LIBERTY PAPER SET

STD. 12 : Biology

Full Solution

Time : 3 Hours **ASSIGNTMENT PAPER 15**

Part A

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

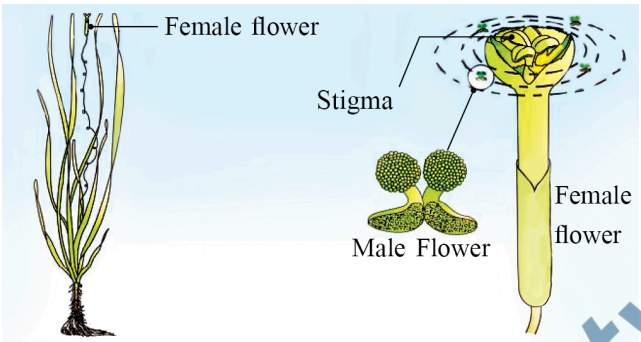
Part B

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.

(a) Autogamy

- In this type, pollination is achieved within the same flower.
- Transfer of pollen grains is from the anther to the stigma of the same flower. (i.e. flowers are bisexual)
- Some plants such as *viola* (common pansy), *oxalis* and *commelina* produce two types of flowers (i) Chasmogamous (ii) Cleistogamous

(i) Chasmogamous : These are flowers which are similar to flowers of other species with exposed anthers and stigma.

- Like normal flowers, here also complete autogamy is rare

(ii) Cleistogamous :

- These are flowers which do not open at all
- In such flowers the anthers and stigma lie close to each other.
- When anther dehisce in the flower buds, pollen grains come in contact with the stigma to affect pollination.
- Thus, cleistogamous flowers are invariably autogamous as there is no chance of cross-pollen landing on the stigma.
- Cleistogamous flowers produce assured seed-set even in the absence of pollinators.

(b) Geitonogamy

- It is the Transfer of pollen grains from the anther to the stigma of another flower of the same plant.
- Although geitonogamy is functionally cross-pollination involving a pollinating agent, genetically it is similar to autogamy since the pollen grains come from the same plant. Monoceious plant like maize show geitonogamy but not autogamy.

3.

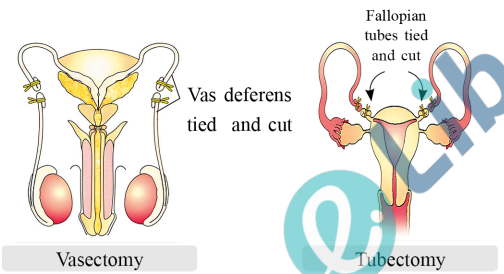
- Surgical Method of sterilisation :
- Surgical methods, also called sterilisation, are generally advised for the male/female partner as a terminal method to prevent any more pregnancies.
- Surgical intervention blocks gamete transport and thereby prevent conception.

(1) Vasectomy :

- Sterilisation procedure in the male is called 'vasectomy'.
- In vasectomy, a small part of the vas deferens is removed or tied up through a small incision on the scrotum.

(2) Tubectomy :

- Sterilisation procedure in female, is called tubectomy.
- In tubectomy, a small part of the fallopian tube is removed or tied up through a small incision in the abdomen or through vagina.
- These techniques are highly effective but their reversibility is very poor.
- It needs to be emphasised that the selection of a suitable contraceptive method and its use should always be undertaken in consultation with qualified medical professionals.
- One must also remember that contraceptives are not regular requirements for the maintenance of reproductive health.
- In fact, they are practiced against a natural reproductive event, i.e., conception/pregnancy. One is forced to use these methods either to prevent pregnancy or to delay or space pregnancy due to personal reasons.
- No doubt, the widespread use of these methods has a significant role in checking uncontrolled growth of population.
- However, their possible ill-effects like nausea, abdominal pain, breakthrough bleeding, irregular menstrual bleeding or even breast cancer, though not very significant, should not be totally ignored.



4.

- Amniocentesis is a test on the foetus carried out during pregnancy to check for and to detect chromosomal abnormalities like Down's syndrome, haemophilia, sickle cell anemia and other defects or disorders in the foetus.
- It can also be used for sex determination.
- It is carried out by testing a sample of the amniotic fluid from the uterus of pregnant women.

5.

- The methods involved two major approaches. One approach focused on identifying all the genes that are expressed as RNA (referred to as Expressed Sequence Tags (ESTs).
- The other took the blind approach of simply sequencing the whole set of genome that contained all the coding and non-coding sequence, and later assigning different regions in the sequence with functions (a term referred to as Sequence Annotation).
- For sequencing, the total DNA from a cell is isolated and converted into random fragments of relatively smaller sizes (recall DNA is a very long polymer, and there are technical limitations in sequencing very long pieces of DNA) and cloned in suitable host using specialised vectors.
- The cloning resulted into amplification of each piece of DNA fragment so that it subsequently could be sequenced with ease.

- The commonly used hosts were bacteria and yeast, and the vectors were known as BAC (bacterial artificial chromosomes), and YAC (yeast artificial chromosomes).
- The fragments were sequenced using automated DNA sequencers that worked on the principle of a method developed by Frederick Sanger. (Remember, Sanger is also credited for developing method for determination of amino acid sequences in proteins).
- There sequences were then arranged based on some overlapping regions present in them.
- This required generation of overlapping fragments for sequencing. Alignment of these sequences was humanly not possible.
- Therefore, specialised computer based programs were developed.
- These sequences were subsequently annotated and were assigned to each chromosome.
- The sequence of chromosome 1 was completed only in May 2006 (this was the last of the 24 human chromosomes - 22 autosomes and X and Y - to be sequenced).
- Another challenging task was assigning the genetic and physical maps on the genome.
- This was generated using information on polymorphism of restriction endonuclease recognition sites, and some repetitive DNA sequences known as microsatellites (one of the applications of polymorphism in repetitive DNA sequences shall be explained in next section of DNA fingerprinting).

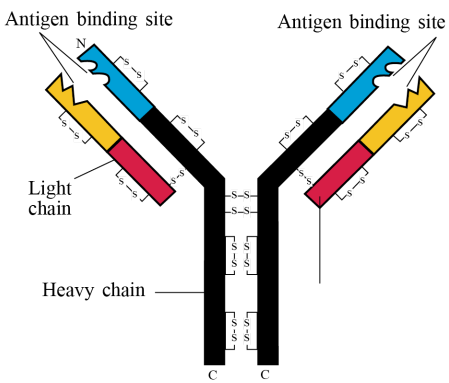
6.

- (ii) Klinefelter's Syndrome : It is the presence of an additional copy of X-chromosome in male (trisomy).
- Features :
  - Overall masculine development. However, the fetninine developtnent is also expressed. e.g. Development of breast (Gynaecomastia).
  - Sterile.
  - Mentally retarded.

7.

- When a colony of bacteria is grown in agar culture medium supplemented with tetracycline antibiotics, the tetracycline-sensitive colonies die.
- Darwinian selection theory suggests that the environment selects organisms with useful variation over those which do not have useful variations.
- It is mainly because, in a dynamic environment, these organisms are better adapted to survive.
- A well-defined example for Darwin's theory is antibiotic resistance in bacteria.
- When bacteria were grown on tetracycline containing agar medium, all the bacteria died. However, the ones having variations conferring tetracycline resistance survived. Later, these bacteria multiplied and increased their number.
- As a result of this, tetracycline-resistant bacteria evolved and survived because of the environment that selected these over the others.

8.



Structure of an antibody molecule

9.

- (I) Streptokinase :
  - This enzyme is derived from *streptococcus* bacterium.
  - This bacterium is modified by using genetic engineering.
- (II) Statins :
  - It is derived from *Monascus purpurus* a yeast.
  - This drug is used as blood cholesterol lowering agent.
  - It is used as "clot bluster" for removing clots from the blood vessels of patients.
  - This drug is used for those patients who have undergone myocardial infraction leading to heart attack.

10.

- (a) Commensalism : This is the interaction in which one species benefits and the other is neither harmed nor benefited.

  Examples :
  - An orchid growing as an epiphyte on a mango branch
  - barnacles growing on the back of a whale

11.

- The size of a population for any species is not a static parameter. It keeps changing with time, depending on various factors including food availability, predation pressure and adverse weather.
- In fact, it is these changes in population density that give us some idea of what is happening to the population – whether it is flourishing or declining.
- Whatever might be the ultimate reasons, the density of a population in a given habitat during a given period, fluctuates due to changes in four basic processes, two of which (natality and immigration) contribute to an increase in population density and two (mortality and emigration) to a decrease.

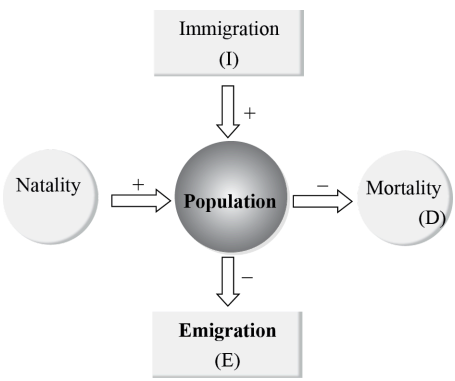
  (i) Natality refers to the number of births during a given period in the population that are added to the initial density.

  (ii) Mortality is the number of deaths in the population during a given period.

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

  (iv) Emigration is the number of individuals of the population who left the habitat and gone elsewhere during the time period under consideration.
- So, if N is the population density at time t, then its density at time t + 1 is

  $Nt + 1 = Nt + [(B + I) – (D + E)]$
- Population density will increase if the number of births plus the number of immigrants (B + I) is more than the number of deaths plus the number of emigrants (D + E).
- Under normal conditions, births and deaths are the most important factors influencing population density, the other two factors assuming importance only under special conditions.
- For instance, if a new habitat is just being colonized, immigration may contribute more significantly to population growth than birth rates.



12.

➥ Each trophic level has a certain mass of living material at a particular time called as the standing crop.

Section B

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

13.

➥ Parturition is the process of delivery of a newborn or a foetus, in simple words but for parturition to occur, many other processes are responsible and help to make a successful childbirth.

➥ Fetal ejection reflex is one of those important initial processes which is observed at the time of delivery.

➥ It is the initial mild contraction of the uterus which is caused by the placenta after the baby is fully developed in the womb.

➥ This reflex leads to release of oxytocin from the maternal pituitary gland which further intensifies the contractions leading to parturition finally.

14.

➥ The salient features of genetic code are as follows :

(i) The codon is a triplet. 61 codons code for amino acids and 3 codons do not code for any amino acids, hence they function as stop codons.

(ii) Some amino acids are coded by more than one codon, hence the code is degenerate.

(iii) The codon is read in mRNA in a contiguous fashion. There are no punctuations.

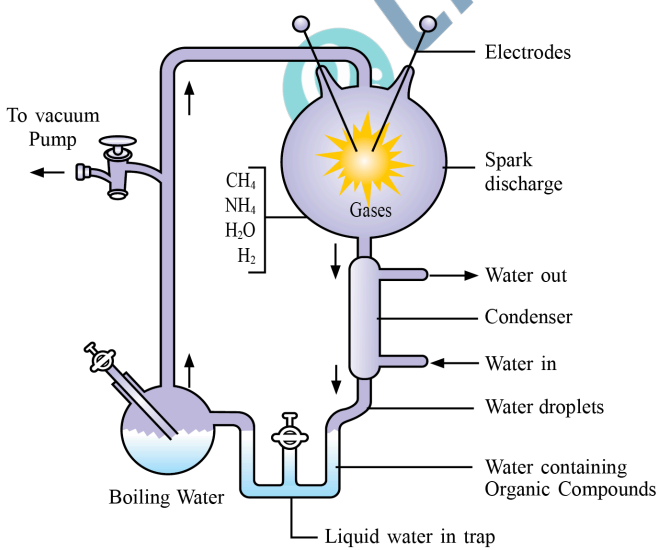
(iv) The code is nearly universal:for example, from bacteria to human UUU would code for Phenylalanine (phe). Some exceptions to this rule have been found in mitochondrial codons, and in some protozoans.

(v) AUG has dual functions. It codes for Methionine (met) , and it also act as initiator codon.

(vi) UAA, UAG, UGA are stop terminator codons.

15.

➥



Diagrammatic representation of Miller's experiment

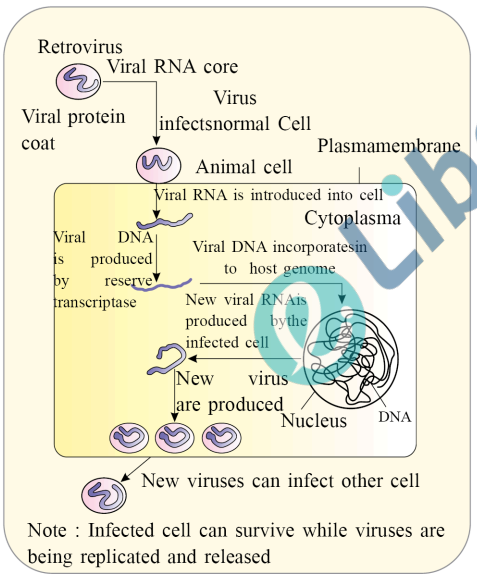
➥ In 1953, an American scientist named S. L. Miller created in the laboratory a condition similar to the Earth's primordial atmosphere.

➥ He mixed CH_4, H_2, NH_3 and water vapour in a closed flask at a temperature of 800 C 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 O) 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.

16.

- Mechanism of action/replication of HIV :
- 1) HIV (Human Immunodeficiency virus) is an RNA virus
  - Its structure includes identical RNA strands, reverse transcriptase which are enclosed in protein coat.
  - Target cell of HIV- Macrophage & Helper T- lymphocyte (TH).
  - HIV first binds to the receptor on host macrophage where fusion of HIV takes place.
  - HIV RNA/ viral RNA- released in cytoplasm which undergoes reverse transcription with Reverse transcriptase enzyme- HIV DNA/ viral DNA.
  - Viral DNA enters host nucleus & integrates with host DNA transcription- new viral RNA forms viral genome & some translates in cytoplasm to new viral proteins.
  - Viral proteins & RNA- moves to surface of cell & buds off as new HIV.
  - They target helper T-lymphocyte- replicates & produce progeny virus- reduces helper T- lymphocytes.



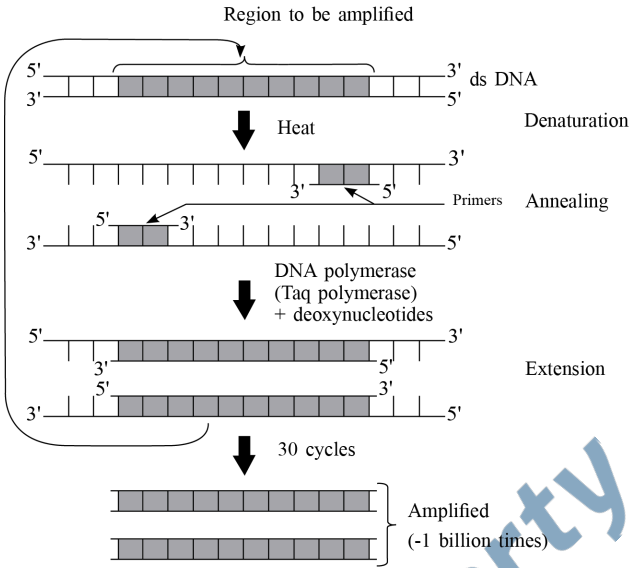
Replication of retrovirus

17.

- (a) PCR
  - PCR stands for Polymerase Chain Reaction.
  - In this reaction, multiple copies of the gene (or DNA) of interest is synthesised in vitro using two sets of primers (small chemically synthesised oligonucleotides that are complementary to the regions of DNA) and the enzyme DNA polymerase.
  - The enzyme extends the primers using the nucleotides provided in the reaction and the genomic DNA as template.
  - If the process of replication of DNA is repeated many times, the segment of DNA can be amplified to approximately billion times, i.e., 1 billion copies are made.

- Such repeated amplification is achieved by the use of a thermostable DNA polymerase (isolated from a bacterium, *Thermus aquaticus*), which remain active during the high temperature induced denaturation of double stranded DNA.

- The amplified fragment if desired can now be used to ligate with a vector for further cloning.



18.

- Several nematodes parasites a wide variety of plants and animals including human beings.
- A nematode *Meloidegyne incognitia* infects the roots of tobacco plants and causes a great reduction in yield.
- A novel strategy was adopted to prevent this infestation which was based on the process of RNA interference (RNAi).
- RNAi takes place in all eukaryotic organisms as a method of cellular defense.
- This method involves silencing of a specific mRNA due to a complementary dsRNA molecule that binds to and prevents translation of the mRNA (silencing).
- The source of this complementary RNA could be from an infection by viruses having RNA genomes or mobile genetic elements (transposons) that replicate via an RNA intermediate.
- Using *Agrobacterium* vectors, nematode-specific genes were introduced into the host plant.
- The introduction of DNA was such that it produced both sense and anti-sense RNA in the hostcells.
- These two RNA's being complementary to each other formed a double stranded (dsRNA) that initiated RNAi and thus, silenced the specific mRNA of then ematode.
- The consequence was that the parasite could not survive in a transgenic host expressing specific interfering RNA.
- The transgenic plant therefore got itself protected from the parasite.

19.

- Yes, microbes are used as a source of energy.
- For example microbes are used to produce biogas or gobar gas from dung and bio waste.
- Biogas-gobar gas is a product of anaerobic respiration of which main component is methane gas.
- The spent slurry from the biogas plant is used as fertiliser.

20.

➥ (f) Primary productivity and Secondary productivity

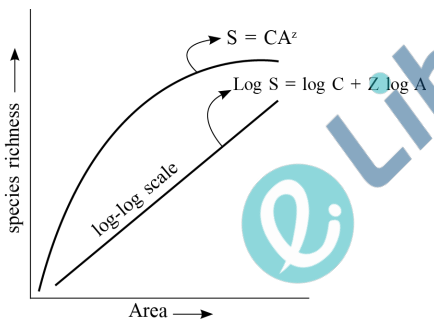
➥

Primary productivity	Secondary 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.	Secondary productivity is defined as the rate of formation of new organic matter by consumers.
It depends upon green plants.	It depends upon heterotrophs.
It has two types: gross primary productivity and net primary productivity.	It has no types.
It is in a large amount.	It is in a small amount.

21.

➥ During his pioneering and extensive explorations in the wilderness of South American jungles, the great German naturalist and geographer Alexander von Humboldt observed that within a region species richness increased with increasing explored area, but only up to a limit.

➥ In fact, the relation between species richness and area for a wide variety of taxa (angiosperm plants, birds, bats, fresh water fishes) turns out to be a rectangular hyperbola.



➥ On a logarithmic scale, the relationship is a straight line described by the equation

➥ log S = log C + Z log A

➥ Where,

S = Species richness

A = Area

Z = slope of the line (regression coefficient)

C = Y-intercept

➥ Ecologists have discovered that the value of Z lies in the range of 0.1 to 0.2, regardless of the taxonomic group or the region (whether it is the plants in Britain, birds in California or molluscs in New York state, the slopes of the regression line are amazingly similar).

➥ But, if you analyse the species-area relationships among very large areas like the entire continents, you will find that the slope of the line to be much steeper (Z values in the range of 0.6 to 1.2).

➥ For example, for frugivorous (fruit-eating) birds and mammals in the tropical forests of different continents, the slope is found to be 1.15.

Section C

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

22.

➥ Majority of flowering plants produce hermaphrodite (bisexual) flowers and pollen grains are likely to come in contact with the stigma of the same flower. Continued self-pollination result in inbreeding depression.

- Flowering plants have developed many devices to discourage self-pollination and to encourage cross-pollination.
- Dichogamy - In some species, pollen release and stigma receptivity are not synchronised. Either the pollen is released before the stigma becomes receptive or stigma becomes receptive much before the release of pollen.
- Heterostyly - In some other species, the anther and stigma are placed at different positions so that the pollen cannot come in contact with the stigma of the same flower.
- Both these devices prevent autogamy.
- Self-incompatibility - This is a genetic mechanism and prevents self-pollen (from the same flower or other flowers of the same plant) from fertilising the ovules by inhibiting pollen germination or pollen tube growth in the pistil.
- Dicliny/Unisexuality - It is the production of unisexual flowers.
- If both male and female flowers are present on the same plant such as castor and maize (monoecious), it prevents autogamy but not geitonogamy.
- In several species such as papaya, male and female flowers are present on different plants, that is each plant is either male or female (dioecy). This condition prevents both autogamy and geitonogamy.

23.

➥ Ans. Spermatogenesis is a process by which mature sperm cells are produced from immature male germ cells (spermatogonia) in testes. It begins at puberty.

➥ The spermatogonia (sing. spermatogonium) are present on the inside wall of seminiferous tubules.

➥ They multiply by mitotic division and increase in numbers.

➥ Each spermatogonium is diploid and contains 46 chromosomes.

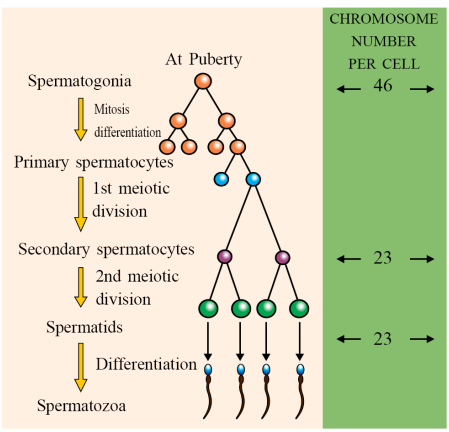
➥ Some of the spermatogonia called primary spermatocytes, periodically undergo meiosis.

➥ A primary spermatocyte completes the first meiotic division (reduction division) leading to formation of two equal, haploid cells called secondary spermatocytes, which have only 23 chromosomes each.

➥ The secondary spermatocytes undergo the second meiotic division to produce four equal, haploid spermatids. The number of chromosome in each spermatid is 23.

➥ The spermatids are transformed into spermatozoa (sperms) by the process called spermiogenesis.

➥ After spermiogenesis, sperm heads become embedded in the sertoli cells, and are finally released from the seminiferous tubules by the process called spermiation.

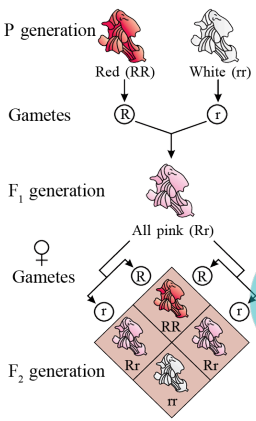


(a)

24.

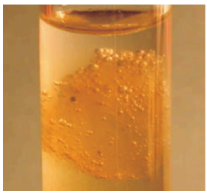
- When experiments on peas were repeated using other traits in other plants, it was found that sometimes the F_1 had a phenotype that did not resemble either of the two parents and was in between the two.
- The inheritance of flower colour in the dog flower (snapdragon or Antirrhinum sp.) is a good example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

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



25.

- 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).
- 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.
- Purified DNA ultimately precipitates out after the addition of chilled ethanol.
- This can be seen as collection of fine threads in the suspension.
- DNA that separates out can be removed by spooling.




26.

- Innate immunity is non-specific type of defence, that is present at the time of birth. This is accomplished by providing different types of barriers to the entry of the foreign agents into our body. Innate immunity consist of four types of barriers. These are —
  - **(i) Physical barriers :** Skin on our body is the main barrier which prevents entry of the micro-organisms. Mucus coating of the epithelium lining the respiratory, gastrointestinal and urogenital tracts also help in trapping microbes entering our body.
  - **(ii) Physiological barriers :** Acid in the stomach, saliva in the mouth, tears from eyes–all prevent microbial growth.
  - **(iii) Cellular barriers :** Certain types of leukocytes (WBC) of our body like polymorpho-nuclear leukocytes (PMNL-neutrophils) and monocytes and natural killer (type of lymphocytes) in the blood as well as macrophages in tissues can phagocytose and destroy microbes.
  - **(iv) Cytokine barriers :** Virus-infected cells secrete proteins called **interferons** which protect non-infected cells from further viral infection.

27.

- In the year 1963, the two enzymes responsible for restricting the growth of bacteriophage in *Escherichia coli* were isolated.
- One of these added methyl groups to DNA, while the other cut DNA.
- The later was called restriction endonuclease.
- The first restriction endonuclease–Hind II, whose functioning depended on a specific DNA nucleotide sequence.
- Hind -II was isolated and characterised five years later.
- It was found that Hind II always cut DNA molecules at a particular point by recognising a specific sequence of six base pairs.
- This specific base sequence is known as the recognition sequence for Hind II.
- Besides Hind II, today we know more than 900 restriction enzymes that have been isolated from over 230 strains of bacteria each of which recognise different recognition sequences.
- Nomenclature :
  - The convention for naming these enzymes is the first letter of the name comes from the genus and the second two letters come from the species of the prokaryotic cell from which they were isolated.
- e.g., EcoRI
  - It comes from Escherichia coli RY 13.
  - In EcoRI, the letter 'R' is derived from the name of strain.
  - Roman numbers following the names indicate the order in which the enzymes were isolated from that strain of bacteria.
- TYPES :
  - Restriction enzymes belong to a larger class of enzymes called nucleases. These are of two kinds.

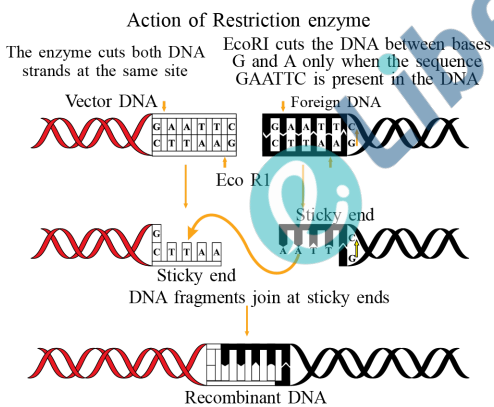
- (a) Exonucleases
- (b) Endonucleases.
- (1) Exonucleases remove nucleotides from the ends of the DNA.
- (2) Endonucleases make cuts at specific positions within the DNA.

- Each restriction endonuclease functions by 'inspecting' the length of a DNA sequence.
- Once it finds its specific recognition sequence, it will bind to the DNA and cut each of the two strands of the double helix at specific points in their sugar -phosphate backbones.

- PALINDROMIC SEQUENCE :
  - Each restriction endonuclease recognises a specific palindromic nucleotide sequences in the DNA.
- The palindrome in DNA is a sequence of base pairs that reads same on the two strands when orientation of reading is kept the same. For example, the following sequences reads the same on the two strands in 5' → 3' direction. This is also true if read in the 3' → 5' direction.

- 5' —— GAATTC —— 3'
- 3' —— CTTAAG —— 5'

- Mechanism of action :
- Restriction enzymes cut the strand of DNA a little away from the centre of the palindrome sites, but between the same two bases on the opposite strands.
- This leaves single stranded portions at the ends.
- There are overhanging stretches called sticky ends on each strand.



- When cut by the same restriction enzyme, the resultant DNA fragments have the same kind of 'sticky-ends' and, these can be joined together using DNA ligases.
- Unless one cuts the vector and the source DNA with the same restriction enzyme, the recombinant vector molecule cannot be created.
- Restriction endonucleases are used in genetic engineering to form 'recombinant' molecules of DNA, which are composed of DNA from different sources/genomes.