

All India CBSE Board 2020 Solved Paper

GENERAL INSTRUCTIONS

Read the following instructions very carefully and strictly follow them:

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

SECTION A

1. ‘Cry’ protein’ coded by gene Cry IAb controls
 - (a) Cotton bollworm
 - (b) Corn borer
 - (c) Tobacco budworm
 - (d) Mosquito
2. Meselson and Stahl carried out centrifugation in CsCl_2 density gradient to separate:
 - (a) DNA from RNA
 - (b) DNA from protein
 - (c) the normal DNA from $^{15}\text{N} - \text{DNA}$
 - (d) DNA from tRNA
3. Self-pollination is fully ensured if
 - (a) the flower is bisexual
 - (b) the style is longer than the filament
 - (c) the flower is cleistogamous
 - (d) the time of pistil and anther maturity is different

OR

Zoopores are the reproductive units to carry asexual reproduction in

- (a) Chlamydomonas
 - (b) Spirogyra
 - (c) Yeast
 - (d) Rhizopus
4. Micropropagation can be achieved by
 - (a) self-pollination
 - (b) asexual reproduction
 - (c) tissue culture
 - (d) vegetative propagation

OR

The microbes commonly used in kitchens are

- (a) Lactobacillus and Yeast
 - (b) Penicillium and Yeast
 - (c) Microspora and E. coli
 - (d) Rhizopus and Lactobacillus
5. The main barrier that prevents the entry of micro-organisms into our body is
 - (a) Antibodies
 - (b) Macrophages
 - (c) Monocytes
 - (d) Skin

SECTION B

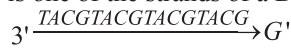
6. Name the genus of baculovirus that acts as a biological control agent in spite of being a pathogen. Justify by giving three reasons that make it an excellent for the job.

OR

“Micro-organisms play an important role for the biological treatment of sewage.” Justify.

7. It is often observed that the chances of a person suffering from measles in his or her lifetime are low if he or she has suffered from the disease in their early childhood. Justify the statement.
8. Wings of birds and wings of butterflies contribute to locomotion. Explain the type of evolution such organs are a result of.
9. Name and mention the events that occur in the cells when HIV gets into blood after gaining entry into the human body.

10. List the four different human male accessory ducts.
11. State what is out-crossing type of breeding. Mention on what type of cattle this practiced.
12. Given below is one of the strands of a DNA segment:



- (a) Write its complementary strand.
- (b) Write a possible RNA strand that can be transcribed from the above DNA molecule formed.

SECTION C

13. Generally it is observed that human males suffer from hemophilia more than that of human females who rarely suffer from it. Explain giving reason.

OR

F_1 progeny of pea plant bearing violet flowers and snapdragon plant bearing red flowers were selfed to produce their respective F_2 progeny. Compare the phenotypes, the genotypes and the pattern of inheritance of their respective F_2 progeny.

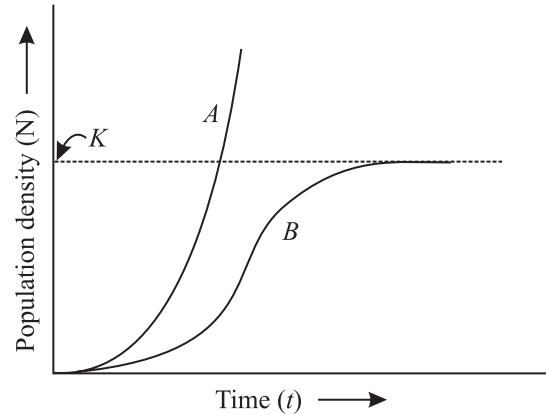
14. For a layman, both apple and banana are fruits. But a biology student categorises fruits as true fruits, false fruits and parthenocarpic fruits. Justify.
15. Draw a schematic transverse section of a mature anther of an angiosperm. Label its epidermis, middle layers, tapetum, endothecium, sporogenous tissue and the connective.
16. Alien species invasion has been a threat to biodiversity. Justify with the help of a suitable example. List any other three causes responsible for such a loss.
17. Explain the changes that milk undergoes when suitable starter/inoculum is added to it. How does the end product formed prove to be beneficial for human health?
18. Explain the three steps carried out in the formation of recombinant DNA using the enzyme EcoRI.
19. In an *E. coli* cloning vector pBR 322, state the role of the following genes:
- (a) ori gene
- (b) Antibiotic resistance gene
- (c) rop gene
20. Study the table given below and identify a, b, c, d, e and f:

Crops	Variety	Resistance to disease
A	Pusa sadabahar	B
C	d	White rust
E	Himgiri	f

OR

What is plant breeding? Explain the two steps involved in classical plant breeding.

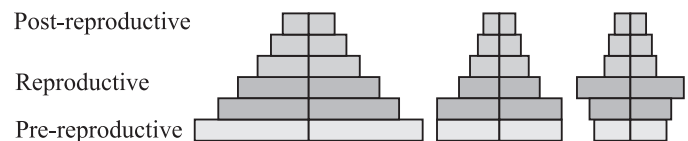
21. Study the population growth curve given below and answer the questions that follow:



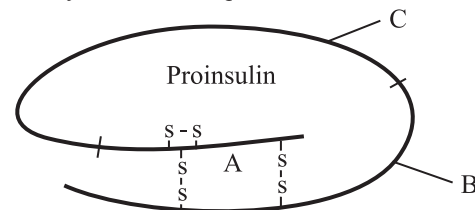
- (a) Identify 'A' and 'B' shown in the graph.
- (b) When and why do such curves occur in a population?

SECTION D

22. Study the age pyramid 'A', 'B' and 'C' of the human population given below and answer the questions that follow:

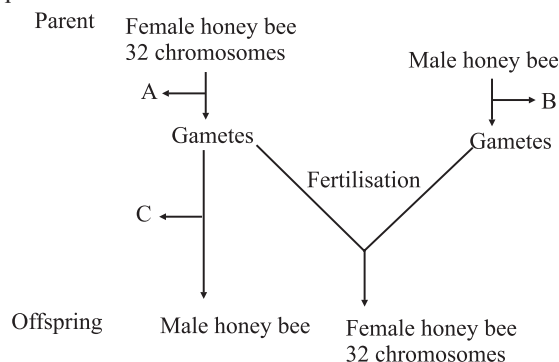


- (a) Identify pyramid 'B' and 'C'.
- (b) Write the basis on which the above pyramids are plotted.
23. Insulin in the human body is secreted by pancreas as prohormone/proinsulin. The schematic polypeptide structure of proinsulin is given below. This proinsulin needs to undergo processing before it becomes functional in the body. Answer the questions that follow:



- (a) State the change the proinsulin undergoes at the time of its processing to become functional.
- (b) Name the technique the American company Eli Lilly used for the commercial production of human insulin.
- (c) How are the two polypeptides of a functional insulin chemically held together?

24. The cytological observations made in a number of insects led to the development of the concept of genetic/chromosomal basis of sex-determination mechanism. Honey bee is an interesting example to study the mechanism of sex-determination. Study the schematic cross between the male and the female honey bees given below and answer the questions that follow:



- (a) Identify the cell divisions 'A' and 'B' that lead to gamete formation in female and male honey bees respectively.
- (b) Name the process 'C' that leads to the development of male honey bee (drone).

SECTION E

25. Describe the model of phosphorus cycle in the terrestrial ecosystem.

OR

Describe the DDT biomagnification occurring in an aquatic food chain. State the negative effects the process has on the organisms at the last trophic level of the food chain.

26. (a) Write the features that a biomolecule must fulfil to be able to act as a genetic material.
- (b) DNA and RNA are both genetic materials. Which one of the two is more stable and why?

OR

- (a) Explain Hardy-Weinberg Principle on the basis of the algebraic equation $p^2 + 2pq + q^2 = 1$.
- (b) How do gene migration and genetic drift affect this genetic equilibrium?
27. (a) IVF is a very popular method these days that is helping childless couples to bear a child. Describe the different steps that are carried out in this technique.
- (b) Would you consider Gamete Intrafallopian Transfer (GIFT) as an IVF? Give a reason in support of your answer.

OR

- (a) Draw a sectional view of a human ovary and label primary follicle, tertiary follicle, Graafian follicle and corpus luteum in it.
- (b) Name the gonadotropins and explain their role in oogenesis and the release of ova.

Solutions

SECTION A

1. (b) The Bt toxin genes were isolated from *Bacillus thuringiensis*. The toxin which is coded by a gene called cry. The 'Cry' protein encoded by gene Cry IAb controls corn borer.
2. (c) The Meselson and Stahl carried out centrifugation in $CsCl_2$ density gradient for separation the normal DNA from ^{15}N DNA. The normal DNA was extracted from the culture one generation after the transfer ^{15}N to ^{14}N medium which has hybrid or intermediate density.
3. (c) The process of self-pollination is fully insured if the flower is cleistogamous. The cleistogamous flowers are the type of flower which does not open at all. In such flowers, the anther and stigma lie close to each other and when the anthers dehisce in the flower buds, and then the pollen grains come in contact with the stigma results in self-pollination.

OR

- (a) *Chlamydomonas* is an aquatic and unicellular organism. The *Chlamydomonas* reproduce asexually by zoospores. Zoospores are flagellated asexual spores and they are formed during the night time under favourable condition.
4. (c) The method of micropropagation involves the production of thousands of plants by tissue culture. The plants grown by micropropagation are identical to their original plant and are called somaclones.

OR

- (a) The microbes that are commonly used in kitchens are *Lactobacillus* and *Yeast (Saccharomyces cerevisiae)*. The bacteria *Lactobacillus* and other Lactic acid bacteria (LAB) are used for conversion of milk into curd. As, *Lactobacillus* and other Lactic acid bacteria (LAB) are grow in milk and these bacteria produce acids which helps in the coagulation of milk and partially digest the milk proteins. While the yeast is used for fermentation and in baking and bread making.
5. (d) The main barrier that prevents the entry of microorganisms into our body is skin. Skin on human body serves as the main physical barrier that prevents the entry of the microorganisms.

SECTION B

6. Baculoviruses are the pathogens which attack insects and other arthropods and are used as a biological control agents. Baculoviruses belongs to the genus *Nucleopolyhedrovirus*.

These viruses are used as an excellent source for species-specific, narrow specturum insecticidal applications. They are not harmful for plants, mammals, birds, fishes and on target insects.

OR

Secondary treatment of sewage is also called biological treatment because it involves biological organisms such as aerobic and anaerobic microbes and fungi for digestion of organic waste.

In this, the primary effluent is passed into the large aeration tanks and is constantly agitated mechanically. In this, air is pumped and this allows the vigorous growth of useful aerobic microorganisms into flocs. These microbes consume the maximum part of the organic matter in the effluent. This significantly reduces the biochemical oxygen demand (BOD) of the effluent. The sewage water is treated till the BOD is reduced.

7. During the initial stage of infection, memory cells are generated in the body. The memory cells create information about the pathogen that causes measles in the human body for the first time and produce antibodies for them. During the second stage of measles infection, the memory cells are activated that are formed during first encounter. These memory cells produce an antibody against the antigen that cause measles and kills the virus that causes measles.
8. The wings of butterfly and wings of birds are look alike but are not anatomically similar structures but they perform similar functions. Such organs are called analogous organs. Analogous organs are the results of convergent evolution.
9. Replication of viral RNA genome takes place in the cells when the HIV gets into the blood after gaining entry into the human body. The RNA genome of the HIV virus tends to replicate with the help of an enzyme of reverse transcriptase. The viral DNA gets incorporated into host cell's DNA and directs the infected cells to form virus particles.
10. The human male sex accessory ducts are rete testis, vasa efferentia, vas deferens and epididymis.

Rete testis: The seminiferous tubules of the testis open into the vasa efferentia through rete testis.

Vasa efferentia: It leaves the testis and opens into the epididymis which is located along the posterior surface of each testis.

Epididymis: This leads to vas deferens which ascends to the abdomen and loops over the urinary bladder. The epididymis receives a duct from seminal vesicle that opens into urethra as the ejaculatory duct.

11. **Outcrossing:** This type of mating occurs between the animals of the same breed but have no common ancestors on either side of their pedigree up to 4-6 generations. The offspring produced by such mating is called out-cross. This method is considered as the best breeding method for animals that are below average in milk production, growth rate in beef cattle and so on.
12. (a) The complementary strand formed is:
Given strand-
3'-TACGTACGTACGTACG-5'
Complementary strand-
5'-ATGCATGCATGCATGC-3'.
- (b) The RNA strand that can be transcribed from the given DNA segments 3'-TACGTACGTACGTACG-5' is
5'-AUGCAUGCAUGCAUGC-3'.

SECTION C

13. Hemophilia is a recessive X-linked genetic disorder. Hemophilia is more common among males than females because males only inherit one X-chromosome. Humans have 22 pairs of autosomal chromosomes and one pair of sex chromosome. There are 46 chromosomes in humans. Females have XX chromosome while males have X and Y chromosome. So, male offspring inherit X-chromosome from their mother and Y-chromosome from their father. Males only have one X-chromosome and if the X-chromosome and this is the reason that males are suffering from haemophilia if the X-chromosome carries mutation. While in females, as they have two X chromosomes, and this is a recessive disorder so females are carrier of this disease and can pass this disorder to male offsprings.

OR

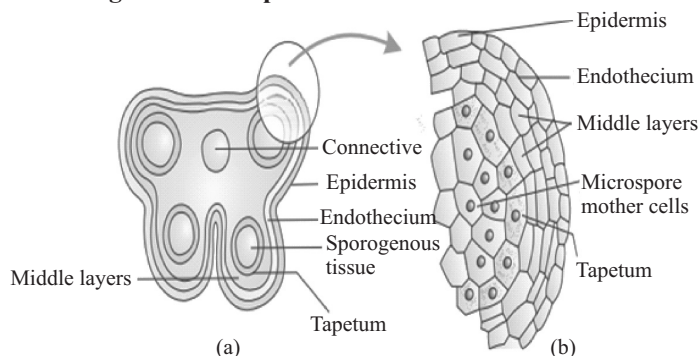
The pattern of inheritance is Incomplete dominance in which the none of the two alleles are dominant over each other. So, when both the alleles are present together intermediate or new phenotypes are formed. Intermediate formed is intermediate between the independent expressions of two alleles.

The phenotypic ratio and genotypic ratio such as 1:2:1 are same in case of incomplete dominance.

14. Fruits that are matured ovaries of flowers are called true fruits and false fruits are develop only from the ovary. Fruits formed as a result of fertilization, while some species of fruits that are develop without fertilisation and such fruits

are called parthenocarpic fruits. Banana is a parthenocarpic and seedless fruit.

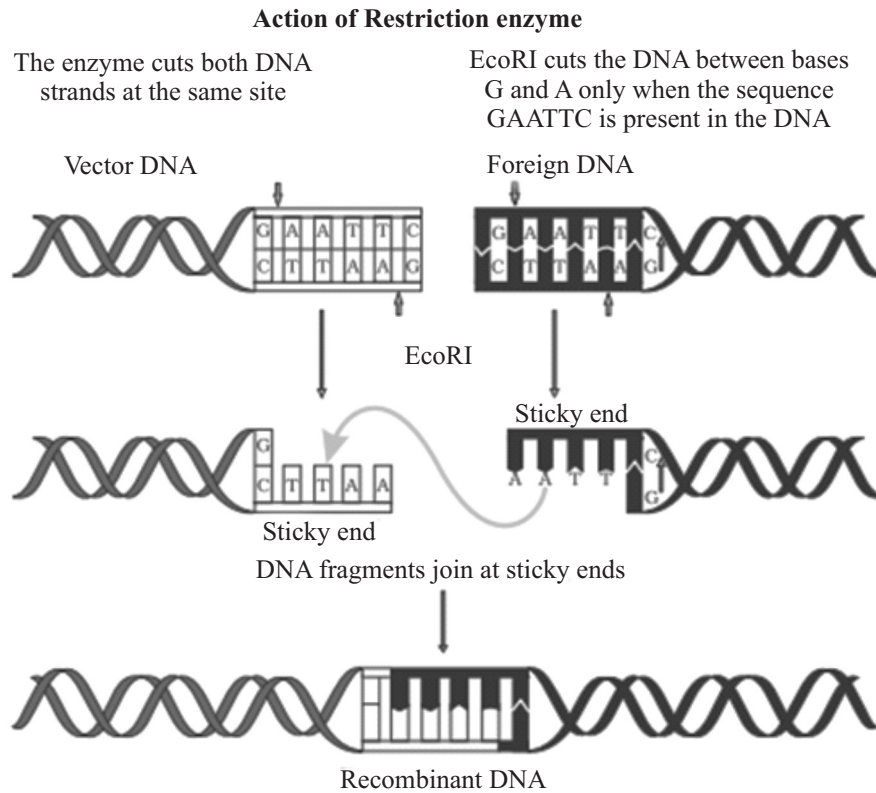
15. **Diagrammatic representation of mature anther:**



A typical angiosperm anther is bilobed with each lobe having two theca such as they are ditheous.

16. Alien species are introduced and cause decline or extinction of indigenous species. When the Nile perch introduced into Lake Victoria in east Africa results in the extinction of an ecologically unique assemblage of more than 200 species of cichlid fish in the lake. Other invasive species are carrot grass (*Parthenium*), *Lantana* and water hyacinth (*Eicchornia*). Introduction of African catfish *Clarias gariepinus* for purpose of aquaculture causes threat to the indigenous catfishes in the rivers.
17. LAB (lactic acid bacteria) and *Lactobacillus* are commonly grow in milk and helps in the conversion of milk into curd. It produces acid that helps in coagulation and partial digestion of milk proteins. LAB also plays essential role in checking disease causing microbes. A small amount of curd is added to the fresh milk that serves as an inoculum. The inoculum contains millions of LAB, and LAB at suitable temperature tends to multiply results in the conversion of milk into curd. LAB also improves the nutritional quality by increasing vitamin B₁₂.
18. The steps involved in the formation of recombinant DNA by the action of restriction endonuclease enzymes EcoRI:
- EcoRI cuts the DNA between the nitrogenous bases G and A only when the sequence GAATTC is present in the DNA.
 - The restriction endonuclease enzyme cuts both the DNA strands such as vector DNA and foreign DNA at the same site.
 - Then, the DNA fragments are joined at sticky ends and recombinant DNA is produced.

Diagrammatic representation of steps involved in the formation of recombinant DNA by action of restriction endonuclease enzyme EcoRI.



19. (a) **ori gene:** It is origin of replication. A gene sequence that initiates the process of replication. It controls the copy number of linked DNA.
- (b) **Antibiotic resistance gene:** Some genes encoding resistance to antibiotics such as ampicillin, chloramphenicol, tetracycline or kanamycin are considered as useful selectable markers for *E.coli*. The normal *E.coli* cells that does not carry resistance against any of these antibiotics. Antibiotic resistance gene helps in the selection of transformants.
- (c) **rop gene:** The rop gene present in pBR322 cloning vectors codes for the protein which is involves in the replication of plasmid.

20.

Crops	Variety	Resistance to disease
Chilli	<i>Pusa sadabahar</i>	<i>Chilly mosaic virus, leaf curl and Tobacco mosaic virus</i>
Brassica	<i>Pusa swarnim</i>	White rust
Wheat	<i>Himgiri</i>	<i>Leaf and stripe rust and hill bunt</i>

OR

Plant breeding is defined as the manipulation of plant species for the formation of desired plant species. The desired plants produced by plant breeding are better for cultivation, provide better yields and are disease resistant.

The steps involved in the classical plant breeding are:

- Hybridisation of pure lines
 - Artificial selection for the production of plants having desired characters for higher yield or development of resistance against diseases.
21. (a) **A** in the given graph is $\frac{dN}{dt} = rN$ that indicates exponential growth and **B** in the given graph is $dN = rN \frac{(K - N)}{K}$ that indicates logistic growth.
- (b) The exponential growth occurs when the resources such as food and space are available unlimited. While the logistic growth occurs when the resources are limited and there is competition between the individuals in a given habitat. So, only the 'fittest' individual will survive and reproduce.

SECTION D

22. (a) The pyramid **B** is stable while pyramid **C** is declining.
- (b) Age pyramid is defined as a way for representing the age-sex structure of a population. There are three types of age distribution pyramids such as expanding, stable and declining. A population is composed of individuals of different age groups.

In a stable or Bell-shaped age pyramid the number of pre-reproductive and reproductive individuals is almost equal. If the post-reproductive individuals are comparatively fewer then the population size remains stable as it is neither growing nor diminishing.

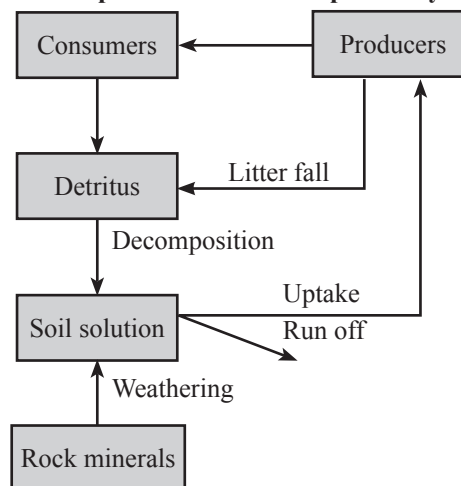
The declining or urn-shaped age pyramid indicates the number of reproductive individuals is higher than that of number of pre-reproductive individuals. The declining age pyramid indicates declining growth.

23. The various steps involved in the production of artificial insulin are as follows:
- The artificial insulin consists of two short polypeptide chains such as chain A and chain B.
 - These two short polypeptide chains are linked together by disulphide bond.
 - In mammals such as humans, insulin is synthesised as a prohormone that contains an extra stretch called the **C peptide**.
 - This **C peptide** is not present in mature insulin and is removed during maturation into insulin.
 - The proinsulin is cleaved in order to remove extra stretch called C-peptide for the formation of mature insulin that contains only two chains such as A-chain and B-chain which is joined together by disulphide bond.
- (b) The technique used by American company Eli Lilly is recombinant DNA technology for the formation of recombinant insulin.
- (c) Insulin is composed of two peptide chains such as A-chain and B-chain. The A-chain consists of 21 amino acids and B-chain consists of 30 amino acids. The two chains are joined together by disulphide bonds for the formation of human insulin.
24. (a) 'A' Female honeybees are diploid so, the process of meiosis takes place for the gamete formation in female honeybees. While 'B' male honeybees are haploid so, mitosis takes place for the gamete formation in male honeybees.
- (b) Honeybees are classified into three categories such as queen, drone and workers. So, the male honey bees are called drones. The male honey bees or drones are developed from the unfertilized female eggs and this phenomenon is called arrhenotoky. Arrhenotoky is a type of parthenogenesis in which unfertilized eggs develop into males.

SECTION E

25. Phosphorus is a major constituent of all biological membranes such as nucleic acids and cellular energy transfer systems. Animals also require a large amount of phosphorus to make shells, bones and teeth. Naturally phosphorus is found in rocks in the form of phosphates. Plants absorb phosphorus through roots from soil when the rocks are weathered, minute amount of phosphates that is dissolved in soil solution. So, the herbivores and other animals obtain phosphorus from plants. Whereas the waste products and the dead organisms are decomposed by phosphate-solubilising bacteria releasing phosphorus.

Diagrammatic representation of Phosphorus cycle:



OR

Biomagnification is the process of increase in the concentration of the toxicant at successive trophic levels. Biomagnification takes place in the aquatic food chain. This process takes place because a toxic substance such as mercury and DDT is accumulated by an organism that cannot be metabolised and excreted and tends to be passed on to the next higher trophic levels. The concentration of DDT is increased at successive trophic level by biomagnification and it can be 25ppm in fish-eating birds through biomagnification. High concentrations of DDT result in calcium metabolism disturbance in the birds. It causes thinning of eggshells and their premature breaking that eventually causes decline in their bird populations.

26. (a) The features that biomolecules must fulfil as a genetic material are as follows:
- Ability to replicate means a biomolecule should have an ability to generate replica.
 - Stability means a biomolecule should be chemically and structurally stable.
 - Mutation means a biomolecule should provide a scope for slow changes which is required for evolution.
 - Expression means a biomolecule should be able to express itself in the form of 'Mendelian characters'.
- (b) DNA is more stable because of the presence of thymine that provides extra stability to the DNA.

OR

- (a) The algebraic equation $p^2 + q^2 + 2pq = 1$ is a binomial expansion of $(p + q)^2$. This algebraic equation represents the Hardy-Weinberg's principle that is used to calculate the genetic variation of a population at equilibrium. The Hardy-Weinberg principle states that the allele frequencies in a population are stable and which remains constant from one generation to another generation.

So, p represents the frequency of allele A , q represents the frequency of allele a , p^2 represents the frequency of AA (homozygous) individuals in a population. Whereas q^2 represents the frequency of aa and $2pq$ represents the frequency of Aa (heterozygous) individuals. It also indicates that the sum of all the allelic frequencies is equal to one.

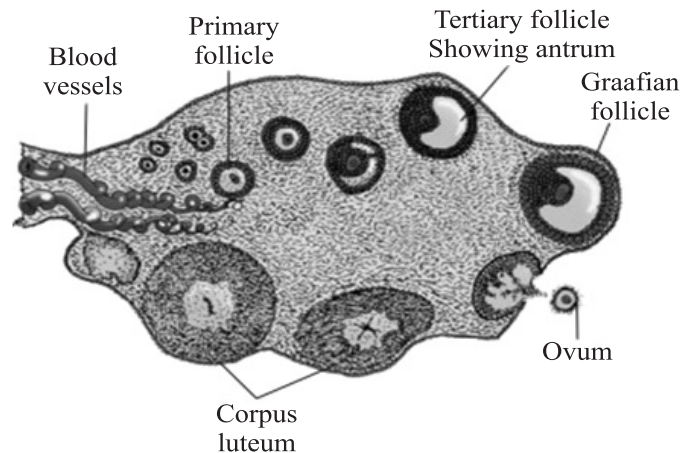
- (b) Gene migration refers to the movement of the alleles from one population to another that result in inbreeding between the members of the two population. So, the removal of alleles from one population or addition of alleles into another population is called gene migration. While genetic drift which is also called 'Swell Wright Effect'. Genetic drift is random in allele frequencies. It results in elimination of alleles or fixation of the other alleles in the population.

27. (a) The technique suggested to the couples who are not able to conceive is IVF (In vitro fertilisation). This method involves embryo transfer. In this method, ova from the wife or donor female and sperms from the husband or donor male are collected. The ova and sperm are induced to form zygote under stimulated conditions in the laboratory.
- (b) ZIFT (Zygote Intra Fallopian Transfer) is an assisted reproductive technology. The doctor suggests **ZIFT (Zygote intra fallopian transfer)** to those couples who are not able to bear a child. In this procedure, the sperm is collected either from the husband or donor and an ovum is collected from wife or donor. Then sperm and ova are induced to form zygote under controlled conditions in the laboratory. Then the

zygote or early embryos upto 8 blastomeres stages are then transferred into the fallopian tube of the female for further development.

OR

- (a) Diagrammatic representation of sectional view of human ovary:



- (b) The gonadotropin hormones are luteinizing hormones and follicle stimulating hormones that are secreted by the anterior lobe of the pituitary gland. As, these hormones stimulates ovaries in females and plays an essential role in the process of reproduction. FSH stimulates egg formation in females and LH alongwith FSH helps in the process of ovulation and also prepares the uterus for pregnancy. Whereas estrogen hormone is secreted by the ovaries that induces and also maintains secondary sexual characteristics in females.