

# CBSE Solved 2017 Paper (Biology)

## SECTION – A

**Q1. Our government has intentionally imposed strict conditions for MTP in our country. Justify giving a reason.**

**Solution:**

MTP stands for medical termination of pregnancy before formation of full term foetus. It is also called induced abortion. In our country, government has intentionally imposed strict conditions for MTP to avoid its misuse over unborn female foetus.

**Q2. State the fate of a pair of autosomes during gamete formation.**

**Solution:**

Gametes are formed by the process of meiosis cell division and therefore carry only one type of each chromosome. For example in humans, females have two X chromosomes (XX) and males have one X and one Y chromosome (XY). During gamete formation, male XY sex-chromosome pair and female XX sex-chromosome pair separates and passes on an X or a Y to separate gametes in case of male and X or X in case of female.

**Q3. What role does an individual organism play as per Darwin's theory of natural selection?**

**Solution:**

Darwin's theory of natural selection is defined as the process by which organisms that are more adaptive to a particular type of environment tend to survive over the organisms that

are less adaptive. These naturally selected organisms can pass useful changes in form of variation or mutation to the next generation and thus help in evolution.

**Q4. Suggest a method to ensure an anamnestic response in humans.**

**Solution:**

When a body encounters an antigen or a pathogen for the first time, its response towards the foreign body is known as primary response. During primary response antibodies are produced in the body. When the body encounter the same antigen or pathogen for the second time it evokes secondary response which is called anamnestic response. By administering the dead antigen or pathogen in a human body one can ensure anamnestic response.

**Q5. What is biopiracy?**

**Solution:**

The term biopiracy is referred to the use of biological resources and genetic material without proper authorisation from the country from where it originates or the people involved in its invention.

Example: Basmati rice grown in India is distinct for its unique flavour and aroma. An American company developed a new variety of Basmati rice by crossing an Indian variety with local varieties to produce Texmati and got patent rights on Basmati through the US patent and trademark office.

## SECTION – B

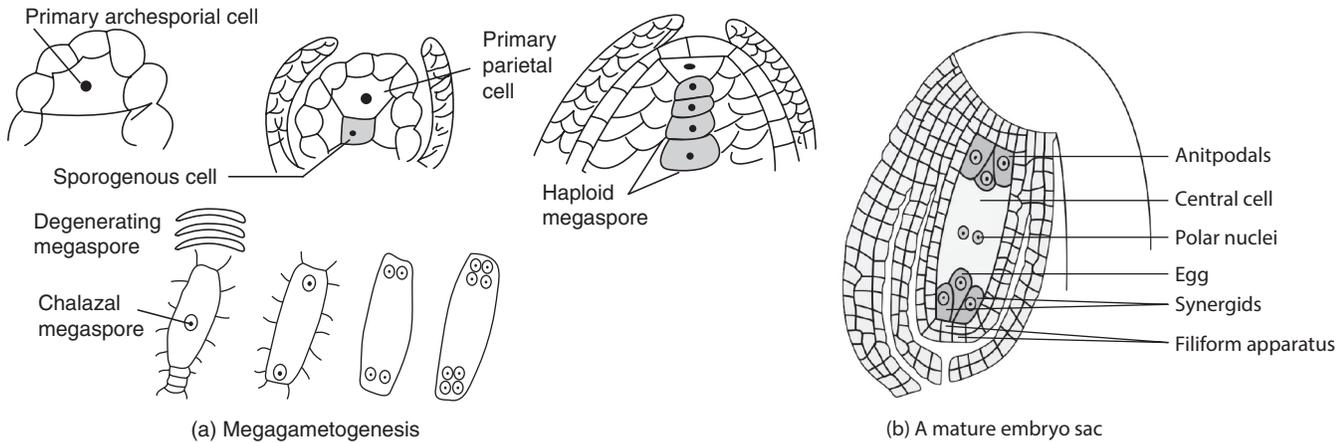
**Q6. A mature embryo sac in a flowering plant may possess 7 cells but 8 nuclei. Explain with the help of a diagram only.**

**Solution:**

Meristematic activity of ovular primordium produces a protuberance of nucellus. The initials of the two integuments develop at the base of the nucellus. They grow and surround the nucellus except at the apex or micropylar region. The archesporial cell divides to form outer primary cell wall and inner sporogenous cell. The sporogenous cell functions as megaspore mother cell and undergoes meiosis to form four potential megaspores. The chalazal megaspore becomes functional and rest degenerate. The chalazal megaspore is

first cell of female embryo sac. It undergoes three successive divisions to produce 8 nuclei. Thus, a mature embryo sac in a flowering plant possesses 7 cells but 8 nuclei. Out of these 8 nuclei, three get organised at the micropylar end. These cells are known as egg apparatus and other three nuclei get organised at the chalazal end as antipodal cells and the remaining two nuclei get organised at the centre as polar nuclei which fuse together to form secondary nucleus. Thus, the embryo sac consists of 8 nuclei but 7 cells: three at micropylar, three at chalazal and one at the centre.

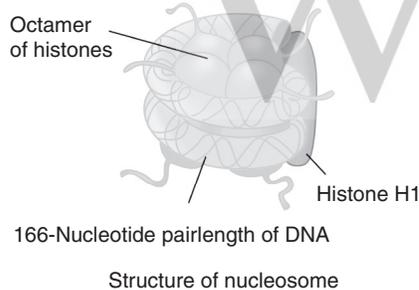
The figure below describes the development of an embryo sac in flowering plants.



**Q7. Describe the structure of a nucleosome.**

**Solution:**

Eukaryotic chromosomes are composed of DNA and proteins. DNA is negatively charged therefore, in order to stabilize the system positively charged histone proteins are bound to it. There are large amount of DNA in our cells which created packaging problem so in order to maintain high degree of organisation, firstly, histone proteins organise to make a unit of eight molecules called histone octamer, then, negatively charged DNA molecule wrap around this octamer. This complex structure of DNA molecule combines and eight histone protein molecules form a nucleosome.



OR

**Mention the evolutionary significance of the following organisms:**

- (a) Shrews
- (b) Lobefins
- (c) *Homo habilis*
- (d) *Homo erectus*

**Solution:**

- (a) Shrews:
  - They were first mammals.
  - Examples: Long-tailed insectivorous, squirrel like creatures.
  - They evolved into primitive primates like lemurs and tarsiers.
- (b) Lobefins:
  - They were first amphibians.
  - These were fish with stout and strong fins.
  - They evolved into salamanders and frog.
  - They lived for 350 mya and become extinct.
- (c) *Homo habilis*:
  - They were first primates that were human – like.
  - They were found in Africa.

- They originated 2 million years ago.
- They were herbivores.
- Their brain capacities were between 650 cc to 800 cc.
- (d) *Homo erectus*:
  - They were secondary primates.
  - They evolved from *Homo habilis*.
  - They had larger brain capacities (around 900 cc).
  - They ate meat.
  - They had erect posture.
  - Their fossils were found in Java.
  - They originated 1.5 million years ago.

**Q8. In an agriculture field there is a prevalence of the following organisms and crop diseases which are affecting the crop yield badly:**

- (a) White rust
- (b) Leaf and stripe rust
- (c) Black rot
- (d) Jassids

**Recommend the varieties of crops the farmers should grow to get rid of the existing problem and thus improve the crop yield.**

**Solution:**

The following varieties of crops the farmers should grow to get rid of the given crop diseases and thus improve the crop breeding.

Disease	Crop	Variety
(a) White rust	Brassica	Pusa Swarnim (Karan Rai)
(b) Leaf and stripe rust	Wheat	Himgiri
(c) Black rot	Cauliflower	Pusa Shubhra, Pusa Snowball K-1
(d) Jassids	Flat Bean	Pusa Sem 2, Pusa Sem 3

**Q9. How does the application of the fungal genus, *Glomus*, to the agricultural farm increase the farm output?**

**Solution:**

*Glomus* belongs to the genus of fungi. Fungi are known form of symbiotic associations with plants (mycorrhiza). The fungal symbiont absorbs phosphorous from soil and passes it to plants and in return derives sugars from plant cell for survival. Such associations provide resistance to root borne pathogens and tolerance to salinity and drought and

increases phosphorous availability to the crops. All these benefits increase the overall growth and development of the plant.

**Q10. Plenty of algal bloom is observed in a pond in your locality.**

- (a) Write what has caused this bloom and how does it affect the quality of water.  
 (b) Suggest a preventive measure.

**Solution:**

- (a) Causes:
- Algal blooms are formed due to high availability of nutrients like nitrate and phosphates in the water.

- These nutrients get dissolved into the soil from the chemicals present in the fertilizers and then get washed away into the water bodies.

Affects:

- Algal blooms deteriorate the quality of water.
- They reduce content of dissolved oxygen in the water.
- Mortality rate of fishes gets increased.
- Some algal secrete chemicals that are toxic to humans and animals.

(b) Preventive measure:

- Natural fertilizers like manures should be used.
- Biodegradable cleaning agents should be used.
- Techniques like vermicomposting should be used.

## SECTION – C

- Q11. (a)** List the three stages the annuals and biennial angiosperms have to pass through during their life cycles.  
 (b) List and describe any two vegetative propagules in flowering plants.

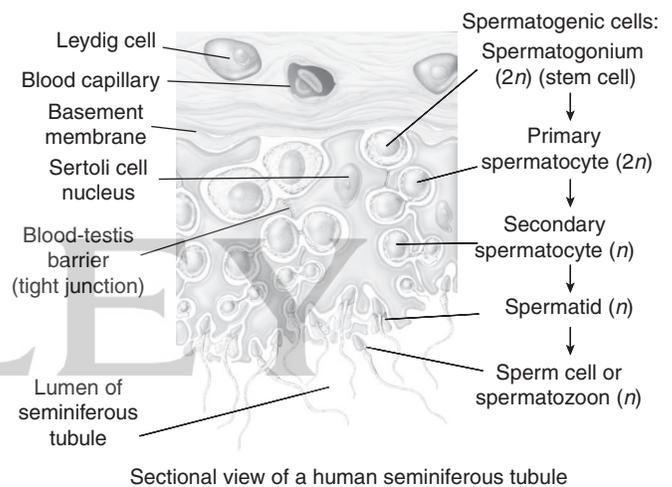
**Solution:**

- (a) The three stages the annuals and biennial have to pass through during their life cycles are as follows:
- Juvenile stage:** It also known as vegetative stage. It is the stage before which angiosperms (plants) grow but do not sexually reproduce.
  - Reproductive stage:** After juvenile stage ends reproductive stage begins. At this stage plants can reproduce i.e., when plants show flowers.
  - Senescent stage:** It is also called ageing stage. It is the stage where reproduction ends.
- (b) There are various modes of vegetative propagation in flowering plants like roots, underground stems, creeping stems, aerial shoots, leaves, and bulbils.
- Roots:** Roots of plants like populus, guava etc., can develop adventitious buds which can grow to form new plants. Root tubers in sweet potato, dahlia etc., also have adventitious buds which when placed in soil can grow into leafy shoots called slips. These slips can be separated and planted to grow new plants.
  - Leaves:** Leaves of plants like *Kalanchoe* and *Bryophyllum* can develop adventitious buds. These buds can sprout for vegetative propagation while the leaf is attached to plant or in some cases after being detached from the plant.

**Q12. Draw a labelled diagrammatic sectional view of a human seminiferous tubule.**

**Solution:**

Primary sexual organ of male is called testis. Testis is a compound tubular gland that is packed with numerous highly coiled seminiferous tubules. Below is a labelled diagram of seminiferous tubule.



**Q13. During a medical investigation, an infant was found to possess an extra chromosome 21. Describe the symptoms the child is likely to develop later in life.**

**Solution:**

Down's syndrome is due to failure of separation of pair of homologous chromosome 21 in the ovum during meiotic division. Such individuals have  $(2n + 1)$  i.e., 47 chromosomes. Chances of the infant having Down's syndrome increase with the age of the mother. Characteristics of Down's syndrome include:

- Causes developmental delays
- Mild to moderate cognitive impairment
- Learning disability
- Round and flat face
- The back of the head is slightly flat
- Small mouth cavity, large and wrinkled tongue. Constantly open mouth
- Many loops on fingers
- Nose may be small with a flat and low bridge
- Ears may also be small and low-set
- Dwarfness

**Q14. A number of passengers were severely burnt beyond recognition during a train accident. Name and describe**

**a modern technique that can help hand over the dead to their relatives.**

**Solution:**

To find the identity of dead person in order to hand over the dead to their relatives, DNA fingerprinting method can be used. DNA fingerprinting is performed on the dead person and their relatives. DNA fingerprinting uses short nucleotide repeats called variable number of tandem repeats as markers (VNTRs). VNTRs vary from one person to other person. These are inherited from one generation to other. Closely related individuals have similar VNTRs hence it is easy to identify the dead person and its relatives.

The DNA fingerprinting involves following steps:

- Isolation of DNA
- Digestion of DNA by restriction endonucleases
- Separation of DNA fragments by electrophoresis
- Transfer of separated DNA fragments to synthetic membranes
- Hybridization of separated fragments using VNTRs marker
- Detection of hybridized DNA fragment by autoradiography
- The bands obtained after autoradiography has different bands that are characteristics of an individual
- Similarities in bands obtained for dead and their relatives is then used in handing over the dead to their relatives

**Q15.  $p^2 + 2pq + q^2 = 1$ . Explain this algebraic equation on the basis of Hardy Weinberg's principle.**

**Solution:**

$$p^2 + 2pq + q^2 = 1$$

This is a Hardy Weinberg equation. The Hardy Weinberg principle considers large population which is not experiencing mutation, natural selection, sexual selection or migration. The equation represents the frequency of genotypes in the population and is used to calculate genetic variation of such a population at equilibrium. If we consider an organism with alleles *A* and *a* at a given locus, there are three possible genotypes: *AA*, *Aa*, and *aa*. Then in the given equation,

- *p* is frequency of dominant allele "*A*"
- *q* is frequency of recessive allele "*a*"
- $p^2$  is frequency of dominant homozygous genotype "*AA*"
- $q^2$  is frequency of recessive homozygous genotype "*aa*"
- $2pq$  is frequency of heterozygous genotype "*Aa*"

**Q16: (a) What precaution(s) would you recommend to a patient requiring repeated blood transfusion?**

**(b) If the advice is not followed by the patient, there is an apprehension that the patient might contract a disease that would destroy the immune system of his/her body. Explain with the help of schematic diagram only how the immune system would get affected and destroyed.**

**Solution:**

**(a)** Blood transfusion is a procedure in which blood from one person is transferred into the circulatory system of another person. If a patient requires repeated blood

transfusion then the donor's blood should be carefully examined before transfusion for the presence of any contamination like HIV virus or any other pathogen that can affect the immune system of the patient's body.

**(b)** If the advice is not followed by the patient, then the patient might contract AIDS. AIDS stands for acquired immunodeficiency syndrome i.e., symptoms of deficiency of immune system. It is caused by human immunodeficiency virus (HIV). It is a retrovirus. When it enters human body, it enters the macrophages where it replicates into viral DNA using viral enzyme reverse transcriptase as shown in Figure. Simultaneously, the virus enters helper T-lymphocytes (T) and replicates to produce progeny viruses. These attack the T-helper cells and decrease its number. The depletion of T-helper cells weakens the immune response of the infected person.

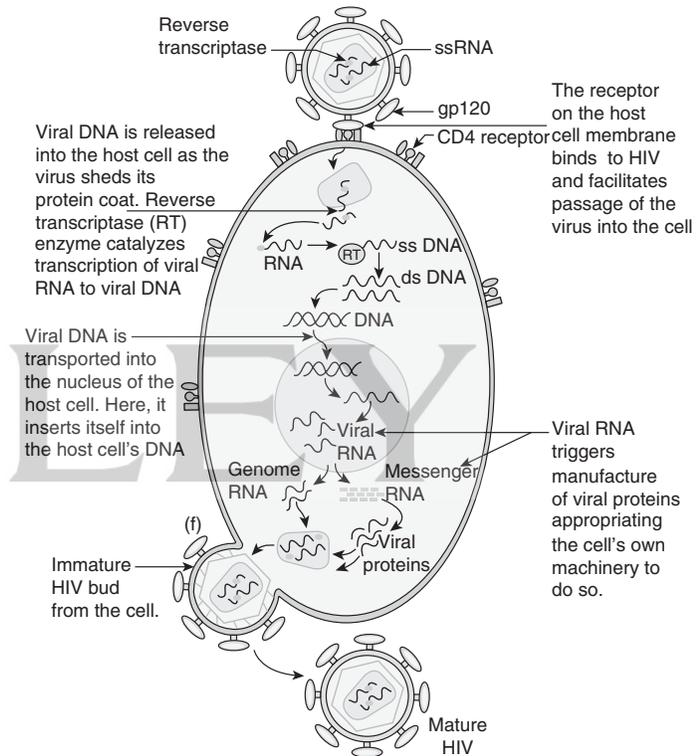


Diagram showing replication of retrovirus

**Q17. (a) What is inbreeding depression? (b) Explain the importance of "selection" during inbreeding in cattle.**

**Solution:**

**(a)** Inbreeding refers to mating of more closely related individuals within the same breed for 4 – 6 generations. Inbreeding is done to express desirable superior genes in an organism. Superior males and females of the same breed containing desirable characteristics are mated in pairs.

Example: Dogs are selectively bred to obtain desired characteristics like herding, fetching and tracking skills, in case of human beings in order to keep bloodlines pure, first cousins, uncles and nieces were married. Inbreeding increases homozygosity. Continued inbreeding can cause decrease in fertility and productivity of an organism. This is called inbreeding depression. To

overcome inbreeding depression, organisms should be mated with unrelated superior animals of same breed.

- (b) Selection is done to evolve a pureline and to express desirable superior genes in an animal.
- To carry out this procedure, superior males and superior females containing these desirable characteristic are selected.
  - In case of cattle, a superior female is the cow or buffalo that produces more milk per lactation and superior male is a bull. Mating of these two will produce a superior offspring having all the desired characteristics.
  - Productivity of inbred population is increased by selection at every time step.

**Q18. Describe how do 'flocs' and 'activated sludge' help in sewage treatment.**

**Solution:**

- The wastewater containing human excreta is called sewage. Before being discharged into natural bodies sewage is treated in sewage treatment plant. During primary treatment, large and small particles are removed by filtration and sedimentation. The primary effluent formed in this treatment is then passed to secondary treatment.
- Primary effluent is passed into large aeration tanks having constant mechanical agitation and air supply. This leads to growth of useful microbes into flocs. This consumes major part of organic matter in effluent and reduces BOD of the effluent. BOD stands for biological oxygen demand. Low BOD means low pollution of waste water.
- After the BOD of the effluent has reduced it is passed to settling tank where the flocs are allowed to settle. This sediment is called activated sludge. A small part of the activated sludge is pumped back to the aeration tank, it serves as inoculum. Inoculum is a material containing microbes that can start new culture. This way same microbial culture is recycled and reused again to start new culture for the treatment.

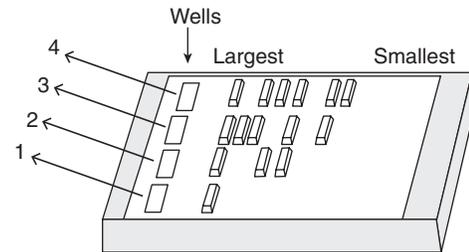
**Q19. Explain the role (s) of the following in biotechnology:**

- (a) Restriction endonuclease  
 (b) Gel electrophoresis  
 (c) Selectable markers in pBR322

**Solution:**

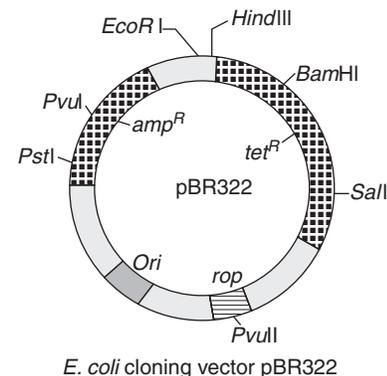
- (a) Restriction endonuclease:
- Enzymes that are used to cut within the DNA segment at a specific site are called restriction enzymes.
  - They are used in biotechnology to form recombinant molecules of DNA that are composed of DNA from different sources.
  - They are used to cut a strand of DNA with sticky ends so that a foreign DNA strand can be inserted into the intact DNA.
  - They cut the DNA strand little away from the centre of the palindrome sequence between the same two bases on both the strands which results in single stranded stretches on both the complementary strands at their ends. These stretches are called sticky ends.
- (b) Gel electrophoresis:
- Fragments of DNA obtained after cutting by restriction endonuclease are separated by technique called gel electrophoresis.

- The DNA fragments are negatively charged thus can be forced to move towards anode under electric field through a medium/matrix. Agarose is the most commonly used matrix.
- The fragments of DNA get separated according to their sizes through the sieving effect which is provided by the agarose gel.
- Fragments of DNA of desired length can then be isolated and then can be used to construct recombinant DNA.
- A typical agarose gel electrophoresis showing migration of undigested (lane 1) and digested (lane 2 to 4) set of DNA fragments.



(c) Selectable markers in pBR322:

- pBR322 consists of two antibiotic resistance genes for ampicillin and tetracycline.
- These antibiotic resistance acts as selectable marker which can be used to differentiate between recombinants and non-recombinants.
- If a foreign DNA is ligated at tetracycline site of resistance gene in pBR322 vector, the recombinant plasmid loses tetracycline resistance. This can still be selected out from non-recombinants by plating the transformants on ampicillin containing medium.
- The transformants growing on the ampicillin containing medium are then transferred on the medium containing tetracycline.
- The recombinants grow in ampicillin containing medium.
- Non-recombinants grow on both ampicillin and tetracycline.



**Q20. Write the steps you would suggest to be undertaken to obtain a foreign gene product.**

**Solution:**

Introduction of a foreign piece of DNA into the gene of interest is carried out by the technique known as recombinant DNA technology. The gene which is introduced is

called the recombinant gene. Following steps are involved to obtain a foreign gene product.

- Selection of desired gene for administration.
- Selection of perfect vector to be integrated with the gene to form recombinant DNA.
- Transfer of the recombinant DNA into a suitable host cell.
- Selection of recombinant and non-recombinant cells.
- Culturing of recombinant cells under suitable conditions for expression of gene of interest.
- Multiplication of recombinant cells in large scale using a continuous culture system like bioreactors.

**Q21. Why do lepidopterans die when they feed on *Bacillus thuringiensis* (Bt) cotton plant? Explain how it happens.**

**Solution:**

Bt produces a protein crystal that contains a toxic protein which is encoded by a gene known as *cry* gene. Proteins encoded by genes *cryIAc* and *cryIAb* control cotton bollworms. Bt toxin proteins exists in an inactive form but once an insect like lepidopterans ingests the inactive toxin, it is converted into an active form because the alkaline pH of the gut solubilises the protein crystals. The activated toxin binds to the surface of midgut epithelial cells and creates pores that cause cell swelling and lysis leading to death of the insect.

**Q22. *In situ* conservation can help endangered/threatened species. Justify the statement.**

**Solution:**

*In situ* conservation method involves protection of endangered species in their natural habitat. It helps in recovering the population of endangered species in the natural surrounds where they have developed their distinct features

Examples: National parks, biosphere reserves, wildlife sanctuaries etc.

This practice also involves introduction of plants and animal species back into agriculture, horticulture and animal husbandry practices so that they are cultivated and reproduced for reuse. It maintains genetic diversity of species. Biodiversity and ecological integrity is permanently protected and maintained.

**OR**

**Name and describe any three caused of biodiversity losses.**

**Solution:**

Biodiversity losses are caused due to following factors:

- Habitat destruction:** Habitat destruction is considered as the primary cause of biodiversity loss. It is caused by deforestation, over use and urbanisation. Animals living in these territories and animals with migratory habitats are affected badly.
  - Example: Tropical rainforests initially covered 14% of land but now it has reduced to 6%.
- Co-extinction:** When a species in a particular region become extinct then plants and animals associated with it in an obligatory manner also become extinct.
  - Example: If host fish becomes extinct then the parasites found on it will also become extinct.
- Alien species invasion:** In a geographical area, introduction of an alien species may turn invasive and can cause harmful impact leading to decline and extinction of the indigenous species.
  - Example: Introduction of African catfish in Indian rivers is posing threat to the existing species of catfish.
- Over exploitation:** It is one of the major causes of biodiversity loss. Increase in demand of natural resources due to increasing population has resulted in exploration of biological system by man leading to degradation and extinction of natural resources.

## SECTION – D

**Q23. Public all over India is very much concerned about the deteriorating air quality in large parts of North India. Alarmed by this situation the Resident's Welfare Association of your locality organised an awareness programme entitled "Bury not burn". They invite you, being a biology student to participate.**

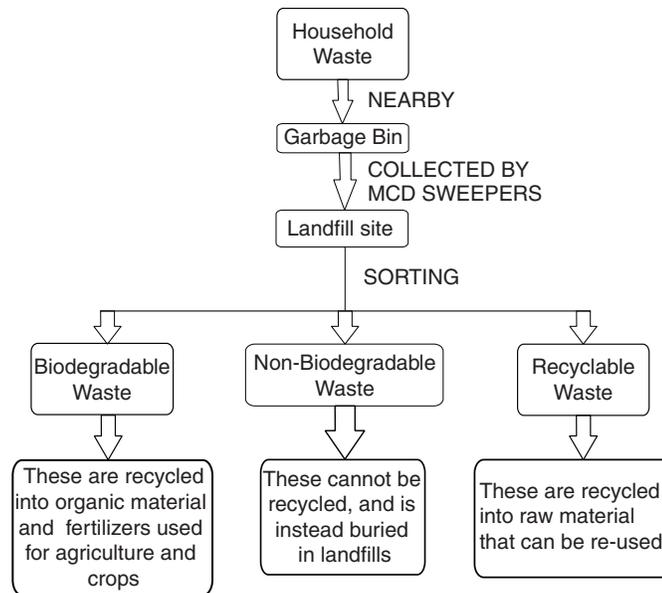
**(a) How would you justify your arguments that promote burying and discourage burning? (give two reasons)**

**(b) With the help of flow charts, one for each practice depicts the chain of events that follow.**

**Solution:**

- Following arguments can be put to promote burying and discourage burning:
  - Everything that goes out in trash from homes, office, schools, hospitals etc. is solid wastes. Burning of solid wastes are sources of air pollution.
  - It releases gases like carbon monoxide, sulphur dioxide, hydrogen chloride etc. and particulate matter in the air.

- These gases are greenhouse gases because they can absorb long wave infrared radiation which causes global warming.
  - Burning of solid wastes also releases a toxic and carcinogenic gas that causes health hazards like headache, respiratory diseases.
- The chain of flow of events are shown in figure below:
    - Waste from house is collected in nearby garbage bins.
    - These are then collected by MCD sweepers and transported to landfill sites.
    - Wastes are sorted depending on the three categories.
      - Organic wastes are recycled into organic materials and fertilizers that are used in agriculture and crops.
      - Recyclable wastes are recycled into raw material that can be reused.
      - Non-recyclable wastes are buried in landfills.



## SECTION – E

**Q24. Read the following statement and answer the questions that follow:**

**“A guava fruit has 200 viable seeds.”**

- What are viable seeds?
- Write the total number of:
  - Pollen grains
  - Gametes, in producing 200 viable guava seeds
- Prepare a flowchart to depict the post-pollination events leading to viable-seed production in a flowering plant.

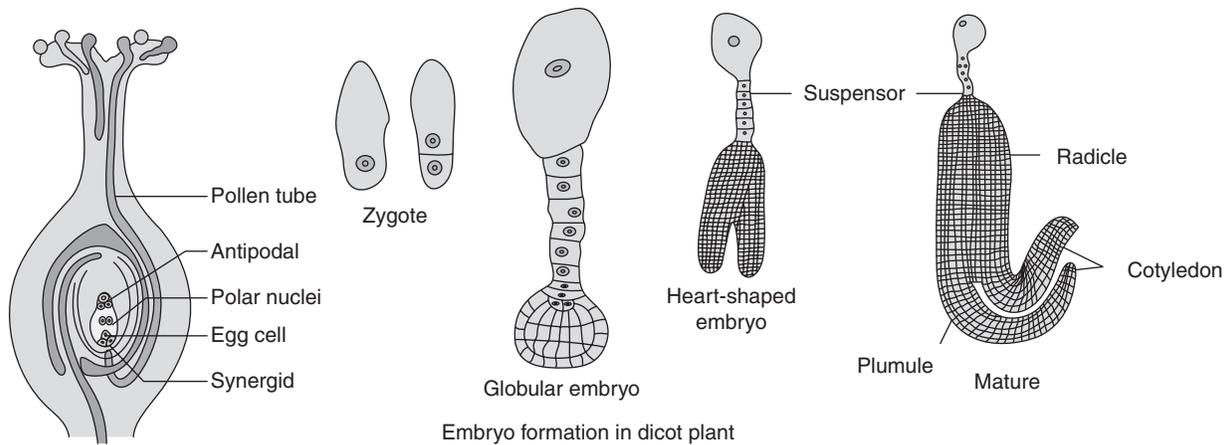
**Solution:**

- Viable seeds carry a living embryo and under appropriate conditions they are capable of germinating into seedling.
- 200 pollens are required to produce 200 viable guava seeds. Each pollen grain contains 2 male gametes out of which one fuses with polar nuclei and form endosperm and other one fuses with egg cell to form zygote which gives rise to seed.
  - 400 gametes are required because 2 gametes participate in double fertilization with polar nuclei and egg to form viable zygote which turns into seed to produce a viable seeds.
- All the processes after fertilization that occur in the flower are called post-pollination events that lead to formation of viable seeds. Major events are:
  - The development of embryo in a dicot takes place through three-fold elongation of zygote in the direction of future apical basal axis.
  - The first division is asymmetric and takes place at right angles to the main axis of the zygote. The basal cell is formed towards the micropyle and terminal cell is formed towards the chalaza.
  - Transverse division takes place in basal cell, while longitudinal division takes place in terminal cell. As a result, four-celled T-shaped proembryo is formed.

- The basal cell undergoes limited number of transverse divisions to form suspensor cell. The swollen uppermost cell of suspensor is called vesicular cell or haustorium, while the lowermost cell is called hypophysis. Hypophysis later forms a part of radicle and root cap. The role of suspensor is to anchor the embryo at the micropyle and allow nutrients, hormones and other growth regulators to pass from the maternal tissues to the developing embryo.
- The terminal cell that has already formed two cells by longitudinal division undergoes another longitudinal division at right angles to the previous one producing a four cells. Each of these four cells undergoes transverse division to form eight-cells arranged in two tiers of four cells each—epibasal (terminal) and hypobasal (near the suspensor). The upper tier of four cells later on produce hypocotyl, while the lower tier of four cells produce plumule and cotyledons.
- These eight cells further undergo a series of divisions to form globular embryo, with outer layer of protoderm or dermatogen, and inner procambium. The protoderm forms the epidermis, the procambium forms the stele, while the ground meristem forms the cortex and pith.
- Further cell divisions lead to initiation of cotyledons producing heart-shaped embryo. The hypocotyl also elongates, while the plumule remains undifferentiated.
- The embryo becomes large and stops growing as the seed approaches maturity. At this stage, it is the mature embryo. By this time, role of suspensor is complete and its cells die.

**OR**

- Arrange the following hormones in sequence of their secretion in a pregnant woman.



Embryo formation in dicot plant

(b) Mention their sources and the function they perform:  
**hcG, LH, FSH, Relaxin**

**Solution:**

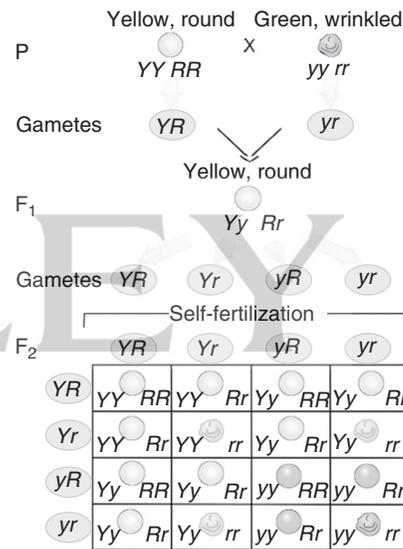
- (a) The sequence of secretion of the given hormones in a pregnant woman are as follows:
- (i) FSH
  - (ii) LH
  - (iii) hcG
  - (iv) Relaxin
- (b) The source and function of given hormones are as follows:
- (i) hcG (Human chorionic gonadotropin)  
 Source: Chorionic cells of placenta  
 Function: Stimulates corpus luteum to secrete progesterone
  - (ii) LH (Luteinizing hormone)  
 Source: Anterior pituitary lobe  
 Function: Maintains corpus luteum and induces ovulation
  - (iii) FSH (Follicle stimulating hormone)  
 Source: Anterior pituitary lobe  
 Function: Stimulates the growth of ovarian follicles and maturation of primary oocytes
  - (iv) Relaxin  
 Source: Ovary  
 Function: Relaxes the pelvic muscles and cervix muscles during child birth

**Q25. State and explain the "law of independent assortment" in a typical Mendelian dihybrid cross.**

**Solution:**

The law of independent assortment states that during a dihybrid cross i.e., crossing of two pair of traits, segregation of one pair of character is independent of the other pair. In Mendelian dihybrid cross, pea plants with two different characters were crossed where each character was controlled by two alleles of gene. Mendel crossed a pea plant having yellow and round seeds with a pea plant having green and wrinkled seeds. Here, in F<sub>2</sub> generation, it was observed that 9 pea plants have yellow and round seeds, 3 pea plants have green and round seeds, 3 pea plants have yellow and wrinkled seeds and 1 pea plant has green and wrinkled seeds. Here yellow round seeds and green wrinkled seeds are parental combinations whereas yellow wrinkled seeds and green round seeds are new combinations. Hence, he concluded that in

combination of the two pairs of traits, *Rr* segregates independent of the *Yy* which forms 4 gametes *RY, Ry, rY, and ry*. This is the law of independent assortment i.e., segregation of one pair of traits is independent of the other pair.



OR

- (a) How do the observations made during moth collection in pre and post industrialization era in England support evolution by natural selection?
- (b) Explain the phenomenon that is well represented by Darwin's finches other than natural selection.

**Solution:**

- (a) Industrial melanism is an example of natural selection of particular species, whose population has changed due to ill effects of pollution created by industrial activities.
- The peppered moth is found in Great Britain. It comes in two forms grey winged and dark winged. In the collection of moth in pre-industrialisation era, it was observed that there was more grey winged moth than black winged. Post-industrialisation when the same collection of moth was carried out, it was observed that there was more black winged moth than grey winged.
  - In pre-industrialisation era, white colour lichen covered the tree bark and grey winged moth resting on

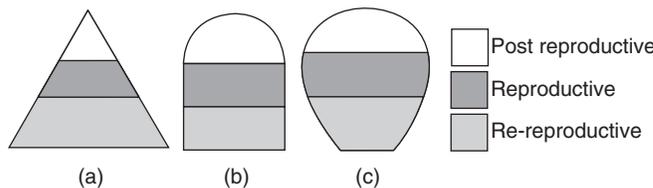
the tree were not visible to the predators, whereas black winged moth were easily picked out by the predators.

- In post-industrialisation era, lichens don't grow in polluted area and the due to industrial pollution the tree trunk became dark. The black winged moth camouflaged better on black trunk tree than the grey winged moth and therefore, population of grey winged moth declined due to predation.
- (b) Charles Darwin carried out several studies on Galapagos Islands. One of the most amazing things he observed was the variety of finches that existed on the island. These finches differed with respect to beak shape and overall size. These finches are called Darwin's finches.
- Previously, finches occupied the South American mainland but later they occupied Galapagos Islands that were very far from the mainland. As the population of finches increased, the resources on the islands decreased and due to intraspecific competition finches could not sustain for long. But due to natural selection and changes in gene pool, finches evolved to become more adaptive to the environment and available resources.
  - Thus, Darwin's finches represent adaptive radiation. In this, the species deriving from a common ancestor over the time have successfully adapted to the environment via natural selection.

- Q26. (a) What is an age-pyramid?**  
**(b) Name three representative kinds of age pyramids for human population and list the characteristics for each one of them.**

**Solution:**

- (a) A graphical representation of distribution of age groups in a population with pre-reproductive groups at base, reproductive groups in the middle and post reproductive groups at the top is called age pyramid.
- (b) The three kinds of age pyramids for human population are:



Age pyramids for (a) Expanding, (b) Stable and (c) Declining populations

- (i) Characteristics of triangular age pyramid:
- Number of pre-reproductive individuals is very large.
  - Number of reproductive individuals is moderate.
  - Number of post-reproductive individuals is very less.
  - Population is growing.
- (ii) Characteristics of bell shaped age pyramid:
- Number of pre-reproductive individuals and number of reproductive individuals are nearly equal.
  - Number of post-reproductive individuals is less compared to pre-reproductive and post-reproductive individuals
  - Population is neither growing nor declining. It is stable.
- (iii) Characteristics of urn shaped age pyramid:
- Number of reproductive individuals is more than number of pre-reproductive individuals.
  - Number of post-reproductive individuals is considerable or fairly large.
  - Population is declining with negative growth.

**OR**

**Discuss the role of healthy ecosystem services as a pre-requisite for a wide range of economic, environmental and aesthetic goods and services.**

**Solution:**

Products of ecosystem process are termed as ecosystem services. Ecosystem services are pre-requisite of wide range of economic, environmental and aesthetic good and services. Some examples are:

- Air and water are purified by healthy forest ecosystems
- Droughts and floods are mitigated
- Cycling of nutrients
- Generation of fertile soil
- Providing wildlife habitat
- Maintaining of biodiversity
- Pollination of crops
- Providing storage sites for carbon by carbon fixation
- Providing aesthetic, spiritual and cultural values

All these services are priceless. Robert Constanza and his group have tried to put price tags on these services. The price has been estimated around 33 trillion US dollars per year. Cost of soil formation is about 50% of the total cost of various ecosystem services. Climate regulation and habitat for wildlife costs about 6%. Other services like recreation and nutrient cycling cost less than 10% each.