

**Class XII Session 2023-24**  
**Subject - Biology**  
**Sample Question Paper – 1**

**Maximum Marks: 70**

**Time: 3 Hours**

**General Instructions:**

- (i) All questions are compulsory.
- (ii) The question paper has five sections and 33 questions. All questions are compulsory.
- (iii) Section-A has 16 questions of 1 mark each; Section-B has 5 questions of 2 marks each; Section- C has 7 questions of 3 marks each; Section- D has 2 case-based questions of 4 marks each; and Section-E has 3 questions of 5 marks each.
- (iv) There is no overall choice. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.
- (v) Wherever necessary, neat and properly labeled diagrams should be drawn.

**SECTION-A**

1. Which of the following contraceptive methods involve a role of hormone?  
(a) Pills, Emergency contraceptives, Barrier methods  
(b) LNG-20 Pills, Emergency contraceptives  
(c) Barrier method, Lactational amenorrhea, Pills  
(d) Copper T, Pills, Emergency contraceptive
2. Given below are four methods (A-D) and their modes of action (i-iv) in achieving contraception. Select their correct matching from the four options that follow.

|    | Method    |       | Mode of Action                  |
|----|-----------|-------|---------------------------------|
| A. | The pill  | (i)   | Prevents sperms reaching cervix |
| B. | Condom    | (ii)  | Prevents implantation           |
| C. | Vasectomy | (iii) | Prevents ovulation              |
| D. | Copper T  | (iv)  | Semen contains no sperms        |

- (a) A-(iii), B- (iv), C-(i), D- (ii)
- (b) A-(ii), B- (iii), C (i), D- (iv)

- (c) A-(iii), B- (i), C- (iv), D- (ii)
- (d) A-(iv), B- (i), C- (ii), D - (iii)

3. In a 3.2 Kbp long piece of DNA, 820 adenine bases were found. What would be the number of cytosine bases?

- (a) 780
- (b) 1560
- (c) 740
- (d) 1480

4. Evolutionary convergence is characterised by

- (a) development of dissimilar characteristics in closely related groups
- (b) development of a common set of characteristics in groups of different ancestry
- (c) development of characteristics by random mating
- (d) replacement of common characteristics in different groups.

5. Which one of the following immune system components does not correctly match with its respective role?

- (a) Interferons - Secreted by virus-infected cells and protect non-infected cells from further viral infection.
- (b) B-lymphocytes - Produce antibodies in response to pathogens into blood to fight with them.
- (c) Macrophages - Mucus secreting cells that trap microbes entering in the body.
- (d) IgA - Present in colostrum in early days of lactation to protect infant from diseases.

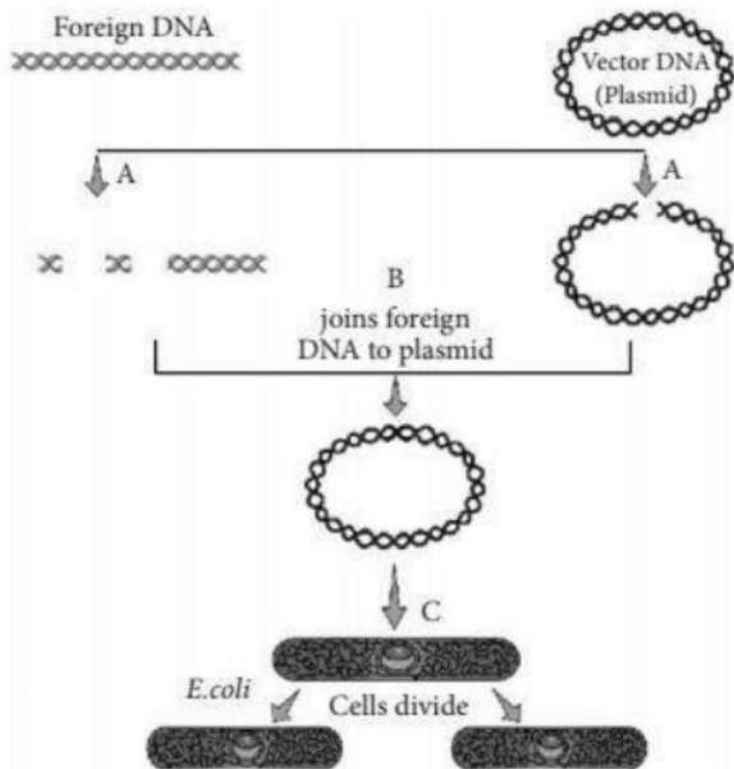
6. MALT is

- (a) Muscle Associated Lymphoid Tissue
- (b) Mucosal Associated Lymphoid Tissue
- (c) Mucosal and Lymphoid Tissue
- (d) Memory Associated Lymphoid Tissue.

7. From a sewage treatment plant, three water samples A, B and C are tested for BOD value and the recorded values of BOD are 6 mg/L, 400 mg/L and 20 mg/L respectively. What is correct about these samples?

- (a) Sample A is taken from untreated sewage.
- (b) Sample B belongs to secondary effluent of sewage treatment plant.
- (c) Sample C is taken from primary effluent.
- (d) Sample B is collected from untreated sewage.

8. Identify A, B and C in the flow chart given below that represents the process of recombinant DNA technology.



- (a) A-Restriction exonuclease, B-DNA ligase, C-Transformation
- (b) A-Restriction endonuclease, B-DNA ligase, C-Transformation
- (c) A-Restriction endonuclease, B-Hydrolase, C-Transcription
- (d) A-Restriction exonuclease, B-Hydrolase, C-Transcription

9. The age structure of a population influences population growth because

- (a) younger females have more offsprings than older females
- (b) different age groups have different reproductive capabilities
- (c) more the number of immature individuals, slower the growth of population
- (d) a shorter generation time results in slower population growth.

10. Competition for light, nutrients and space is most severe between

- (a) closely related organisms growing in different niches
- (b) closely related organisms growing in the same area/niche
- (c) distantly related organisms growing in the same habitat
- (d) distantly related organisms growing in different niches.

11. Food chain in which microorganisms break down the dead organic matter is

- (a) parasitic food chain
- (b) detritus food chain

- (c) consumer food chain
- (d) predator food chain.

12. Which of the following is not an example of in situ conservation?

- (a) Biosphere reserves
- (b) National parks
- (c) Wildlife sanctuaries
- (d) Zoological parks

Question No. 13 to 16 consist of two statements - Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

- (a) Both A and R are true and R is the correct explanation of A
- (b) Both A and R are true and R is not the correct explanation of A
- (c) A is true but R is false
- (d) A is false but R is true

13. Assertion: Ex-albuminous seeds do not possess any residual endosperm, as it is completely consumed during embryo development.

Reason: Wheat, castor, pea and groundnut all are examples of ex-albuminous seeds.

14. Assertion: Linked genes do not show dihybrid ratio of 9:3:3:1.

Reason: Linked genes do not undergo independent assortment.

15. Assertion: Human insulin can be produced into bacterial cells using biotechnology.

Reason: To produce human insulin the A, B and C polypeptides of the human insulin are produced separately in the bacterial cells, extracted and combined by creating disulphide bonds.

16. Assertion: Mycorrhizae represent a mutually beneficial interspecific interaction of fungi with roots of higher plants.

Reason: In a mutualistic relationship, both the organisms enter into some sort of physiological exchange.

## SECTION – B

17. The given figure shows karyotype of a child who is suffering from a sex chromosomal abnormality which occurs during failure of segregation of chromatids during cell division cycle. This results in the gain or loss of a chromosome (s), called aneuploidy. Study the figure and answer the questions that follow:

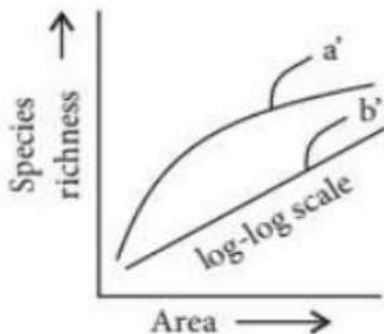
- (a) Identify the disease from the given karyotype.

A human karyotype showing 22 pairs of autosomes and one pair of sex chromosomes (X and Y). The chromosomes are arranged in four rows: the first three rows contain pairs 1 through 16, and the fourth row contains pairs 17 through 22, followed by the X and Y chromosomes. Each pair is represented by two black vertical bars of varying heights and widths, indicating their relative size and shape.

19. Why is Taq polymerase preferred in PCR? Mention the source of this enzyme?

21. The given graph shows the species-area relationship. Answer the following questions as directed.

(b) Write the situation as discovered by the ecologists when the value of 'Z' (slope of the line) lies between



(c) What does 'Z' stand for?



**OR**

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

**SECTION-C**

22. A cross was carried out between two pea plants showing the contrasting traits of height of the plants. The result of the cross showed 50% parental characters.

- (a) Work out the cross with the help of a Punnett square.
- (b) Name the type of the cross carried out.

23. Although a prokaryotic cell has no defined nucleus, yet DNA is not scattered throughout the cell. Explain.

24. 'Plasmid is a boon to biotechnology. Justify this statement quoting the production of human insulin as an example.

25. Prior to a sports event, blood and urine samples of sports persons are collected for drug tests.

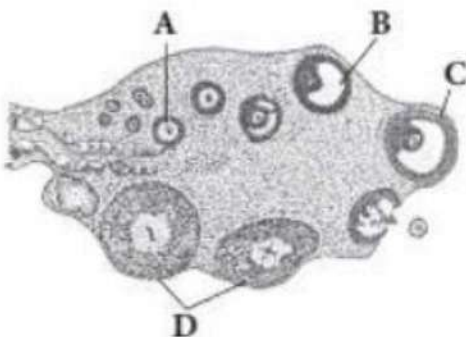
- (a) Why is there a need to conduct such tests?
- (b) Name the drugs the authorities usually look for.
- (c) Write the generic names of two plants from which these drugs are obtained.

26. Why is predation required in a community of different organisms?

**OR**

- (a) Explain "birth rate" in a population by taking a suitable example.
- (b) Write the other two characteristics which only a population shows but an individual cannot.

27. Study the transverse section of human ovary given below and answer the questions that follow.



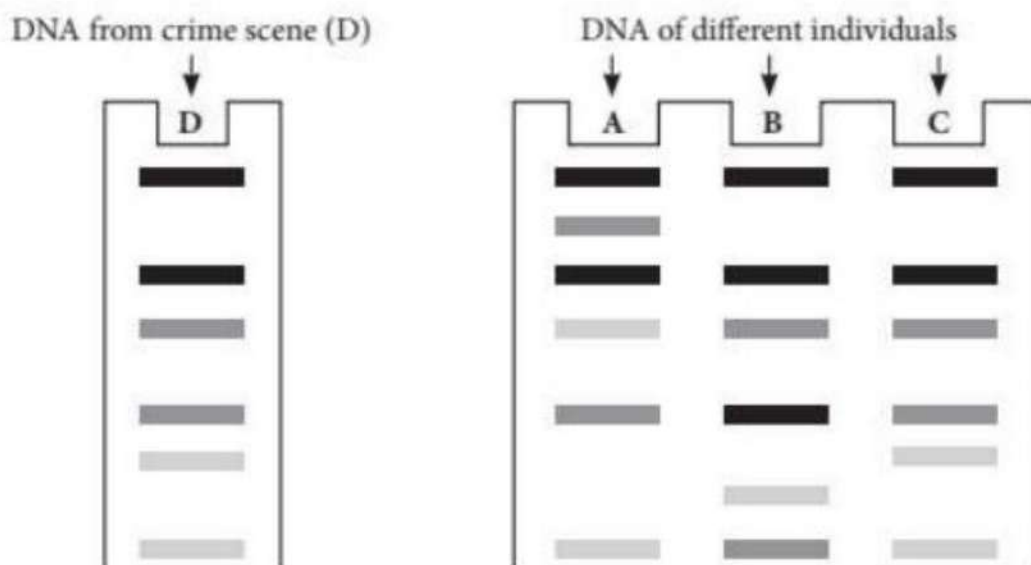
- (a) Name the hormone that helps in growth of  $A \rightarrow B \rightarrow C$ .  
(b) Name the hormone secreted by A and B.  
(c) State the role of hormone produced by D.

28. Explain the post-pollination events leading to seed production in angiosperms.

### SECTION-D

Q. No. 29 and 30 are case based questions. Each question has 3 subparts with internal choice in one subpart.

29. Study the given below picture of the gel electrophoresis showing the banding pattern of DNA from crime scene.



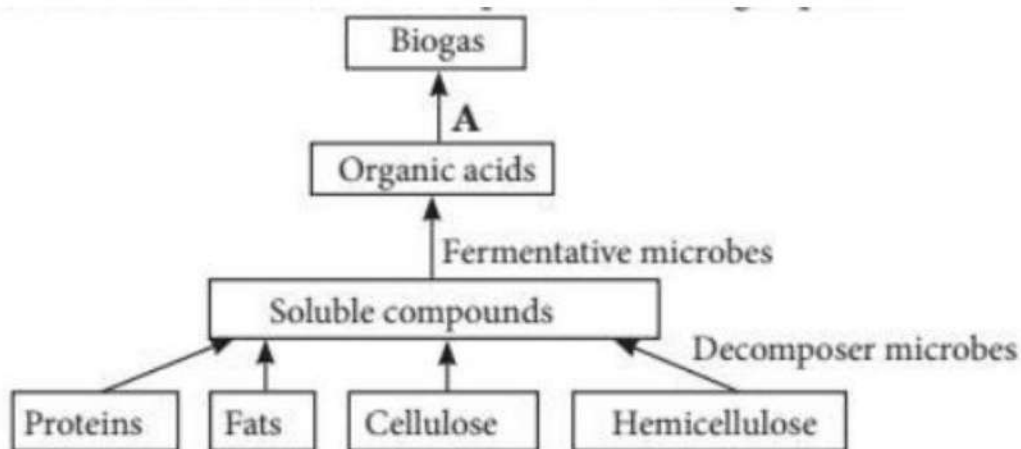
- (a) On the basis of the above given picture of gel electrophoresis, among A, B and C who will be the criminal? Give reason.

**OR**

Which technique is used in the given question for the identification of the criminals?

- (b) On what basis, the DNA fragments of individual A, B and C are separated in the gel electrophoresis?  
(c) What is the basis of technique which is used in the criminal investigation and forensic science?

30. The flow chart given below shows the different components of biogas plant.



- With reference to the given flow chart, explain why there is a need of A?
- What would happen if A is not added in the procedure?
- Where does A can be found apart from the biogas production?

**OR**

What is the significance of biogas produced by A?

### SECTION – E

- What is gene therapy?
  - Mention the cause of ADA deficiency in humans. How has genetic engineering helped patients suffering from it?

**OR**

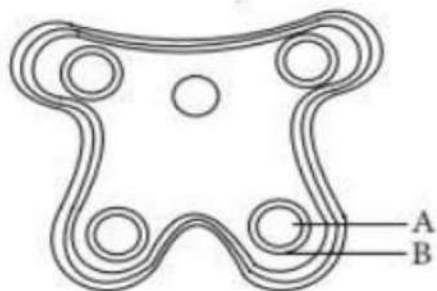
Explain with the help of diagram the process of amplification of a gene of interest using polymerase chain reaction.

- IUDs are said to be effective contraceptives. Name any two commonly used IUDs and write their mode of action.
  - Name and explain the surgical method advised to human males and females as a means of birth control. Mention its one advantage and one disadvantage.

**OR**

- In the T.S. of a mature anther given below, identify "A" and "B" and mention their functions.





(b) Name the organic material present in outer layer of pollen grain.

(c) How are 'pollen banks' useful?

33. Work out a monohybrid cross upto  $F_2$  generation between two pea plants and two *Antirrhinum* plants both having contrasting traits with respect to colour of flower. Comment on the pattern of inheritance in the crosses carried above.

**OR**

(a) Dihybrid cross between two garden pea plant, one homozygous tall with round seeds and the other dwarf with wrinkled seeds was carried.

(i) Write the genotype and phenotype of the  $F_1$  progeny obtained from this cross.

(ii) Give the different types of gametes of the  $F_1$  progeny.

(iii) Write the phenotypes and its ratios of the  $F_2$  generation obtained in this cross along with the explanation provided by Mendel.

(b) How were the observations of  $F_2$  progeny of dihybrid crosses in *Drosophila* by Morgan different from that of Mendel carried in pea plants? Explain giving reasons.

## SOLUTIONS

1. (b) LNG-20 is hormone releasing IUD that make the uterus unsuitable for implantation and the cervix hostile to the sperms. Pills are hormonal preparations (either progestogen or progestogen- estrogen combinations) in the form of tablets which are administered orally by females. They inhibit ovulation, implantation as well as alter the quality of cervical mucus. Emergency contraceptives are pills that contain levonorgestrel, a type of progestin that helps to prevent pregnancy when taken in few days after sex.

2. (c)

3. (a) Total DNA = 3.2 Kbp = 3200 bp

Adenine = 820

According to Chargaff's rule

$$[A] = [T], [G] = [C]$$

So, Thymine = 820

Therefore, total A + T content = 820 + 820 = 1640

Also, A + T = 3200 - (G + C)

So, G + C content = 3200 - 1640 = 1560

So, cytosine =  $\frac{1560}{2} = 780$

4. (b)

5. (c) Macrophages are large phagocytic cells that digest the invading organisms.

6. (b) MALT (Mucosal Associated Lymphoid Tissue) is located within the lining of the major tracts, i.e., respiratory, urogenital and digestive tracts.

7. (d): Sewage contains high amount of organic matter and hence its BOD value is high. During sewage treatment, its organic matter is removed and BOD value reduces drastically.

8. (b)

9. (b): Different age groups have different reproductive capabilities. Pre-reproductive individuals are the young individuals which will enter the reproductive age after some time. They are the potential source of increase in population. Reproductive individuals are the ones which are actually adding new members to the population. Post-reproductive individuals are older individuals which no longer take part in reproduction.

10. (b)

11. (b): Microorganisms such as fungi and bacteria are heterotrophic organisms which feed on dead organic matter or detritus. A food chain which begins with dead organic matter is called detritus food chain.

12. (d): In situ (on site) conservation is conservation and protection of the whole ecosystem and its biodiversity at all levels in order to protect the threatened species. Two methods are being used to save biodiversity, hotspots and protected areas. Protected areas include national parks, sanctuaries, biosphere reserves and sacred forests. Zoological parks serve the purpose of ex-situ conservation.

13. (b)

14. (a): Linked genes are those genes which occurs on the same chromosome. Do not show independent assortment hence deviates from the dihybrid ratio of 9:3:3:1.

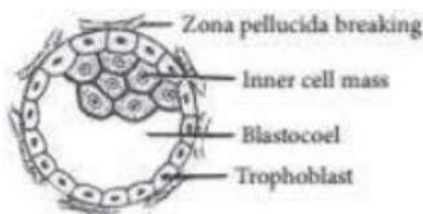
15. (c) Transgenic bacteria have been produced that translate the constituting polypeptide chains of human insulin. These polypeptides can be extracted from the bacterial cells and combined by creating disulphide bonds to produce human insulin. In humans, insulin is produced as a prohormone with three polypeptides A, B and C. After processing the C peptide is removed and mature insulin is formed. When transgenic bacteria are used, instead of producing extra stretch of C peptide, only A and B polypeptides are produced and then linked to produce mature insulin directly.

16. (b) Mycorrhizae refer to the symbiotic association of fungal hyphae with the roots of higher plants. In this association, the two symbionts are in close contact and are physiologically interdependent on each other. Mycorrhizae increase the ability of the plant to extract minerals from the soil. In return, fungi are provided with shelter and products of photosynthesis by the plant. Plants having such associations show other benefits also, such as resistance to root-borne pathogens, tolerance to salinity and drought and an overall increase in plant growth and development.

17. (a) The karyotype shown is of Turner syndrome.

(b) Genotype of the child is  $44 + XO$  i.e.,  $2n = 45$  chromosomes.

18. Blastocyst gets implanted in the uterus. The labelled diagram of blastocysts is as follows:



19. Taq polymerase is a thermostable DNA polymerase isolated from thermophilic bacterium *Thermus aquaticus*. Taq polymerase is heat stable enzyme and is able to withstand high temperature induced denaturation of DNA during PCR hence it is preferred in PCR reactions.

20. Prokaryotic microbes used as biofertilisers comes under taxonomic group Monera. These microbes enrich the nutrient quality of soil. For example, bacteria *Rhizobium* lives in symbiotic association with the roots of leguminous plants. These bacteria fix atmospheric nitrogen into organic forms which is used by plant as nutrient.

21. (a) Alexander von Humboldt studied species- area relationship. He observed that within a region, the species richness increases with increasing area but upto a certain limit.

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

(ii) When the species-area relationship is considered for a very large area like a whole continent, regression coefficient  $Z$  or slope of the line become steeper with  $Z$  values in the range of 0.6-1.2.

(c)  $Z$  stands for regression coefficient.

**OR**

Some ex-situ conservation strategies are:

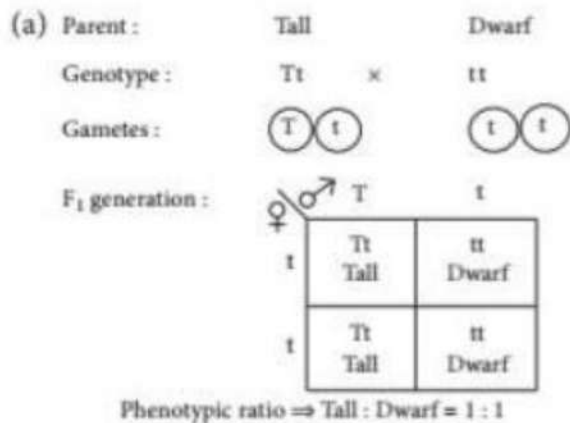
(i) Seed banks: They are used to maintain stocks of viable seeds. Seeds are of two types - orthodox seeds and recalcitrant seeds. Orthodox seeds can tolerate reduction in moisture content (upto 5%), anaerobic conditions and low temperature ( $-10^{\circ}\text{C}$  to  $-20^{\circ}\text{C}$ ), e.g., cereals, legumes. At intervals the seeds are allowed to germinate form plants and develop fresh seeds for storage. Recalcitrant seeds get killed on reduction of moisture and exposure to low temperature, e.g., tea, cocoa, etc. They can be stored for shorter duration after treatment with fungicides in rooms having humid air and normal oxygen.

(ii) Orchards: Plants with recalcitrant seeds are grown in orchards where all possible strains and varieties are maintained.

(iii) Tissue culture: It is carried out through callus formation, embryoids, pollen grains culture, etc. for those plants that are either seedless or where clone is to be maintained. The method is useful in maintaining a large number of genotypes in small area, rapid multiplication of endangered species and hybrid rescue.

22. Two contrasting characters of height are tall and dwarf. In the given cross, if 50% of the progeny shows parental characters, then it must be a cross between a heterozygous tall and a homozygous recessive dwarf parent.





(b) This type of cross is known as test cross.

23. In prokaryotes, DNA lies in the cytoplasm which is supercoiled (coiled and recoiled) with the help of RNAs and non-histone basic proteins like polyamines. DNA being negatively charged is held in place with the help of these proteins that have positive charges in a region termed as nucleoid. The DNA in nucleoid is organised in large loops held by proteins.

24. Plasmids are extra-chromosomal, self replicating, usually circular, double-stranded, DNA molecules found naturally in many bacteria. Plasmid is a boon to biotechnology. It has certain characteristics which make it a good vector in production of human insulin. These are discussed as follows:

- It has specific restriction sites where the enzyme restriction endonucleases make a cut and segment of DNA which codes for human insulin is inserted.
- It has number of origin of replication (ori) where replication starts.
- Recombinant plasmid is introduced into E.coli host cell where it replicates and produces large amount of insulin.

25. (a) It is necessary to conduct such tests on sportspersons because they take various drugs like cocaine/coca alkaloids and cannabinoids to increase their muscle tone and performance in sports.

(b) Cocaine/coca alkaloids and cannabinoids.

(c) Cannabinoids are obtained from Cannabis sativa and cocaine is obtained from Erythroxylum coca.

26. Predators plays an important role in a community:

- They act as conduits for energy transfer across trophic levels.
- Predators keep prey population under control. They are used for biological control of weeds and pests.



- (iii) Predators help in maintaining species diversity.
- (iv) They help in growth of vegetation by controlling population of herbivores.

**OR**

(a) Birth rate refers to per capita births, i.e., average number of individuals produced per unit time. For example, if in a pond there were 20 lotus plants last year and through reproduction 8 new plants are added, then taking the current population to 28, we calculate the birth rate as  $8/20 = 0.4$  offspring per lotus per year.

(b) Other attributes of population which individuals cannot show include -

- (i) Death rate - An individual dies but a population has death rate. It refers to per capita deaths, i.e., average number of individuals that die per unit time.
- (ii) Sex ratio- An individual has sex but a population has sex ratio, i.e., number of females and males per 1000 individuals.

27. (a) In the given figure A is primary follicle, B is tertiary follicle showing antrum and C is Graafian follicle. Anterior lobe of pituitary gland secrete LH and FSH. FSH stimulates the growth of ovarian follicles i.e. from  $A \rightarrow B \Rightarrow C$ .

(b) Hormone secreted by A and B is estrogen.

(c) D in the given figure is corpus luteum. It secretes progesterone which helps in the maintenance of endometrium.

28. Post-pollination events leading to seed formation in angiosperms are as follows:

- (i) After pollination, the pistil recognises the pollen whether it is of the right type (compatible) or of the wrong type (incompatible). Compatible pollens are accepted and germinate on the stigma to produce a pollen tube. Pollen tube grows and reaches the ovary and enters the ovule either through micropyle or chalaza or integuments.
- (ii) The pollen tube bursts open in one of the two synergids to release the two male gametes. One male gamete fuses with the egg to form a diploid zygote or oospore (syngamy). The second male gamete fuses with the diploid secondary nucleus of the central cell to form a primary triploid endosperm nucleus (triple fusion). The whole process is termed as double fertilisation.
- (iii) The primary endosperm nucleus gives rise to endosperm while the zygote develops into embryo.
- (iv) The integuments of fertilised ovule harden to form the seed coat.
- (v) The outer integument becomes hard and forms testa or outer seed coat which ensures survival of seeds.

(vi) The inner integument, if persists, forms the tegmen.

(vii) The micropyle remains in the form of a fine pore on the surface of seed. Funicle is transformed into stalk of the seed. The hilum marks the point of attachment to the stalk. Micropyle facilitates the entry of oxygen and water into the seed.

31. (a) Providing sex education is one of the most effective ways to create a reproductively healthy society because:

(i) It will provide the pre-requisite knowledge to the curious adolescents, which will prevent them from getting misguided.

(ii) It will create awareness about STDs (sexually transmitted diseases) and ways to prevent and cure them.

(iii) It will teach methods of family planning and taking care of a female during pregnancy.

(iv) It will also create awareness about topics such as infertility and different methods of curing the same.

(b) Two indicators of reproductively healthy society are:

(i) Reproductively healthy society does not emphasise on a single sex. In such society, the female and male sex ratio is maintained. Moreover, due to implementation of family planning measures, the population size is under control.

(ii) A reproductively healthy society has fewer incidences of diseases related to reproductive system and few cases of spread of sexually transmitted diseases. Incidences of death of pregnant women or foeticide due to complicated pregnancies are much reduced due to availability of precise health care for pregnant women.

**OR**

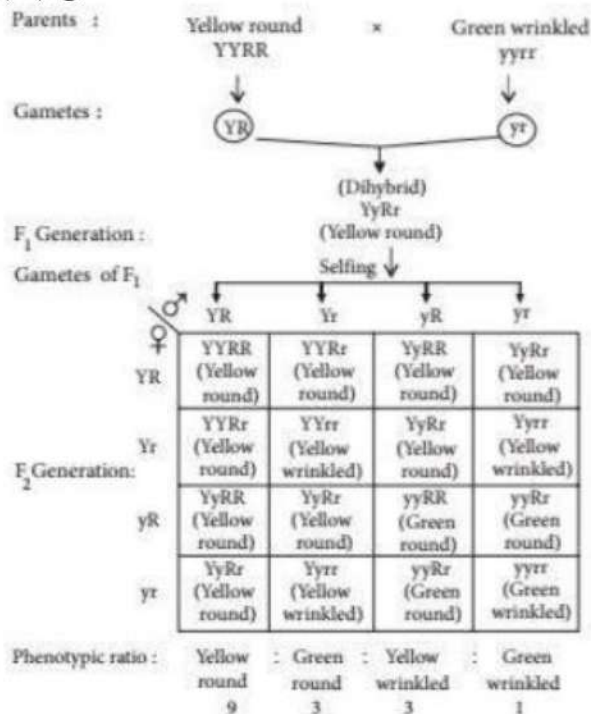
(a) Fertilisation i.e., the fusion of sperm and egg induces the completion of meiotic division of the secondary oocyte.

(b) The ovum released by the ovary is transported to the ampullary-isthmic junction where fertilisation takes place. During fertilisation, a sperm comes in contact with the zona pellucida layer of the ovum and induces changes in the membrane that block the entry of additional sperms. The secretions of the acrosome help the sperm enter into the cytoplasm of the ovum through the zona pellucida and the plasma membrane. This induces the completion of the meiotic division of the secondary oocyte. The second meiotic division is also unequal and results in the formation of a second polar body and haploid ovum (ootid). Soon the haploid nucleus of the sperms and that of the ovum fuse together to form a diploid zygote having 23 pairs of chromosomes. Implantation is the attachment of blastocyst to the uterine wall. It occurs after 7 days of fertilisation. As zygote moves towards the uterus, it undergoes series of mitotic divisions known as cleavage and forms 2, 4, 8 and 16 daughter cells called blastomeres. The

embryo with 8 blastomeres is called morula. The morula transforms into blastocyst. In a blastocyst, the blastomeres are arranged into an outer layer called trophoblast and an inner group of cells called the inner cell mass. The trophoblast then gets attached to the endometrium and the inner cell mass gets differentiated as the embryo. After attachment the uterine cells divide rapidly and cover the blastocyst. As a result, the blastocyst becomes embedded in the endometrium of the uterus. This whole phenomenon is called implantation and it leads to pregnancy.

32. Law of independent assortment states that the allele of two pairs of a trait separate independently of each other during gamete or spore formation and get randomly rearranged in the offspring at the time of fertilisation producing both parental and new combination of traits. This can be explained by the following typical example of Mendelian dihybrid cross. Mendel performed crosses involving two characters (dihybrid crosses) that made to study inheritance of two pairs of genes. The classical example of dihybrid cross given below is the use of two pairs of characters namely the seed colour and seed shape. The plants with yellow and round seeds (pure) were crossed with those having green and wrinkled seeds (pure). The  $F_1$  seeds were yellow and round.  $F_1$  plants were selfed and  $F_2$  seeds obtained which showed all the four possible combinations, i.e.,

- (i) yellow and round seeds,
- (ii) yellow and wrinkled seeds,
- (iii) green and round seeds, and
- (iv) green and wrinkled seeds in 9:3:3:1 ratio. It can be shown by the following cross.





## OR

Tall pea plant with violet coloured flower could have four possible genotypes: TTVV, TtVV, TTVv and TtVv. Case I: Homozygous tall plant with violet colour (homozygous) flower is selfed.

|                  |      |      |    |      |      |
|------------------|------|------|----|------|------|
| Parents:         | TTVV |      | ×  | TTVV |      |
| Gametes:         | TV   | TV   |    | TV   | TV   |
| F <sub>1</sub> : | TV   | TTVV | TV | TTVV | TTVV |

If plant produce all tall plants with violet flowers as offspring, then genotype of plant is TTVV. Case II: Heterozygous tall plant with (homozygous) violet coloured flower is selfed.

|                  |      |             |              |             |      |
|------------------|------|-------------|--------------|-------------|------|
| Parents:         | TtVV |             | ×            | TtVV        |      |
| Gametes:         | TV   | tV          |              | TV          | tV   |
| F <sub>1</sub> : | TV   | TTVV        | tV           | TtVV        | TtVV |
|                  |      | Tall violet |              | Tall violet |      |
|                  | tV   | TtVV        | ttVV         |             |      |
|                  |      | Tall violet | Dwarf violet |             |      |

If plant produces tall plants with violet flowers and dwarf plants with violet flowers in the ratio of 3:1 as offspring, then the genotype of parent is TtVV. Case III: Homozygous tall plant with violet (heterozygous) flower is selfed.

|          |      |             |            |             |      |
|----------|------|-------------|------------|-------------|------|
| Parents: | TTVv |             | ×          | TTVv        |      |
| Gametes: | TV   | Tv          |            | TV          | Tv   |
| Progeny: | TV   | TTVV        | Tv         | TTVv        | TTVv |
|          |      | Tall violet |            | Tall violet |      |
|          | Tv   | TTVv        | TTvv       |             |      |
|          |      | Tall violet | Tall white |             |      |

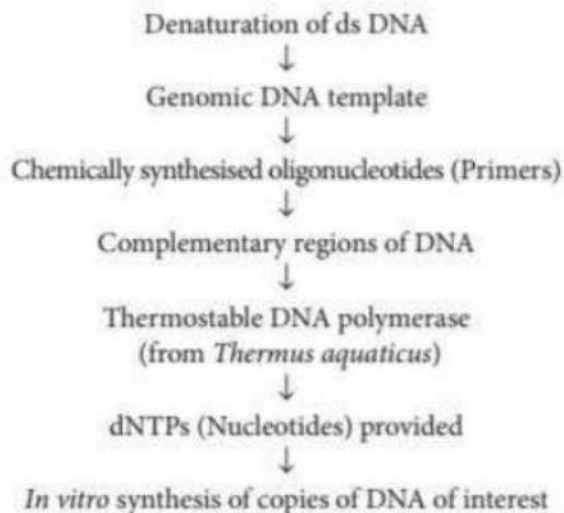
If the plant produces tall plant with violet flower and tall plant with white flower in the ratio of 3: 1 as offspring then the genotype of parent is TTVv. Case IV: Tall plant with violet flower (heterozygous for both the trait) is selfed. If the plant produces tall plant with violet flower and tall plant with white flower in the ratio of 3: 1 as offspring then the genotype of parent is TtVv.

Case IV: Tall plant with violet flower (heterozygous for both the trait) is selfed.

|                  |                     |                     |                      |                      |
|------------------|---------------------|---------------------|----------------------|----------------------|
| Parents :        | TtVv × TtVv         |                     |                      |                      |
| Gametes :        | TV, Tv, tV, tv      |                     |                      |                      |
| F <sub>1</sub> : | TV                  | Tv                  | tV                   | tv                   |
| TV               | TTVV<br>Tall Violet | TTVv<br>Tall Violet | TtVV<br>Tall Violet  | TtVv<br>Tall Violet  |
| Tv               | TtVv<br>Tall Violet | TtVv<br>Tall White  | TtVv<br>Tall Violet  | TtVv<br>Tall White   |
| tV               | TtVv<br>Tall Violet | TtVv<br>Tall Violet | ttVV<br>Dwarf Violet | ttVv<br>Dwarf Violet |
| tv               | TtVv<br>Tall Violet | TtVv<br>Tall White  | ttVv<br>Dwarf Violet | ttvv<br>Dwarf white  |
|                  | Tall violet :<br>9  | Tall white :<br>3   | Dwarf violet :<br>3  | Dwarf white :<br>1   |

If the above given ratio is obtained, then the genotype is TtVv.

33. (a) The two sets of primers (small chemically synthesised oligonucleotides that are complementary to the regions of DNA) are required in each cycle of polymerase chain reaction. Primers hybridise to target DNA region and allow synthesis of the DNA towards one another whereas DNA polymerase synthesise DNA region between the primers using dNTPs and Mg<sup>2+</sup>. Taq DNA polymerase is isolated



(a) The figure E. coli cloning vector pBR322 is as follows:





Origin of replication (ori): This is a sequence from where replication starts and any piece of DNA when linked to this sequence can be made to replicate within the host cells. This sequence is also responsible for controlling the copy number of the linked DNA. So, if one wants to recover many copies of the target DNA it should be cloned in a vector whose origin support high copy number. rop: rop codes for protein involved in the replication of plasmid amp: gene for ampicillin resistance which help in selecting transformants.

(b) Biolistic gene gun helps in the process of gene transfer into the host cell without using a vector. In biolistic method or gene gun method, tungsten or gold particles coated with foreign DNA are bombarded into target cells at a very high velocity. This method is suitable for plants, but is also used to insert genes into animal that promote tissue repair into cells (particularly cancer of mouth) near wounds. It has made great impact in the field of vaccine development.