release factors which help in splitting of the carbosyl end of polypetide and the last tRNA carrying the chain. The completed polypeptide chain is finally released in the cytoplasm and undergoes various other modifications. After the synthesis of protein, mRNA degenerates. The ribosomes and tRNAs on release from the mRNA can function again in the formation of another polypeptide.

OR

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

Ans. In 1928, Frederick Griffith, an English medical bacteriologist, observed two strains of *D. Pneumoniae*. In one strain, considerable amount of polysaccharide material is secreted by the cell which forms a large capsule around the cell. The colony produced by these cells has a flisting appearance and is called smooth (S) type. In the other strain, no polysaccharide slime layer is secreted by the cell. The colony formed by the such cells has an irregular appearance and is said to be rough (R) type. The S-strain is virulent and can cause pneumonia as the capsule protects the bacteria from mammalian immunological defence – phagocytosis by white blood cells. But the non-encapsulated R-strain is non-virulent as it can be inactivated by the defense mechanism. Griffith observed that in the blood of dead mice both rough and smooth type of pneumococci occur. He thus concluded that heat-killed smooth type bacteria caused a transformation of the living rough type bacteria. But he could not understand the cause of baterial transformation. Oswald T. Avery, C. M. MacLeod and M. J. McCarty repeated Griffith's experiments in an in vitro system in order to identify the transforming substance responsible for converting non-virulent into virulent type. They found that the DNA isolated from heat-killed S-cells when added to R-cells changed their surface character from rough to smooth and also made them pathogenic. But when the extract was treated with DNA ase (an enzyme which destroys DNA) the transforming ability. significance : **DNA and not proteins is the genetic material.**

Question 17

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

Ans. Chipko movement : The chipko movement or chipko andolan refers to a forest conservation movement.

- The locals of Garhwal Himalaya's in 1974, showed enormous bravery in protecting trees from the axe of contractors by hugging them.
- The main aim of chipko movement is to stop the felling of trees.
- Sunderlal Bahvgana was the leader of chipko movement.
- It was a nonviolent, social and ecological movement, in which many of the villager sacrificed their life.
- The chipko protests achieved a major victory. in 1980 with a 15 years ban on tree felling in the Himalayan forests of the state by the order of Mrs. Indira Gandhi.

- The chipko type movement dates back to 1730 AD, when in Khejarli village of Rajasthan, many hundreds of people sacrificed their life for conservation and protection of trees.

OR

(b) Write a short note on Joint forest management.

- Ans. (i) Joint forest management involves regeneration and conservation of forests through involvement of village communities in association with state forest departments.
- (ii) It involves contract specifying the distribution of authority, responsibility and benefits between village and state forest departments.
- (iii) States where joint forest management project is running
- Orissa
 - Himachal Pradesh
 - Gujarat
 - Uttar Pradesh
 - Karnataka

Various types of Record handled by Joint forest management

- Monthly checking of plants and woods quality which wood is beneficial and which is not etc.
- Checking of herbs.
- Taking care of every type of plants.

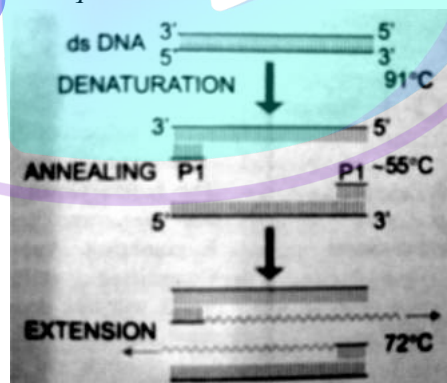
Question 18

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

Ans. PCR stands for Polymerase Chain Reaction

Basic requirements for PCR technique are :

- A DNA segment (100-35, 000 bp in length) be amplified.
- Primers (forward and reverse) which are synthetic oligonucleotides of 17-30 nucleotide. They are complementary to the sequence present on the desired DNA segment.
- Four types of deoxyribonucleotides (dATP, dCTP, dGTP, dTTP). They are collectively called dNTPs.
- A thermostable DNA polymerase, that can withstand upto 94°C. Usually Taq polymerase isolated from bacterium *Thermus aquaticus* is used.



The three essential steps for PCR technique are :

- Heat denaturation :** This step involves heating of DNA at about 91°C. The heating breaks the hydrogen bonds to make ssDNA. The DNA molecule with more G-C pairs, need higher temperature.
- Annealing :** It is pairing of primers to the ssDNA segment. The primer have to be designed as per the requirement. this step requires temperature at about 55°C.

(iii) **Polymerisation** : The temperature is raised to 72°C. The Taq polymerase adds dNTPs behind the primer on the ssDNA.

These three steps constitute one cycle of the reaction. The process is carried out for about 28-30 cycles beyond which its reliability decreases.

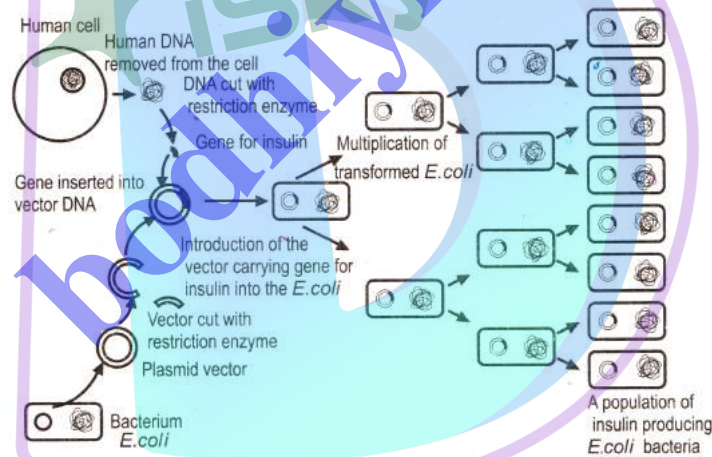
OR

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

Ans. (a) Recombinant DNA (rDNA) technology is the technique of manipulating the genome of a cell or organism so as to change the phenotype desirably.

Following are the basic steps involved in the process :

- (i) Isolating genomic DNA of a 'donor'. The cell or organism from which the required gene is taken is called 'donor'
- (ii) Fragmenting this DNA using "molecular scissors" (Enzymes) : Different enzymes used are; restriction endonucleases, DNA ligase, reverse transcriptase, DNA polymerase, alkaline phosphatases etc. The restriction endonucleases are used to cut DNA at specific points. They are called biological / molecular / chemical scissors / knives / scalpels.
- (iii) Screening the fragments for a 'desired gene'.
- (iv) Inserting the fragments with desired gene into a 'cloning vector' - Vectors are the DNA molecules used to transfer genetic material into another cell. (a plasmid, cosmid or phage DNA), so as to develop a recombinant DNA or chimeric DNA.
- (v) Introducing the recombinant vector into a competent host cell.
- (vi) Culturing these cells to obtain multiple copies or clones of desired fragment of DNA.
- (vii) Using these copies to "Transform" suitable host cells so as to express the desired gene.



(viii) **Selection of transformants by the blue – white method of selection of recombinants.**

It is a screening technique that allows for rapid and convenient detection of recombinant bacteria in vector – based molecular cloning experiments. Recombinant DNA is inserted into a competent host cell viable for transformation, which are then grown in presence of X – gal. Cell transformed with vectors containing Recombinant DNA will produce white colonies, cells transformed with non – recombinant plasmids (i.e. only the vector) grow into blue colonies. This method of screening is usually performed using a suitable bacterial strain, but other organisms such as yeast may also be used.