LIBERTY PAPER SET

STD. 12 : Biology

Full Solution

Time : 3 Hours **ASSIGNTMENT PAPER 3**

Part A

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

Part B

Section A

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

1.

- The first mammals were like shrews.
- Their fossils are small sized.
- Mammals were viviparous and protected their unborn young inside the mother's body. Mammals were more intelligent in sensing and avoiding danger at least.
- When reptiles came down mammals took over this earth.
- There were in South America mammals resembling horse, hippopotamus, bear, rabbit, etc. Due to continental drift, when South America joined North America, these animals were overridden by North American fauna.
- Due to the same continental drift pouched mammals of Australia survived because of lack of competition from any other mammal.

2.

- (i) colourblindness, (ii) Haemophilia.
- **(i) Colour Blindness :**
  - It is a sex-linked recessive disorder due to defect in either red or green cone of eye resulting in failure do discriminate between red and green colour.
  - This defect is due to mutation in certain genes present in the X-chromosomes.
  - It occurs in about 8 per cent of males and only about 0.4 per cent of females.
  - This is because the genes that lead to red-green colour blindness are on the X-chromosomes.
  - Males have only one X-chromosomes and females have two.
  - The son of a woman who carries the gene has a 50 per cent chance of being colour blind.
  - The mother is not herself colour blind because the gene is recessive. That means that its effect is suppressed by her matching dominant normal gene.
  - A daughter will not normally be colour blind, unless her mother is a carrier and her father is colour blind.
- (ii) Haemophilia :
  - This sex linked recessive disease, which shows its transmission from unaffected carrier female to some of the male progeny has been widely studied.
  - In this disease, a single protein that is a part of the cascade of proteins involved in the clotting of blood is affected.
  - Due to this, in an affected individual a simple cut will result in non-stop bleeding.
  - The heterozygous female (carrier) haemophilia may transmit the disease to sons.
  - The possibility of a female becoming a haemophilic is extremely rare because mother of such a female has to be at least a carrier and the father should be haemophilic (unviable in the later stage of life.)
  - The family pedigree of Queen Victoria shows a number of haemophilic descendents as she was a carrier of the disease.

3.

- Cleistogamy is the phenomenon in which the flowers of the plants are closed.
  - Flowers that exhibit cleistogamy are called cleistogamous flowers.
  - In such flowers only self pollination occurs.
- Advantages :

- Cleistogamy helps in producing pure line breeds as there is no cross pollination that occurs in cleistogamous flowers.
- Pollination can occur even in the absence of pollinators in the cleistogamous flowers.

- Disadvantages :
  - Continued self-pollination may lead to inbreeding depression.
  - There is self pollination due to which the chances of variation and evolution of genetically superior plants is reduced. Since the cleistogamous flowers promote self pollination, there will be no variation seen in the offsprings.
  - So, cleistogamy is both advantageous and disadvantageous in nature.

4.

- (1) Cyclosporin A :
  - It is derived from *Trichoderma polysporium* fungi.
  - This bioactive molecule is used as immunosuppressive drug in organ transplant patients.
- (2) Statins :
  - It is derived from *Monascus purpurus* a yeast.
  - This drug is used as blood cholesterol lowering agent.
- (3) Streptokinase :
  - This enzyme is derived from *streptococcus* bacterium.
  - This bacterium is modified by using genetic engineering.
  - 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.

5.

- In agriculture, there is a method of controlling pests that relies on natural predation rather than introduced chemicals.
- A key belief of the organic farmers is that biodiversity furthers health.
- The use of biocontrol measures will greatly reduce our dependence on toxic chemicals and pesticides.
- An important part of the biological farming approach is to become familiar with the various life forms that inhabit the field, predators as well as pests, and also their life cycles, patterns of feeding and the habitats that they prefer. This will help develop appropriate means of biocontrol.
- Different biocontrol agents are as follows:

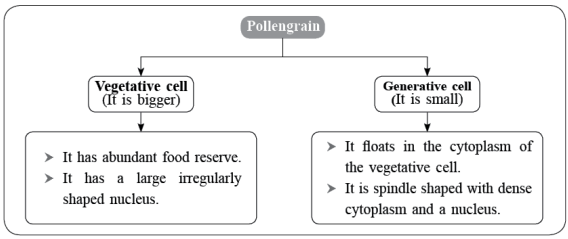
  Ladybird and Dragonflies :
  - These beetles are useful to get rid of aphids and mosquitoes.

  Bacillus thuringiensis:
  - An example of microbial biocontrol agents that can be introduced in order to control butterfly caterpillars is the bacteria *Bacillus thuringiensis* (often written as Bt).
  - These are available in sachets as dried spores which are mixed with water and sprayed onto vulnerable plants such as brassicas and fruit trees, where eaten by the insect larvae.
  - In the gut of the larvae, the toxin is released and the larvae get killed.
  - The bacteria disease will kill the caterpillars, but leave other insects unharmed.
  - The scientists have introduced Bt toxin genes into plants. Such plants are resistant to attack by insect pests.

  Trichoderma :
  - *Trichoderma* species are free living fungi that are very common in root ecosystems.
  - This fungi is used as biocontrol agent for the treatment of plant disease.
  - They are effective biocontrol agents of several plant pathogens.

  Baculoviruses :
  - The majority of baculoviruses used as biocontrol agents are in the genus *Nucleopolyhedrovirus.*
  - *Baculoviruses* are pathogens that attack insects and other arthropods.
- Various biocontrol agents have shown no negative impacts on plants, mammals, birds, fish or even on non target insects.
- Inspite of this, they are desirable when beneficial insects are being conserved to aid in an overall integrated pest management (IPM) programme, or when an ecologically sensitive area is being treated.

6.



7.

- The efficiency of the producers in absorption and conversion of solar energy.
- The use of this converted chemical form of energy by the consumers.
- The total input of energy in form of food and its efficiency of assimilation energy is received in an eco-system.
- The energy is captured by green plants does not revert back to the sun and the energy which passes to the herbivores does not come back to the autotrophs.
- Thus the flow of energy in an ecosystem is always unidirectional.

8.

- This interaction confers benefits on both the interacting species.
- **Lichen :** It is a mutualistic relationship between a fungus & photosynthesizing algae or cyanobacteria.
- **Mycorrhizae :** Associations between fungi & the roots of higher plants. The fungi help the plant in the absorption of essential nutrients from the soil while the plant provides the fungi with carbohydrates.
- **Mutualism between plant & animal through pollination and seed dispersion:**
- **Examples :**

  (1) **Fig trees & wasps.** The fig species is pollinated only by its 'partner' wasp species.

  - Female wasp pollinates the fig inflorescence while searching for suitable egg-laying sites in fruits.
  - The fig offers the wasp some developing seeds, as food for the wasp larvae.

  (2) **Orchids** show diversity of floral patterns. They can attract the right pollinator insect (bees & bumblebees) to ensure pollination. Not all orchids offer rewards.

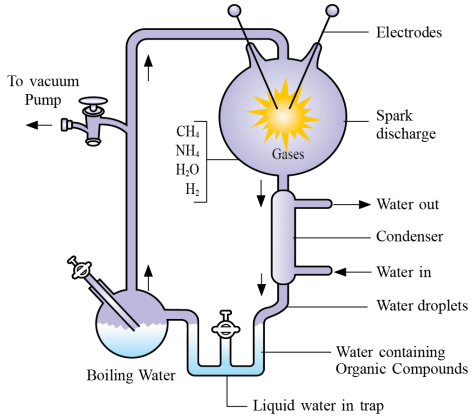
  (3) **'Sexual deceit of *Ophrys*** (Mediterranean orchid). One petal of its flower resembles female bee in size, colour & markings.

  - So male bee 'pseudocopulates' with the flower and is dusted with pollen. When this bee 'pseudocopulates' with another flower, it transfers pollen to it.
  - If the female bee's colour patterns change slightly during evolution, pollination success will be reduced unless the orchid flower co-evolves to maintain the resemblance of its petal to the female bee.

9.

- India has a history of religious and cultural traditions that emphasized protection of nature.
- In many cultures, tracts of forest were set aside, and all the trees and wildlife within were venerated and given total protection.
- Sacred groves means conservation of plants and animals according to religious beliefs.
- Some sacred groves in India :
  - Such sacred groves are found in Khasi and Jaintia Hills in Meghalaya.
  - Aravalli Hills of Rajasthan
  - Western Ghat regions of Karnataka and Maharashtra.
  - Sarguja, Chanda and Bastar areas of Madhya Pradesh.
  - In Meghalaya, the sacred groves are the last refuges for a large number of rare and threatened plants.

10.



11.

- (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

- (b) Parasitism : Parasitism is an interaction in which one species (smaller one) get benefit and another species (bigger one) get harmed.

  Examples :

  - Ectoparasite: lice on humans and ticks on dogs.
  - Many marine fish are infested with ectoparasitic copepods.
  - Endoparasite : liverfluck, tape worm, ascaris etc.

- (c) Camouflage : Prey species have evolved various defenses to lessen the impact of predation.

  - Some organisms are cryptically-coloured (camouflaged) to avoid being detected easily by the predator.
  - Some species of insects and frogs

- (d) Mutualism : This interaction confers benefits on both the interacting species.

  Examples :

  - Lichens, mycorrhiza, fig tree and some species of wasps.

- (e) Interspecific competition : It is an interaction between two species in which both are in loss.

  - Example: some shallow South American lakes, visiting flamingoes and resident fishes compete for their common food, the zooplankton in the lake.

12.

- An ideal contraceptive should be

  (i) user-friendly

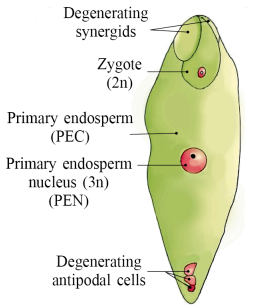
  (ii) easily available

  (iii) effective and reversible with no or least side-effects.

  (iv) it also should in no way interfere with the sexual drive, desire and/or the sexual act of the user.

Section B

13.



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

- After entering one of the synergids, the pollen tube releases the two male gametes into the cytoplasm of the synergid.
  - One of the male gametes moves towards the egg cell and fuses with its nucleus thus completing the syngamy. This results in the formation of a diploid cell, the zygote.
  - The other male gamete moves towards the two polar nuclei located in the central cell and fuses with them to produce a triploid Primary Endosperm Nucleus (PEN).
  - As this involves the fusion of three haploid nuclei it is termed triple fusion.
  - Since two types of fusions, syngamy and triple fusion take place in an embryo sac the phenomenon is termed double fertilisation, an event unique to flowering plants.
  - The central cell, after triple fusion, becomes the Primary Endosperm Cell (PEC) and develops into the endosperm while the zygote develops into an embryo.

14.

- Opium is a caffeic substance that binds to specific receptors present in the central nervous system and gastrointestinal tract.
- Opium is a dry latex obtained by incising the unripe pods of the opium poppy plant (Papaver sominiferum).
- The drugs morphine and codeine are derived from opium.
- Morphine is a well-known sedative & pain-killer & used to reduce pain after surgery.
- It also acts on the neurons in the cerebellum and relieves the body from pain by inhibiting pain. It acts as a stimulant.
- Codeine, another alkaloid derived from opium, is an analgesic. Often used in cough syrups, it calms the process.
- Used to prevent tension in the stomach and intestines.
- Heroin (smack):
  - Chemically diacetyl morphine
  - Bitter, white, odorless, crystalline compound
  - Obtained by acetylation of morphine
  - Taken by snorting & injection
  - Acts as depressant & slows down body function.

15.

- Animals that have had their DNA manipulated to possess and express an extra (foreign) gene are known as transgenic animals.
- Transgenic rats, rabbits, pigs, sheep, cows and fish have been produced, although over 95 per cent of all existing transgenic animals are mice.
- (i) Normal physiology and development :
  - Transgenic animals can be specifically designed to allow the study of how genes are regulated, and how they affect the normal functions of the body and its development,
  - e.g., study of complex factors involved in growth such as insulin-like growth factor. By introducing genes from other species that alter the formation of this factor and studying the biological effects that result, information is obtained about the biological role of the factor in the body.

➥ (ii) Study of disease :

- Many transgenic animals are designed to increase our understanding of how genes contribute to the development of disease.
- These are specially made to serve as models for human diseases so that investigation of new treatments for diseases is made possible.
- Today transgenic models exist for many human diseases such as cancer, cystic fibrosis. rheumatoid arthritis and Alzheimer's.

➥ (iii) Biological products:

- Medicines required to treat certain human diseases can contain biological products, but such products are often expensive to make.
- Transgenic animals that produce useful biological products can be created by the introduction of the portion of DNA (or genes) which codes for a particular product.

➥ Examples :

- human protein (α-1-antitrypsin) used to treat emphysema.
- Similar attempts are being made for treatment of phenylketonuria (PKU) and cystic fibrosis.
- In 1997, the first transgenic cow, Rosie, produced human protein-enriched milk (2.4 grams per litre). The milk contained the human α lactalbumin and was nutritionally a more balanced product for human babies than natural cow-milk.

➥ (iv) Vaccine safety :

- Transgenic mice are being developed for use intesting the safety of vaccines before they are used on humans.
- Transgenic mice are being used to test the safety of the polio vaccine.
- If successful and found to be reliable, they could replace the use of monkeys to test the safety of batches of the vaccine.

➥ (v) Chemical safety testing :

- This is known as toxicity/safety testing.
- The procedure is the same as that used for testing toxicity of drugs.
- Transgenic animals are made that carry genes which make them more sensitive to toxic substances than non-transgenic animals.
- They are then exposed to the toxic substances and the effects studied.
- Toxicity testing in such animals will allow us to obtain results in less time.

16.

➥ In eukaryotes, there are two additional complexities -

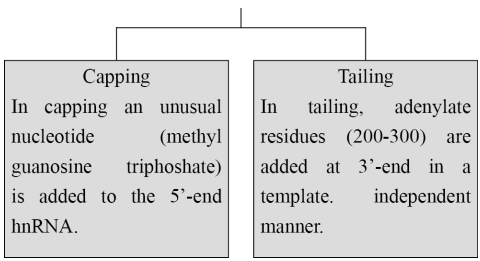
(i) There are at least three RNA polymerases in the nucleus (in addition to the RNA polymerase found in the organelles). There is a clear cut division of labour. The RNA polymerase I transcribes rRNAs (28S, 18S, and 5.8S), whereas the RNA polymerase III is responsible for transcription of tRNA, 5srRNA, and snRNAs (small nuclear RNAs). The RNApolymerase II transcribes precursor of mRNA, the heterogeneous nuclear RNA (hnRNA).

(ii) The second complexity is that the primary transcripts contain both the exons and the introns and are non-functional.

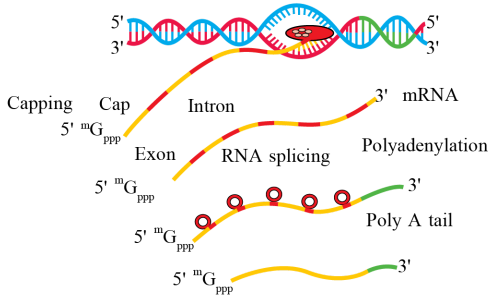
➥ Post-Transcriptional changes

➥ Hence, it is subjected to a process called splicing where the introns are removed and exons are joined in a defined order.

hnRNA undergoes additional processing called as capping and tailing



- It is the fully processed hnRNA, now called mRNA, that is transported out of the nucleus for translation.
- The significance of such complexities is now beginning to be understood. The split-gene arrangements represent probably an ancient feature of the genome.
- The presence of introns is reminiscent of antiquity, and the process of splicing represents the dominance of RNA-world.
- In recent times, the understanding of RNA and RNA-dependent processes in the living system have assumed more importance.



Process of Transcription in Eukaryotes

17.

- It contains alkaloid nicotine which is a stimulant and toxin.
- Nicotine stimulates adrenal gland to release adrenaline & nor-adrenaline which increases blood pressure & heart rate.
- Smoking of tobacco increases chances of lung cancer, bronchitis, emphysema, coronary heart diseases, cancer of throat, gastric ulcer, cancer of urinary bladder etc.
- Chewing of tobacco causes oral cancer. Tobacco is usually chewed or smoked or used as snuff.
- Smoking of tobacco also increases carbon monoxide content of blood & reduces concentration of haem-bound oxygen which causes oxygen deficiency in the body.

18.

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

19.

- Many useful products for mankind are produced or synthesized by using microbes at industrial level
- Beverages and antibiotics are some examples of this.
- For industrial production, useful microbes are grown in to a big vessel which is called fermentors.
- Microbes have been used from time immemorial for the production of beverages like wine,beer,whiskey brandy or rum.
- *Saccharomyses cerevisiae*(brewer's) yeast is used to produce ethanol from cereals and fruit juices.
- Yeast produces ethanol by an anaerobic respiration pathway.
- Depending on the type of the raw material used for fermentation and the type of processing (with or without distillation) different types of alcoholic drinks are obtained.
- Wine and beer are produced without distillation.
- By distillation whisky, brandy and rum are produced.
- (1) Cyclosporin A :
  - It is derived from *Trichoderma polysporium* fungi.
  - This bioactive molecule is used as immunosuppressive drug in organ transplant patients.

- (2) Statins :
  - It is derived from *Monascus purpurus* a yeast.
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- (3) Streptokinase :
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  - This bacterium is modified by using genetic engineering.
  - 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.
- Antibiotics are chemical substances which is produced by microbes. It kills pathogenic microbes or slow down their growth.
- This chemicals are called antibiotics.

  (anti=opposite, bio= life)

  e.g. Penicillin is the first discovered antibiotic.
- Discovery :
  - Alexander Fleming while working on *staphylococci* bacteria , once observed a mould growing in one of his unwashed culture plated 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.
  - This antibiotic was extensively used to treat American soldiers wounded in world war II
  - Fleming, chain and flory were awarded the Nobel prize in 1945, for this discovery.
- Many products which are useful for mankind are produced by microbes on industrial level.
- For example: beverages, antibiotics, chemicals, enzymes and other biochemical molecules.
- *Saccharomyses cerevisiae*– Yeast is used to prepare wine, beer, whiskey, brandy or rum like beverages and also used for bread making.

  Saccharomyses cerevisiae (brewer's) yeast is used to produce ethanol from cereals and fruit juices.
- Antibiotics are chemical substances which are produced by microbes. They kill pathogenic microbes or slow down their growth. For example: penicillin
- We cannot imagine a world without antibiotics.
- Microbes are also used for commercial and industrial production of certain chemicals like organic acids, alcohols and enzymes.

  Examples :

  Aspergillus niger- citric acid

  Acetobacter aceti- acetic acid

  Clostridium butyricum- butyric acid

20.

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

- These cells (oogonia) start dividing and enter into prophase-I of the meiotic division and get temporarily arrested at that stage, called primary oocytes.
- Each primary oocyte then gets surrounded by a layer of granulosa cells and is called the primary follicle. A large number of these follicles degenerate during the phase from birth to puberty. Therefore, at puberty only 60,000-80,000 primary follicles are left in each ovary.
- At puberty the primary follicles get surrounded by more layers of granulosa cells and a new theca and are called secondary follicles.
- The secondary follicle soon transforms into a tertiary follicle which is characterised by a fluid filled cavity called antrum. The theca layer is organised into an inner theca interna and an outer theca externa.
- It is at this stage that the primary oocyte within the tertiary follicle grows in size and completes its first meiotic division. It is an unequal division resulting in the formation of a large haploid secondary oocyte and a tiny first polar body.
- The secondary oocyte retains bulk of the nutrient rich cytoplasm of the primary oocyte.
- The tertiary follicle further changes into the mature follicle or Graafian follicle.
- The secondary oocyte forms a new membrane called zona pellucida surrounding it.
- The Graafian follicle now ruptures to release the secondary oocyte (ovum) from the ovary by the process called ovulation.

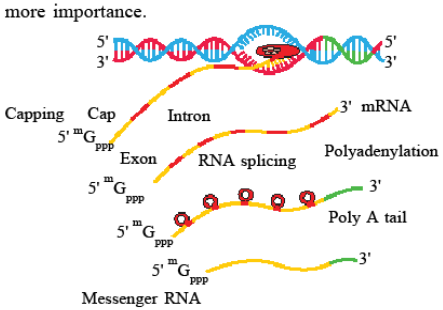
24.

- In eukaryotes, there are two additional complexities -
  (i) There are at least three RNA polymerases in the nucleus (in addition to the RNA polymerase found in the organelles). There is a clear cut division of labour. The RNA polymerase I transcribes rRNAs (28S, 18S, and 5.8S), whereas the RNA polymerase III is responsible for transcription of tRNA, 5srRNA, and snRNAs (small nuclear RNAs). The RNApolymerase II transcribes precursor of mRNA, the heterogeneous nuclear RNA (hnRNA).
  (ii) The second complexity is that the primary transcripts contain both the exons and the introns and are non-functional.
- **Post-Transcriptional changes**
- Hence, it is subjected to a process called splicing where the introns are removed and exons are joined in a defined order.

hnRNA undergoes additional processing called as capping and tailing

Capping	Tailing
In capping an unusual nucleotide (methyl guanosine triphoshate) is added to the 5'-end hnRNA.	In tailing, adenylate residues (200-300) are added at 3'-end in a template. independent manner.

- It is the fully processed hnRNA, now called mRNA, that is transported out of the nucleus for translation.
- The significance of such complexities is now beginning to be understood. The split-gene arrangements represent probably an ancient feature of the genome.
- The presence of introns is reminiscent of antiquity, and the process of splicing represents the dominance of RNA-world.
- In recent times, the understanding of RNA and RNA-dependent processes in the living system have assumed more importance.



Process of Transcription in Eukaryotes

- Since, DNA fragments are negatively charged molecules they can be separated by forcing them to move towards the anode under an electric field througha medium/matrix.
- The DNA fragments separate (resolve) according to their size through sieving effect provided by the agarose gel.
- Hence, the smaller the fragment size, the farther it moves.
- The separated DNA fragments can be visualised only after staining the DNA with a compound known as ethidium bromide followed by exposure to UV radiation.
- DNA appears as bright orange coloured bands of DNA in an ethidium bromide stained gel exposed to UV light.
- The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is known as elution.
- The DNA fragments purified in this way are used in constructing recombinant DNA by joining them with cloning vectors.

27.

- The male and female gametes in flowering plants are produced in the pollen grain and embryo sac, respectively. As both types of gametes are non-motile, they have to be brought together for fertilisation to occur. Pollination is the mechanism to achieve this objective.
- Transfer of pollen grains (shed from the anther) to the stigma of a pistil is termed pollination.
- Flowering plants have evolved an amazing array of adaptations to achieve pollination.
- They make use of external agents to achieve pollination.
- Kinds of Pollination : Depending on the source of pollen, pollination can be divided into following three types.
    (i) Autogamy
    (ii) Geitonogamy and,
    (iii) Xenogamy