

Biology Delhi (Set 3)

General Instructions:

Read the following instructions very carefully and strictly follow them:

- (i) Question paper comprises **five** sections – A, B, C, D and E.
- (ii) There are **27** questions in the question paper. **All** questions are compulsory.
- (iii) Section **A** question number **1** to **5** are multiple choice questions, carrying **one** mark each.
- (iv) Section **B** question number **6** to **12** are short answer questions type-I, carrying **two** marks each.
- (v) Section **C** question number **13** to **21** are short answer questions type-II, carrying **three** marks each.
- (vi) Section **D** question number **22** to **24** are short answer questions type-III, carrying **three** marks each.
- (vii) Section **E** question number **25** to **27** are long answer questions, carrying **five** marks each.
- (viii) Answer should be brief and to the point also the above word limit be adhered to as far as possible.
- (ix) There is no overall choice in the question paper. However, an internal choice has been provided in two questions of **1** mark, one question of **2** marks, two questions of **3** marks and three questions of **5** marks questions. Only **one** of the choices in such questions have to be attempted.
- (x) The diagram drawn should be neat proportionate and properly labelled, wherever necessary.
- (xi) In addition to this, separate instructions are given with each section and question, wherever necessary.

Question 1

Louis Pasteur demonstrated that

- (a) early life came from outer space
- (b) non-living chemicals produced living molecules
- (c) life comes from pre-existing life
- (d) life originated spontaneously

Solution:

Louis Pasteur disproved the theory of spontaneous generation by his famous swan-flask experiment and proved that even at microscopic level life originated from pre-existing life-forms only.

Hence, the correct answer is option C.

Question 2

Mating of a superior male of a breed of a cattle to a superior female of another breed is called

- (a) in breeding
- (b) out crossing
- (c) out breeding
- (d) cross breeding

OR

Large-holes in 'Swiss-Cheese' are due to

- (a) *Propionibacterium sharmanii*
- (b) *Saccharomyces cerevisae*
- (c) *Penicillium chrysogenum*
- (d) *Acetobacter aceti*

Solution:

Mating of superior male of one breed and superior female of another breed to obtain the desirable qualities of two breeds can be combined by the process of cross breeding. e.g., Hisardale is a new breed of sheep developed in Punjab by crossing Bikaneri ewes and Marino rams.

Hence, the correct answer is option D.

OR

The large holes in 'Swiss cheese' are due to the production of a large amount of CO₂ by a bacterium called *Propionibacterium sharmanii*.

Hence, the correct answer is option A.

Question 3

Increased concentration of DDT in fish-eating birds is due to

- (a) eutrophication
- (b) bio-magnification
- (c) cultural eutrophication
- (d) accelerated eutrophication

OR

Species-Area relationship is represented on a log scale as

- (a) hyperbola
- (b) rectangular hyperbola
- (c) linear
- (d) inverted

Solution:

Biomagnification is the increase in the concentration of non biodegradable material at each trophic level of the food chain. e.g., Biomagnification of DDT in the food chain.

Hence, the correct answer is option B.

OR

The species-area relationship, when represented on a logarithmic scale, shows a typical linear curve.

Hence, the correct answer is option C.

Question 4

Which one of the following part of the plant when put into the soil is likely to produce new offspring?

- (a) Part of an internode
- (b) A stem cutting with a node
- (c) Part of a primary root
- (d) A flower

Solution:

The new plantlet grows from the nodes present in the stem of the flowering plants.

Hence, the correct answer is option B.

Question 5

In a bacterium when RNA-polymerase binds to the promoter on a transcription unit during transcription, it

- (a) terminates the process
- (b) helps remove introns
- (c) initiates the process
- (d) inactivates the exons

Solution:

RNA polymerase is the key enzyme for the process of transcription. This enzyme recognizes the promoter region and initiates the transcription process. This leads to the formation of RNA (or mRNA) from the template DNA.

Hence, the correct answer is option C.

Question 6

Name one air-borne and a water borne disease in humans. List one specific symptom of each one of them.

Solution:

Airborne : Pulmonary Tuberculosis, Influenza

Symptoms of Tuberculosis : Pain and difficulty in breathing or coughing.

Waterborne : Diarrhoea, Typhoid

Symptoms of Diarrhoea : loose motions and watery stool.

Question 7

(a) Name the two techniques employed to meet the increasing demand of fish in the world.

(b) Name any two fresh water fishes.

OR

Describe the contributions of Alexander Fleming, Ernest Chain and Howard Florey in the field of microbiology.

Solution:

a) The two techniques employed to meet the increasing demand of fish in the world are:

- Pisciculture- It is the rearing of fish for food in enclosures such as fish ponds or tanks.
- Inland Fisheries- Inland fisheries are the commercial fishing operations that takes place in freshwater. It includes capture fishery, where the fish living naturally in a body of water are harvested. The other type of inland fishery is the fish farm, where fish are raised in tanks or ponds, generally for human consumption.

b) Rohu, Common Carp

OR

Alexander Fleming while working on *Staphylococci* bacteria, once observed a mould growing in one of his unwashed culture plates around which *Staphylococci* could not grow. He found out that it was due to a chemical produced by the mould and he named it Penicillin after the mould *Penicillium notatum*.

However, its full potential as an effective antibiotic was established much later by Ernest Chain and Howard Florey. This antibiotic was extensively used to treat American soldiers wounded in World War II. Fleming, Chain, and Florey were awarded the Nobel Prize in 1945, for this discovery.

Question 8

All cloning vectors do have a 'selectable marker'. Describe its role in recombinant DNA-technology.

Solution:

The role of selectable marker is to identify and distinguish the bacterial cells that have taken up the recombinant vector during the transformation process.

Question 9

Mention how have plants developed mechanical and chemical defence against herbivores to protect themselves with the help of one example of each.

Solution:

The plants exhibit mechanical and chemical defence to protect themselves against herbivores. These have been enlisted as follows:

The chemical defence includes certain secondary metabolites produced by the plants. They do not participate in the metabolism of the plant and act by impeding certain biochemical pathways in herbivores. Example: alkaloids present in plants produce noxious smell and taste to keep the herbivores away.

Structures such as thorns and spines constitute the mechanical defence of the plant. These structures are the modifications of various plant parts, like thorn-modified branches and spines-modified leaves. They cause physical damage to the herbivores such as rashes and cuts.

Question 10

How is humus formed? Mention any three characteristics of humus.

Solution:

Humus is formed as a result of action of decomposers and detritivores on the organic waste by the process of humification.

Three major characteristics of humus are following:

- (i) Amorphous
- (ii) Dark Coloured
- (iii) Colloidal and rich in inorganic minerals.

Question 11

State what are Mendelian disorders. Both thalassemia and colour blindness categorised as Mendelian disorders. Justify.

Solution:

The Mendelian disorder is a type of genetic disorder in humans which is characterized by mutation in a single gene. Their mode of inheritance follows the principles of Mendelian genetics. Mendelian disorders can be autosomal dominant (muscular dystrophy), autosomal recessive (sickle cell anaemia) or sex linked (haemophilia).

Thalassemia- Thalassemia is a recessive autosomal genetic defect that results in defect in the synthesis of globin polypeptide. The individuals whose one of the parents is a carrier may also becomes a carrier of the disease. If both the parents are carriers of the disease, the individual has 25% chance of inheriting the disease.

Colour Blindness- It is a sex-linked recessive trait in which the gene controlling a specific trait is present in its recessive form on the X-chromosome. It is a congenital disease (hereditary disease) in which the individual fails to distinguish red and green colours.

This gene appears in the normal (dominant) and the mutant (recessive) form. Because females have two X chromosomes while males have only one X chromosome, for a female to get affected by haemophilia she has to have the mutant gene on both the X chromosomes while males may be affected if they carry it on the X chromosome.

Question 12

State two advantages of an apomictic seed to a farmer.

Solution:

Apomictic seeds are advantageous over the hybrid seeds in the following ways:

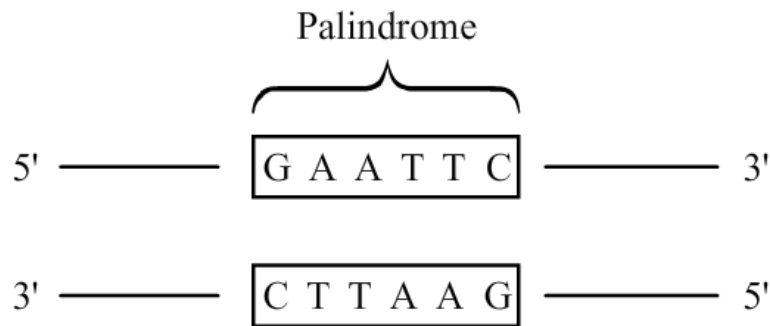
- (i) They reduce the cost of hybrid breeding programmes.
- (ii) Desired traits can be maintained without losing superiority of hybrids over parents (hybrid vigour), and farmers can replant these seeds year after year.

Question 13

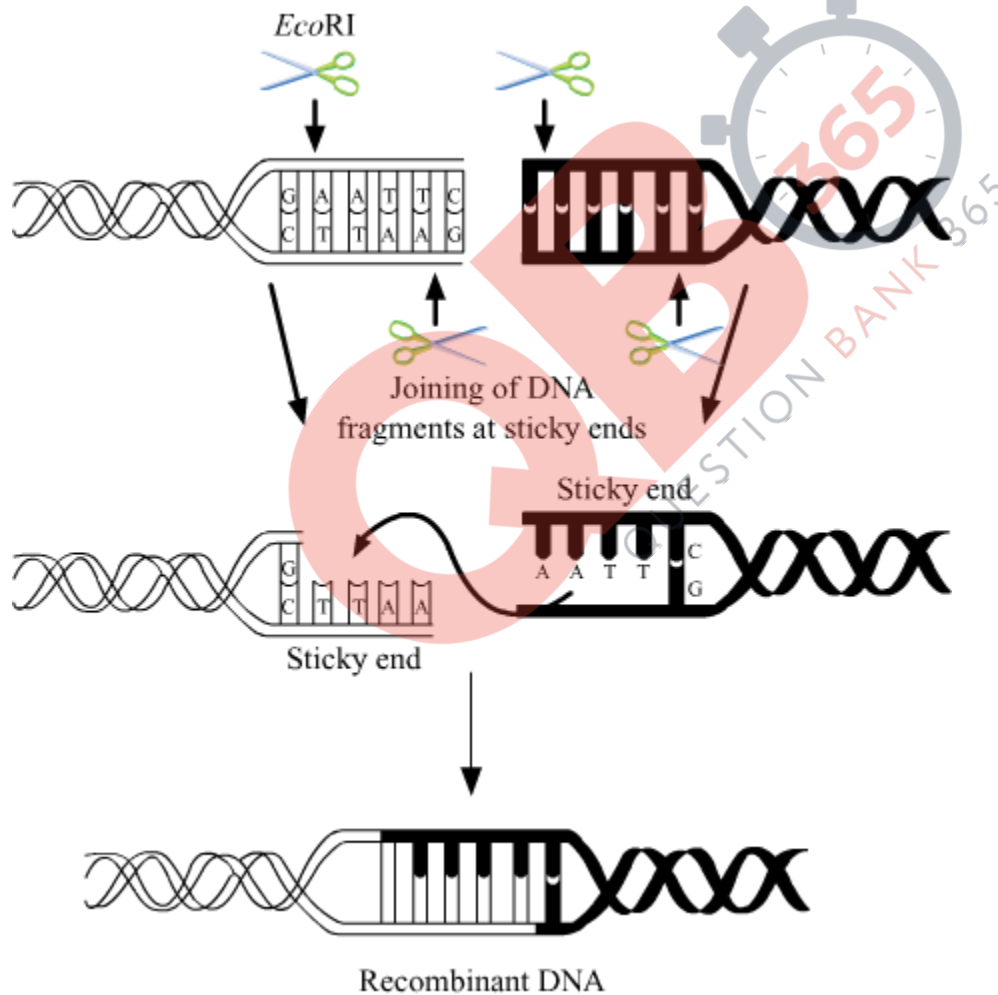
- (a) Write the palindromic nucleotide sequence EcoRI recognises.
- (b) Draw the vector DNA and a foreign DNA showing the sites where EcoRI has acted to form the sticky ends.
- (c) Name the enzyme that helps in forming recombinant DNA.

Solution:

(a)



(b)



(c) There are many enzymes that help in forming recombinant DNA such as : Restriction enzymes, DNA ligases, DNA dependent DNA polymerase etc.

Question 14

Differentiate between “Pioneer-species”; “Climax-community” and “Seres”.

OR

Explain any three ways other than zoological parks, botanical gardens and wildlife safaries, by which threatened species of plants and animals are being conserved 'ex situ'.

Solution:

The differences between pioneer species, climax community and seres can be summarised as follows:

Pioneer species: A pioneer species is a species that is first to colonize a bare area. A typical example of pioneer species is lichen which firstly colonizes a bare rock during primary succession.

Climax community: A climax community is that community which arises during the final stages of succession and remain unchanged for a long period of time (as long as the environment remains stable). A typical example includes a forest community.

Seres: Sere refers to the overall sequence of communities that arise during the course of ecological succession. Each community that exists during ecological succession is called a seral community.

OR

In addition to zoological parks, botanical garden and wildlife safaris, the following methods are being employed for the ex-situ conservation of plants and animals:

1. **Seed banks:** In this method, viable seeds from different plants are preserved in a temperature and moisture controlled environment. These seeds are then stored for extended periods of time.
2. **Gene banks:** This method is preferred for animals. In gene banks, embryos, sperms or eggs of endangered animals are stored in the low-temperature environments.
3. **Cryopreservation:** In this method, pollens, embryos or tissues can be preserved in liquid nitrogen at a temperature of -196°C .

Question 15

Explain 'Integrated organic' farming as successfully practiced by Ramesh C. Dagar, a farmer in Sonapat (Haryana).

Solution:

"Integrated Organic farming" is an agricultural technique that relies on crop rotation, green manure, biological pest control and compost. In this kind of farming, the waste from one process is utilised in another process, and hence it is zero waste process. It limits the use of synthetic fertilizers and pesticides.

Ramesh Chander Dagar, an organic farmer, followed integrated organic farming and has been proven to be successful. It comprises of many practices like bee keeping, dairy management, water harvesting, composting and agriculture, which support each other and allow economic, sustainable and environment friendly venture. Cow dung is used as manure, and the plant wastes are used as compost in this practice.

Question 16

- (a) Explain the mode of action of Cu^{++} releasing IUDs as a good contraceptive. How is hormone releasing IUD different from it?
(b) Why is "Saheli" a preferred contraceptive by women (any two reasons)?

Solution:

- (a) Cu^{++} releasing IUDs such as CuT exert their effects in two ways:
- They can trigger phagocytosis of sperms within the uterus.
 - They can also affect the fertilizing ability of sperms and suppress their motility.

In contrast to Cu^{++} releasing IUDs, hormone-releasing IUDs alter the uterus through hormonal actions such that implantation does not occur.

- (b) Saheli is a preferred contraceptive because of the following reasons:
1. Minimal side effects
 2. High contraceptive value

Question 17

What are 'SNPs'? Where are they located in a human cell? State any two ways the discovery of SNPs can be of importance to humans.

Solution:

SNP refers to Single Nucleotide Polymorphism. It refers to the variation in the genome of organisms within a particular species because of changes in the sequence of a single nucleotide.

SNPs are located within the chromosomes in certain discrete locations. The discovery of SNPs can prove useful to humans in the following manner:

1. SNPs can be used to specifically identify genetic regions associated with certain

genetic disorders.

2. SNPs can also be used in forensic sciences.

Question 18

(a) Rearrange the following in the correct order of their appearance on Earth between two million years and 40,000 years back.

Neanderthals, Australopithecus, Homo erectus and Homo habilis.

(b) Which one of the above

(i) had the largest brain size

(ii) ate fruits

Solution:

a) The correct order of the appearance of human on Earth between two million years and 40,000 years back is-

Australopithecus, Homo habilis, Homo erectus, Neanderthals.

b)

i) Neanderthal man - had the largest brain size.

ii) *Australopithecus*- ate fruits.

Question 19

Explain Mendel's "Law of segregation" in a typical monohybrid cross with the help of a suitable example.

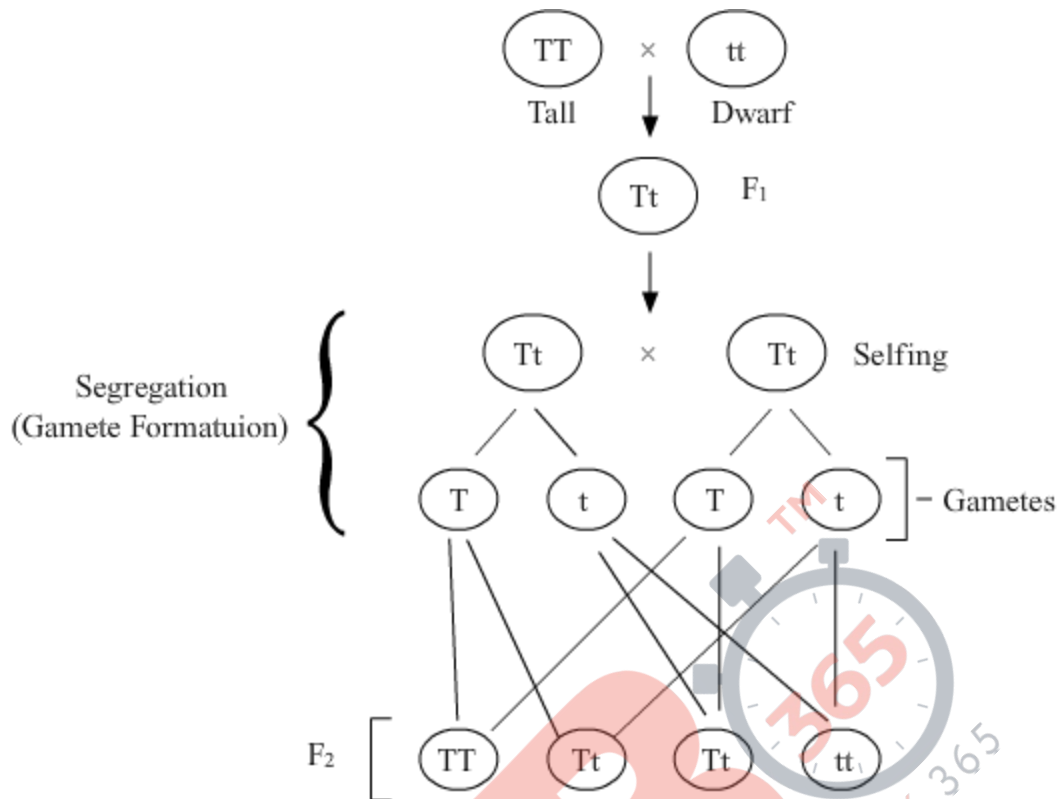
Solution:

Law of Segregation :

This law states that a pair of alleles of a gene stay together in the individual until gamete formation and do not mix with each other.

During gamete formation through meiosis, each allele segregates (separates) from its paired partner so that a gamete receives only one allele of the character.

Example :



Question 20

- (a) Explain why bee-hives are setup on the farms for some of our crop-species. Name any two such crop species.
- (b) List any three important steps to be kept in mind for successful bee keeping.

Solution:

(a) Beehives kept in crop fields during the flowering period, increase the pollination efficiency. This increases the yield of crop and honey.

Also, bees can easily collect huge amounts of nectar from the flowers of the crop in a close reach without much foraging. This increases honey production. This technique is practiced in apple and watermelon fields.

(b) Apiculture or bee keeping refers to the maintenance of hives of honeybees for the production of honey. For successful bee keeping, the following steps are necessary:

- i. Accurate knowledge of nature and habit of bees
- ii. Selection of a suitable location for maintaining beehives
- iii. Management of beehives during different seasons

Question 21

Explain three different modes of pollination that can occur in chasmogamous flower.

OR

Explain the formation of placenta after implantation in a human female.

Solution:

(i) **Autogamy** – It is the transfer of pollen grains from the anther to the stigma of the same flower. Autogamy requires the anther and the stigma to lie close. It also requires synchrony in the pollen release and stigma receptivity. Plants like Viola, Oxalis, etc. produce two kinds of flowers—chasmogamous (with an exposed anther and stigma) and cleistogamous (which do not open at all, only autogamy occurs).

(ii) **Geitonogamy** – It is the transfer of pollen from the anther of one flower to the stigma of another flower in the same plant. Genetically, it is similar to autogamy but requires pollinating agents.

(iii) **Xenogamy** – It is the transfer of pollen grains from the anther to the stigma of a different plant. Xenogamy causes genetically different types of pollens to be brought to a plant.

OR

The formation of placenta occurs after 12 weeks of pregnancy, when the finger like projection called chorionic villi appears on the trophoblast, penetrate the endometrium lining of uterine tissue.

This chorionic villi and uterine tissue interdigitate to form the structural and functional unit between developing embryo and maternal body called placenta, which help the embryo to obtain nutrients and oxygen and remove the metabolic waste and carbon dioxide.

Question 22

"The population of a metro city experiences fluctuations in its population density over a period of time."

(a) When does the population in a metro city tend to increase?

(b) When does the population in metro city tend to decline?

(c) If 'N' is the population density at the time 't', write the population density at the time 't + 1'.

Solution:

(a) The population in a metro city will tend to increase when natality and immigration will be higher.

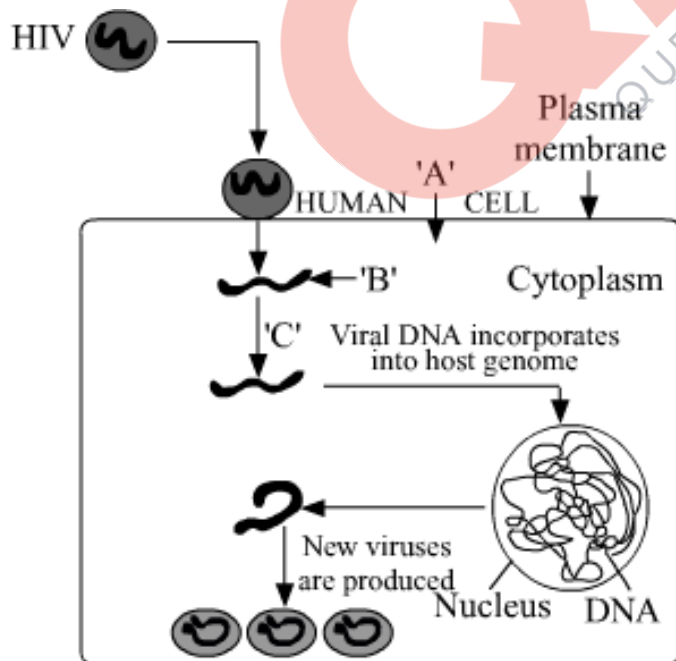
(b) The population in metro city will tend to decline when mortality and emigration will be higher.

(c) The equation $N_{t+1} = N_t + [(B+I) - (D+E)]$ represents the population density at time t + 1. The components of the equation are

- **N_{t+1}** : Population density at time t + 1.
- **N_t** : Population density at time t.
- **B**: This represents natality. Natality refers to the number of births during a given period in the population.
- **I**: It refers to immigration. It is the number of individuals of the same species that have come into habitat from elsewhere during the considered time period.
- **D**: This represents mortality. Mortality is the number of deaths in the population during a given period.
- **E**: It refers to emigration. It is the number of individuals of the population who left the habitat and went elsewhere during the considered time period.

Question 23

Study the diagram showing the entry of HIV into the human body and the processes that are followed :



- (a) Name the human cell 'A' HIV enters into.
- (b) Mention the genetic material 'B' HIV releases into the cell.
- (c) Identify enzyme 'C'.

Solution:

(a) HIV which is the causative agent of AIDS specifically attacks helper T-cells. So, 'A' is helper T-cells.

(b) Viral RNA is introduced into the cell. So, 'B' is RNA.

(c) Enzyme 'C' is reverse transcriptase.

Question 24

Following a road accident four injured persons were brought to a nearby clinic. The doctor immediately injected them with tetanus antitoxin.

- (a) What is tetanus antitoxin ?
- (b) Why were the injured immediately injected with this antitoxin?
- (c) Name the kind of immunity this injection provided.

Solution:

(a) Tetanus antitoxin is solution of preformed antibodies.

(b) *Clostridium tetani*, a bacterium enters the body through cut & wounds and obstructs nerve signalling. This antitoxin neutralises the effect of tetanus toxin in the body. As the injured persons required immediate immunization in this case, so pre-formed antibodies(tetanus antitoxin) were delivered to the patients.

(c) Passive immunity would be provided in this case.

Question 25

(a) Name the insect that attacks cotton crops and causes lot of damage to the crop. How has Bt cotton plants overcome this problem and saved the crop? Explain.

(b) Write the role of gene Cry IAb.

OR

(a) Explain the different steps carried out in Polymerase Chain Reaction, and the specific roles of the enzymes used.

- (b) Mention application of PCR in the field of
 - (i) Biotechnology

(ii) Diagnostics

Solution:

a) Cotton Bollworm is a lepidopteran larvae which is notoriously known as the major pest of cotton plants. Bt cotton plants are GMOs containing the active Cry gene from *Bacillus thuringiensis* which leads to a production of inactive insecticidal protein, which becomes active and functional due to the alkaline pH in the gut of the lepidopteran larvae.

This happens when the pest larvae feeds on the GMO Bt crop, which produces the inactive toxin as produced by the *Bacillus thuringiensis*. The functional protein inside the larvae gut binds to the surface of midgut epithelial cells leading to formation of pores in them.

Due to this the midgut epithelial cells of the insect larvae swells up and lyse, leading to the death of the larvae itself. This way it leads to control of the major insect pest cotton bollworm.

b) CryIAb gene is responsible for the control of corn borer just like the way CryIAc controls the cotton bollworm.

OR

a) Polymerase Chain Reaction (PCR)- This process is used to amplify specific DNA into million or billion copies in vitro. It was invented in 1983 by Kary Mullis.

Two sets of primers (chemically synthesised oligonucleotide stretches that are complementary to a region of DNA), enzyme DNA polymerase, and deoxynucleotides are used in this process.

• PCR consists of 3 steps:

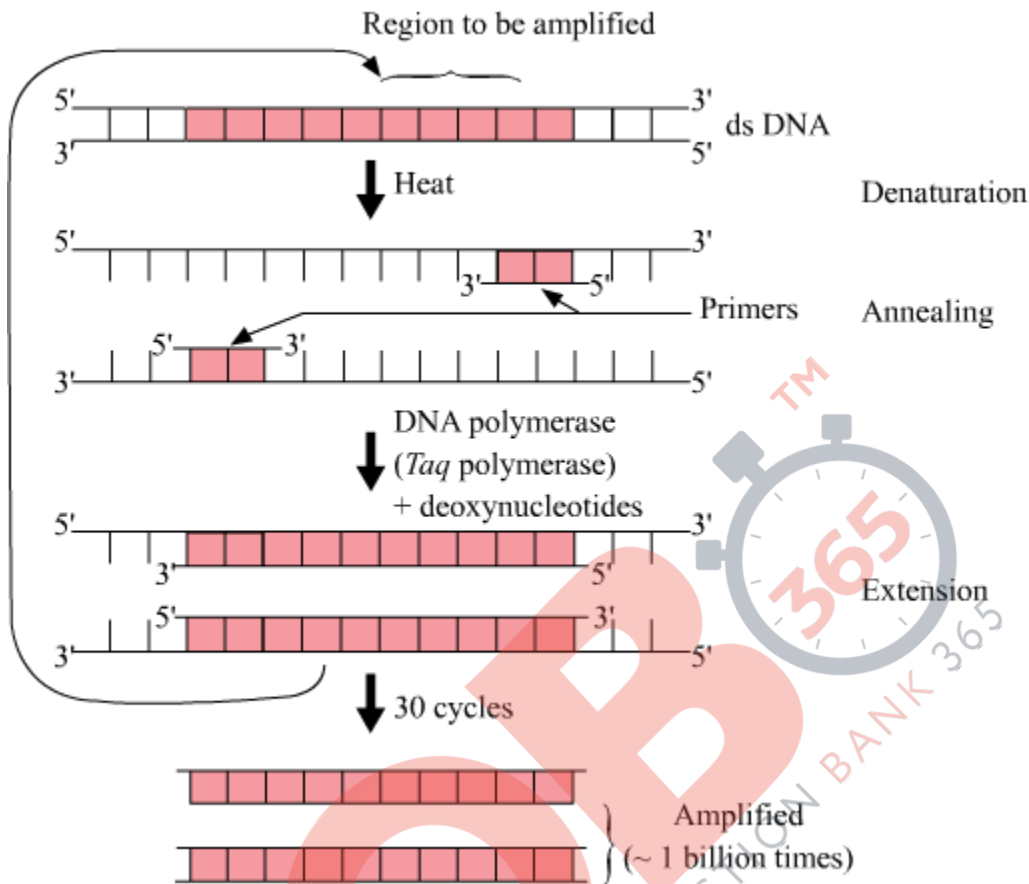
◦ Denaturation – Double helical DNA is denatured by providing high temperature. DNA polymerase does not get degraded in such high temperatures since the DNA polymerase used in this reaction is thermostable as it is isolated from thermophilic bacteria, *Thermus aquaticus* (Taq).

◦ Annealing- It is the step in which primers are annealed to single stranded DNA templates. Two sets of primers (small chemically synthesised oligonucleotides that are complementary to the regions of DNA) are used.

The temperature of reaction mixture is lowered to 50- 65°C for some seconds to allow annealing of primers. DNA polymerase extends the primer in 5' to 3' direction.

◦ Extension – Replication of DNA occurs in vitro.

This cycle is repeated several times to generate up to 1 billion identical copies of the DNA.



The enzymes used in PCR is Taq polymerase which is obtained from the bacterium *Thermus aquaticus*, which yields DNA polymerase.

This enzyme is thermostable and can withstand the high temperature and is used in PCR in recombinant DNA technology.

b) i) In molecular biology to amplify a single or a few copies of a piece of DNA across several orders of magnitude, generating thousands to millions of copies of a particular DNA sequence.

ii) PCR is used in early diagnosis of bacteria and virus in body, when the concentration is extremely low, can be done by PCR since it amplifies the DNA several folds. It is used to detect HIV virus in suspected AIDS patients and mutations in genes in suspected cancer patients.

Question 26

- (a) Describe the process of double fertilisation in angiosperms.
- (b) Trace the development of polyploid cell that is formed after double fertilisation in a non-albuminous seed and albuminous seed.

OR

- (a) List any two reasons other than physical and congenital disorders for causing infertility in couples.
- (b) Explain how IVF as a technique helped childless couples in having children.
- (c) Compare GIFT with ICSI.

Solution:

a) Double fertilisation is a process unique to angiosperms only. During the process of double fertilisation following events occur:

- (i) The two generative cells carried by the pollen tube moves towards the embryo sac.
- (ii) Pollen tube carrying the two male gametes (generative cells) is guided into the embryo sac by the filiform apparatus of the two synergid cells on either side of the female egg cell.
- (iii) As the first generative cell is carried over the filiform apparatus towards the female gamete, the two fuses (undergoes syngamy) or fertilises to form the diploid zygote.
- (iv) The second generative cell continues to move further into the embryo sac.
- (v) Meanwhile the two polar nuclei within the central cell of the embryo sac fuses with each other to form a secondary nucleus.
- (vi) The second generative cell fuses with the diploid secondary nucleus in an event termed as triple fusion (as three individual haploid nuclei have fused with each other), leading to the formation of a triploid endosperm nucleus.

These two consecutive events of syngamy and triple fusion are together termed as double fertilisation.

b) The triploid endosperm nucleus formed during double fertilisation leads to the formation of the triploid Primary Endosperm Cell (PEC).

This PEC undergoes repeated mitotic divisions to form a multicellular, triploid, endosperm. This serves as the nutritive tissue for the budding embryo within the seed.

In case of albuminous seeds, endosperm is retained and in many cases a rudimentary cotyledon often termed as scutellum is derived from it in case of monocots.

QB365-Question Bank Software

In case of non-albuminous seeds, this multicellular triploid endosperm is almost completely utilised or digested or absorbed to aid in the formation of fleshy cotyledon tissue as in the case of most dicot seeds.

OR

(a) Infertility is caused by defects in the male or female or in both. Two reasons other than physical and congenital disorders for causing infertility in couples:

- Alcoholism which causes problems in spermatogenesis.
- Early miscarriage.

(b) In Vitro Fertilization (IVF) is a technique in which the fusion of ovum and sperm is done outside the body of female to form a zygote and allowed to grow until a certain celled stage (in Vitro) and then planted in the uterus where it develops into a foetus which in turn develops into a child.

This technique has helped childless couples who had no chances of natural fertilization either because of low success rate of fertilization or because of inability to produce sperm or egg (in which case they could use a donor sperm/egg). Such babies are called "test tube babies".

(c) Both Gamete Intra Fallopian Transfer (GIFT) and Intra Cytoplasmic Sperm Injection (ICSI) are assisted reproductive technologies to solve infertility problems.

GIFT	ICSI
- A combination of two oocytes along with 200000-500000 sperm inserted into the distal end of the fallopian tube through laproscope.	- One single spermatozoan or spermatid is directly injected into the cytoplasm of oocyte through injecting micropipette.
- Fertilization of gametes takes place in vivo.	- The fusion of gametes are done in vitro.
- Success rate is high 60-70%	- Success rate is less 20-30%

Question 27

- (a) Why did T.H. Morgan select Drosophila melanogaster for his experiments?
(b) How did he disprove Mendelian dihybrid F₂ phenotypic ratio of 9 : 3 : 3 : 1? Explain giving reasons.

OR

- (a) List any four major goals of Human Genome project.
(b) Write any four ways the knowledge from HGP is of significance for humans.
(c) Expand BAC and mention its importance.

Solution:

a) T. H. Morgan selected *Drosophila melanogaster* as the model organism for his genetic studies because of the following reasons:

(i) *Drosophila* is easy and suitably grown on cheap synthetic medium under laboratory conditions in all seasons.

(ii) *Drosophila* has a short life cycle of two weeks only.

(iii) High number of progenies are generated per generation making it easy to observe variation.

(iv) Male and female flies can be easily distinguished from each other.

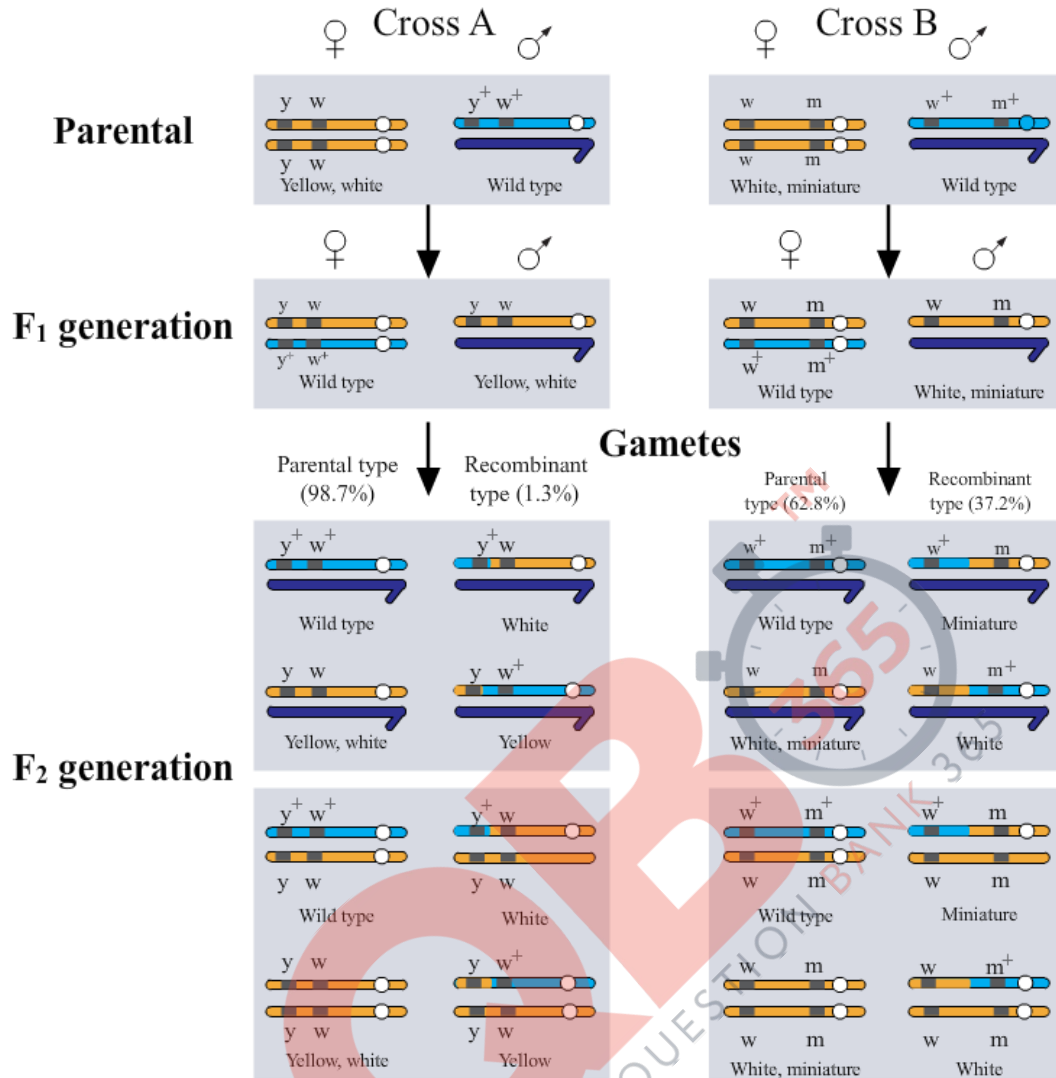
(v) Observable genetic variations can be easily noticed using a low power microscope or a hand lens.

(vi) Four pair of chromosomes in diploid organisms makes *Drosophila* a fairly simple model for genetic studies.

b) Morgan observed that for many genetic characters observed in case of *Drosophila*, the typical mendelian dihybrid cross ratio of 9:3:3:1 is not observed. This was proved by test cross of F₁ generation flies of dihybrid cross.

If the two genes involved in the dihybrid cross are assorting independently then the test cross of the F₁ generation individuals will result in off springs with 50% parental genetic combination and 50% recombinants, but that is not the case as observed by Morgan in case of *Drosophila*.

This can be demonstrated as follows:



OR

a) Main goals of Human genome project (HGP) are:

To identify all the genes (approximately 20,000-25,000) present in the human DNA.
 To determine the accurate sequence of 3 billion chemical base pairs which make up the human genome

To store the above information in the form of databases.

To improve the tools available for data analysis

(b) The four important advantages of the Human genome project (HGP) are:

1. HGP has led to better understanding of Human Biology and Genetics in general.
2. HGP has paved the way for personalised medicine in future based on one's own

genome.

3. HGP has shed a lot of light on human evolution and phylogenetics.

4. HGP has provided greater insights into the field of genetic disorders and their cures.

c) BAC stands for Bacterial Artificial Chromosome. It is an artificially constructed vector containing the origin of replication & selectable marker for identification.

It is capable of carrying large DNA fragments and can replicate easily inside a bacterial cell.

These vectors are used in the human genome project for cloning large chunks of fragmented human genome with ease.

