

Xamidea
Sample Papers Simplified

BIOLOGY–XII

Sample Papers 6 to 15 (Solutions)

SAMPLE PAPER – 6

SECTION—A

1. (b) A—1, B—2, C—3

2. (c) ICSI

3. (b)

(b)	Methionine	UAC
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4. (b) divergent evolution

5. (b) (ii) and (iv)

6. (a) certain types of bacteria

7. (d) methane

8. (c) DNA ligase—biological scissors

9. (a) The population's birth and death rates are both high.

10. (b) 1, 3

11. (c) cobra

12. (c) linear

13. (a) Both A and R are true and R is the correct explanation of A.

14. (d) A is False but R is true.

15. (b) Both A and R are true and R is not the correct explanation of A

16. (b) Both A and R are true and R is not the correct explanation of A

SECTION—B

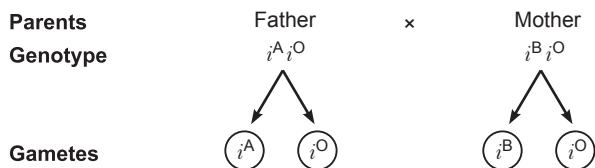
17. After implantation interdigitation of maternal and foetal tissues results in formation of structural and functional unit between embryo and maternal body called placenta.

It facilitates supply of oxygen and nutrients to the embryo, removal of carbon dioxide and excretory material and also acts as an endocrine tissue and produces hormones like HCG, hPL, estrogen, progesterone and relaxin.

18. Father has blood group A so the genotype will be either $i^A i^A / i^A i^O$

Mother has blood group B so the genotype will be either $i^B i^B / i^B i^O$.

Since an offspring has blood group AB, the cross will be:



Now on doing the Punnett square we get (we will get possible combination)

F₁ generation

		i^A	♀	i^O
	i^B	$i^A i^B$ Blood group AB	$i^B i^O$ Blood group B	
♂	i^O	$i^A i^O$ Blood group A	$i^O i^O$ Blood group O	

Now these are four possible combinations of blood groups that the children might inherit from parents that is in this case $i^A i^B$ (AB) and $i^O i^O$ (O) is inherited by each child.

19. The first encounter of the body with the antigens of the disease measles in early childhood leads to development of memory cells. Any subsequent encounter with the same pathogen elicits a highly intensified secondary response. Therefore, the chances of suffering again from the disease are low.

OR

Passive immunity is provided by the mother to the newborn baby.

The yellowish fluid colostrum secreted by mother during the initial days of lactation has abundant antibodies (Ig^A) to protect the infant. Here the baby receives ready-made antibodies directly to protect the body against foreign agents.

20. The result shows that the four types of offspring are in a ratio of 1 : 1 : 1 : 1. Such a result is observed in a test cross progeny of a dihybrid cross.

The cross can be represented as:

Parents: Tall and red (TtRr) × Dwarf and white (ttrr)

Offsprings:

♀	♂	TR	Tr	tR	tr
	tr	TtRr Tall and red	Tttr Tall and white	ttRr Dwarf and red	tttr Dwarf and white

21. (a) Nearly 12 million

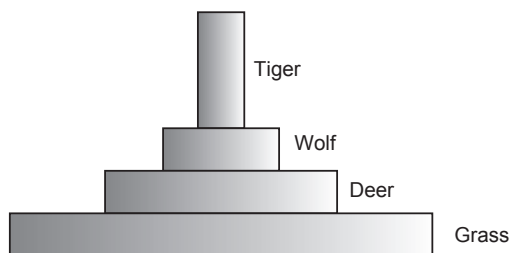
(b) Trophic level

TC (Tertiary consumer)

SC (Secondary consumer)

PC (Primary consumer)

PP (Primary producer)

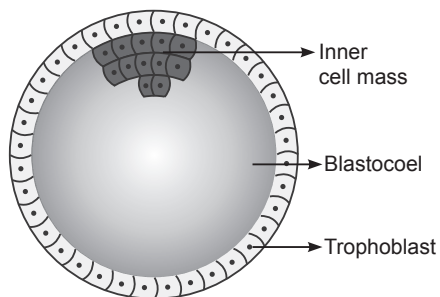


SECTION-C

22. Tapetum develops during microsporogenesis in the microsporangium (anther). It nourishes the developing pollen grains.

Synergids develop during megasporogenesis in the megasporangium (ovule). Synergids have filiform apparatus to guide the pollen tube into it.

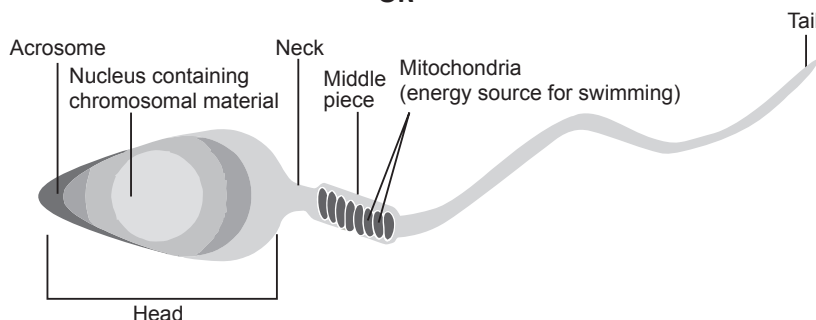
23.



■ Trophoblast helps in implantation or attachment to endometrium.

■ Inner cell mass gets differentiated into an embryo.

OR



(a) **Acrosome:** Contains hydrolytic enzymes that help in dissolving membranes of the ovum for fertilisation.

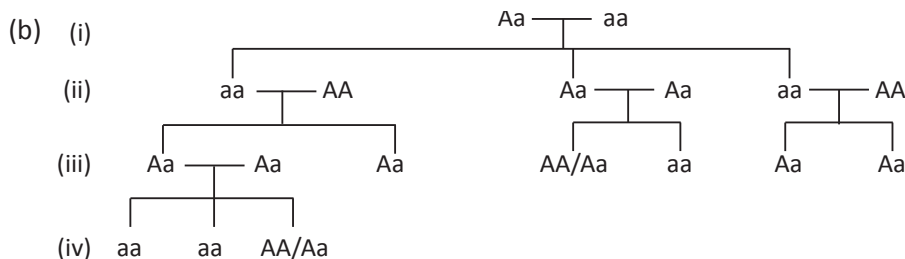
(b) **Nucleus:** Carries genetic material of male.

(c) **Middle piece:** Contains a number of mitochondria that provide energy for the movement of the tail that facilitate sperm motility.

24. (a) Ammonium chloride (NH_4Cl).
 (b) To check if DNA replication was semi-conservative.
 (c) The heavy and light DNA molecules were distinguished by centrifugation in a caesium chloride density gradient.
 (d) The scientists concluded that DNA replicates semi-conservatively.
25. In a diploid if p represents the frequency of allele A and q represents the allele frequency of a , then frequency of AA individuals in a population is p^2 . Similarly of aa is q^2 and of Aa is $2pq$. Hence $p^2 + 2pq + q^2 = 1$. This is a binomial expansion of $(p+q)^2$.
 According to Hardy–Weinberg principle, total genes and their alleles in a population or gene pool remains constant. This is called genetic equilibrium. Sum total of all the allelic frequencies is 1.
26. (a) 'A' is macrophage
 (b) 'B' is viral RNA
 (c) 'C' is reverse transcriptase
27. Plasmids and bacteriophages are natural cloning vectors. Their ability to replicate within bacterial cells and high copy number within the bacterial cells make them cloning vectors. Characteristics engineered vectors are made to possess:
 (a) Easy linking of foreign DNA
 (b) Selection of recombinants from non-recombinants
28. **1. Cryopreservation:** Gametes of threatened species can be preserved in viable and fertile condition for long periods using cryopreservation techniques, eggs can be fertilised *in vitro*.
2. Micropropagation: Plants can be propagated using tissue culture methods.
3. Seed banks: Seeds of different genetic strains of commercially important plants can be kept for long periods in seed banks.

SECTION-D

29. (a) The inheritance exhibited is autosomal recessive.



OR

- (b) There is 25% chance of a child being affected.
- (c) Sickle cell anaemia
30. (a) Leukocytes/Neutrophils/Monocyte/Natural Killer (type of lymphocyte), macrophages.
(Any two)
- (b) Thymus provides micro-environment for the development and maturation of T-lymphocytes. Its degeneration will weaken the immune system so the child will be prone to frequent infections.
- (c) Cytokine barriers provide innate immunity by releasing interferons. These interferons are secreted by virus infected cells and protect the non-infected cells from further viral infection.

OR

- (c) Active immune response.

SECTION–E

31. ■ The process of fusion of a sperm with an ovum is called fertilisation.
- The mitotic division starts as the zygote moves through the isthmus of the oviduct, called cleavage, towards the uterus and forms 2, 4, 8, 16 daughter cells called blastomeres.
 - The embryo with 8 to 16 blastomeres is called a morula.
 - The morula continues to divide and transforms into blastocyst as it moves further into the uterus.
 - The blastomeres in the blastocyst are arranged into an outer layer called trophoblast and an inner group of cells attached to trophoblast called the inner cell mass.
 - The trophoblast layer then gets attached to the endometrium and the inner cell mass gets differentiated as the embryo.
 - After attachment, the uterine cells divide rapidly and covers the blastocyst. As a result, the blastocyst becomes embedded in the endometrium of the uterus. This is called implantation and it leads to pregnancy.

OR

- (a) Spermatogenesis occurs in the seminiferous tubules.

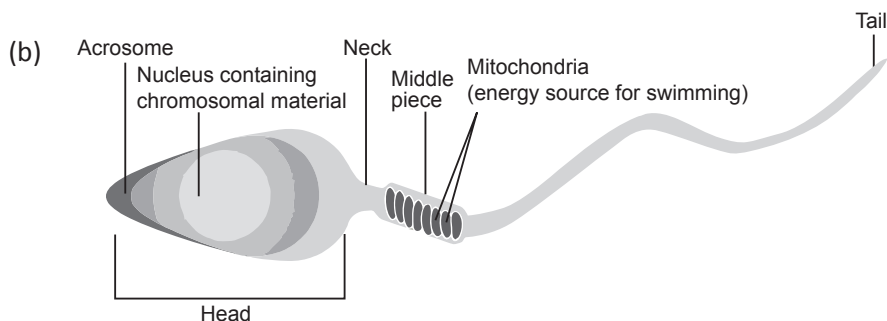
The process of formation of spermatozoa (sperms) from diploid spermatogonia is called spermatogenesis.

It includes the following phases:

- (i) **Multiplication phase:** The male germ cells (spermatogonia) present on the inside wall of seminiferous tubules multiply by mitotic division and increase in numbers.
- (ii) **Growth phase:** Spermatogonia grow and increase in size and form primary spermatocytes. Each spermatogonium is diploid and contains 46 chromosomes.

(iii) Maturation phase or formation of spermatids: Some of the spermatogonia called primary spermatocytes periodically undergo meiosis. A primary spermatocyte completes the first meiotic division (reduction division) leading to formation of two equal haploid cells called secondary spermatocytes, which have only 23 chromosomes each. The secondary spermatocytes undergo the second meiotic division to produce four equal haploid spermatids.

(iv) Differentiation phase: The spermatids are transformed into spermatozoa (sperms) by the process of spermiogenesis. After spermiogenesis, the sperm's head gets attached to Sertoli cells to draw nourishment and are finally released from the seminiferous tubules by the process called spermiation.



32. Methodology and Technique

- DNA is isolated and extracted from the cell or tissue by centrifugation.
- By the process of polymerase chain reaction (PCR), many copies are produced. This step is called amplification.
- DNA is cut into small fragments by treating with restriction endonucleases.
- DNA fragments are separated by agarose gel electrophoresis.
- The separated DNA fragments are visualised under ultraviolet radiation after applying suitable dye.
- The DNA is transferred from electrophoresis plate to nitrocellulose or nylon membrane sheet. This is called Southern blotting.
- VNTR probes are now added which bind to specific nucleotide sequences that are complementary to them. This is called hybridisation.
- The hybridised DNA fragments are detected by autoradiography. They are observed as dark bands on X-ray film.
- These bands being of different sizes, give a characteristic pattern for an individual DNA. It differs from individual to individual except in case of monozygotic (identical) twins.

On comparing the DNA prints of blood samples A and B, it can be confirmed that the blood sample picked up from the crime scene belongs to the same individual or to two different individuals by matching the position and thickness of the bands.

OR

- (a) *i* gene is the regulatory gene and codes of repressor which acts as inhibitor as inhibits the transcription of structural genes.

The repressor of the operon is synthesised from the *i* gene. The repressor protein in the absence of an inducer (lactose or allolactose) binds to the operator region of the operon and prevents RNA polymerase from transcribing the structural genes. Thus 'switching off' the operon.

- (b) Regulation by *lac* operon is referred to as negative regulation because the repressor binds to the operator for 'switching off' the operon.
- (c) Lactose or allolactose acts as an inducer. Gene *z* codes for β -galactosidase (*gal*) enzyme which breaks lactose into galactose and glucose. Gene *y* codes for permease, which increases the permeability of the cell to lactose.
33. (a) It is a transgenic variety of cotton which contains a foreign gene obtained from bacterium *Bacillus thuringiensis*.
- (b) The inactive Bt toxins is converted into an active protein due to alkaline pH of the gut of the bollworm. The toxin binds to midgut cells and create pores on the surface. This causes cell swelling and lysis that kills the bollworm.
- (c) *CryIAb* provides resistance to corn plants and *CryIAc* and *CryIIAb* provide resistance to cotton plants.
- (d) Bt toxin exist as inactive protoxin in the bacterium. It becomes active only when it enters the gut of insect due to the alkaline pH of the gut which solubilise the crystals.

OR

- (a) Two short polypeptide chains of insulin are linked together by disulphide bridges.
- (b) C-peptide (extra stretch of polypeptide) makes the insulin inactive.
- (c) An extra stretch called C-peptide is removed from pro-insulin during maturation.
- (d) (i) Insulin being a hormone is produced in very little amounts in the body. Hence, a large number of animals need to be sacrificed for obtaining small quantities of insulin. This makes the cost of insulin very high, demand being manifold higher than supply.
- (ii) Slaughtering of animal is also not ethical.
- (iii) There is potential of immune response in humans against the administered insulin which is derived from animals.
- (iv) There is possibility of slaughtered animals being infested with some infectious micro-organism which may contaminate insulin.



SAMPLE PAPER – 7

SECTION–A

- (d) (i), (ii), (iii) and (iv)
- (c) A—(iii), B—(i), C—(iv), D—(ii)
- (a) probes
- (a) Oparin and Haldane
- (d) A—(iii), B—(iv), C—(ii), D—(i)
- (b) Widal test
- (b) Cyclosporin A
- (a) Human gene may have intron which bacteria cannot process
- (b) Stable population
- (b) Frog—secondary consumer
- (c) Gaseous nutrient cycle Carbon and Nitrogen
Sedimentary nutrient cycle Sulphur and Phosphorus
- (a) move away from equator to poles
- (d) A is False but R is true
- (a) Both A and R are true and R is the correct explanation of A.
- (d) A is False but R is true.
- (c) A is true but R is false

SECTION–B

- The three hormones produced in women only during pregnancy are:
 - Human chorionic gonadotropin (hCG)
 - Human placental lactogen (hPL)
 - RelaxinThe levels of progesterone and estrogen increase during pregnancy.
- (a) Haemophilia is sex-linked because it shows transmission from unaffected carrier female to some of the male progeny.
(b) Haemophilia is caused by 'X'-linked gene because the heterozygous female for haemophilia may transmit the disease to sons. It appears more in males because of only one X chromosome.
- The response is called allergy.
It is due to substances called allergens like dust, pollen, mites, etc.

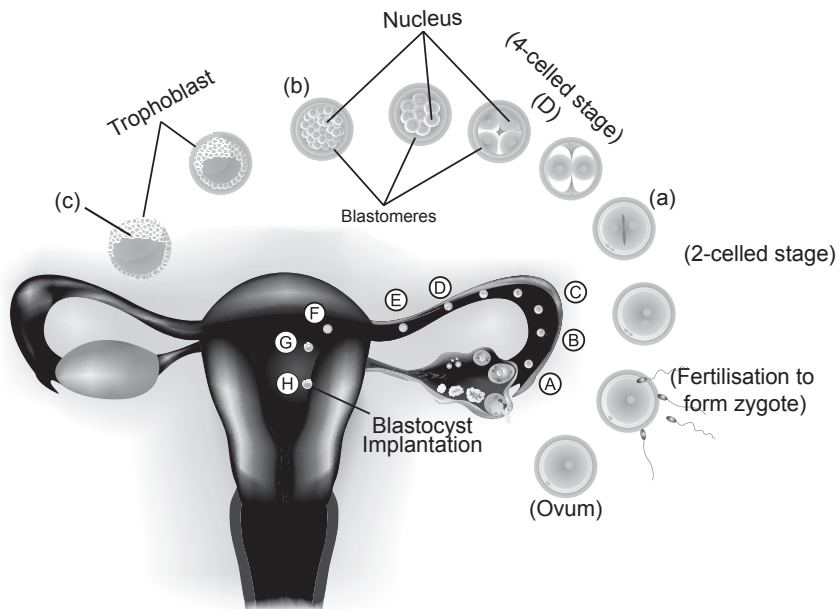
OR

- (a) *Streptococcus*
- (b) Fungus
- (c) Cyclosporin A
- (d) *Clostridium butylicum*

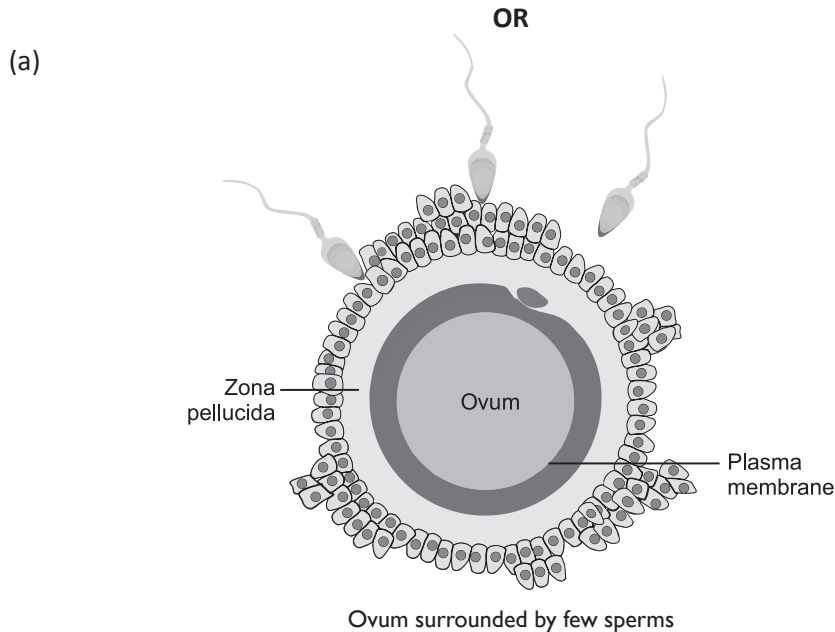
20. *EcoRI* comes from *Escherichia coli* RY 13. In *EcoRI*, the letter 'R' is derived from the name of strain. Roman numbers following the names indicate the order in which the enzymes were isolated from that strain of bacteria.
21. Microbes are referred to as heterotrophs and saprotrophs. They fulfil their energy requirement by feeding on dead remains of plants and animals through the process of decomposition.

SECTION-C

22. (a) **Germ pore:** Exine of pollen grain. It is the site from where pollen tube emerges.
(b) **Sporopollenin:** Exine of pollen grains. It protects the pollen grains from high temperature, strong acids and alkali, enzymes and adverse conditions.
(c) **Generative cell:** These are present in pollen grains. These give rise to two male gametes.
- 23.

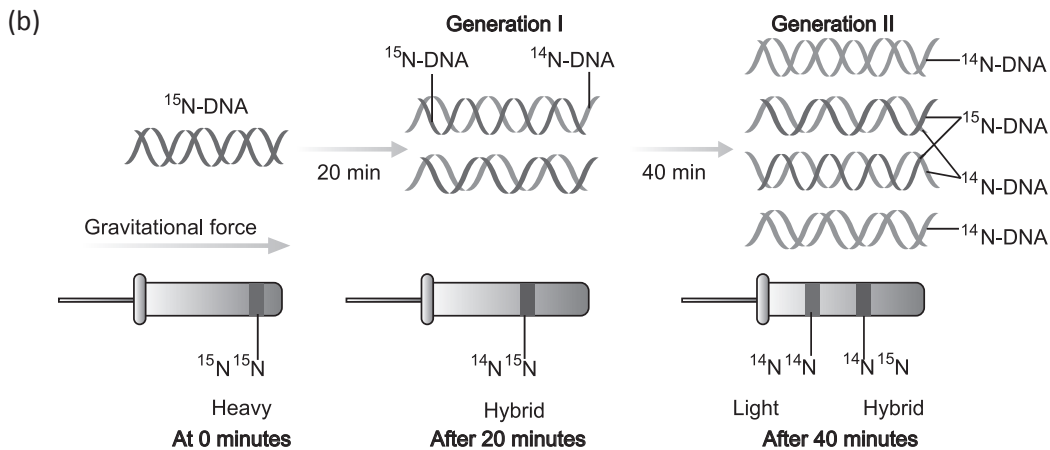


Transport of ovum, fertilisation and passage of growing embryo through fallopian tube



(b) Zona pellucida allows the entry of one sperm into the cytoplasm of the ovum and then undergoes changes to prevent entry of additional sperms.

24. (a) Centrifugation in a CsCl density gradient.



25. A colony of bacteria (say A) growing in a given medium has built in variation in terms of ability to utilise a feed component, a change in the medium composition would bring out only that part of the population (say B) that can survive under the new conditions.

In due course of time this variant population outgrows the others and appears as new species, thus organisms with shorter life-cycle or life-span will undergo evolution faster. For the same thing to happen in fish or fowl it would take millions of years as life spans of these animals are in years.

26. (a) Since DNA fragments are negatively charged molecules they move towards the anode (positive rod) under an electric field through a medium/matrix.
 (b) Agarose gel.
 (c) The separated DNA fragments can be visualised only after staining the DNA with ethidium bromide followed by exposure to UV radiation. It is visible as orange coloured bands.

27. Example of Alien species invasion

(Any one)

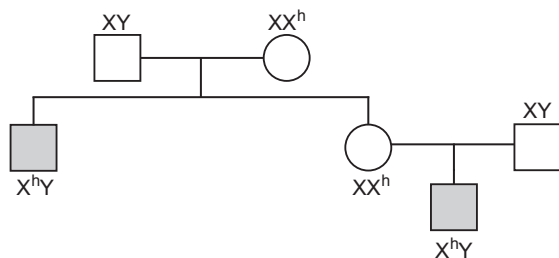
- (a) Nile Perch was introduced into lake Victoria in East Africa. This led to extinction of more than 200 species of Cichlid fish in the lake.
 (b) Introduction of African cat fish, *Clarias gariepinus*, for aquaculture posed threat to indigenous cat fish.
 (c) Introduction of carrot grass, *Parthenium* is an invasive weed that posed threat to native species.

Other causes for biodiversity loss:

- (a) Habitat loss and fragmentation
 (b) Over-exploitation
 (c) Co-extinction
28. The condition is called allergy. Mast cells are responsible for such reactions. To avoid such reactions following precautions must be taken.
 (a) Use of drugs like antihistamine, adrenaline and steroids quickly reduces the symptoms.
 (b) Avoid contact with substances to which a person is hypersensitive.

SECTION-D

29. (a)



(b) Sex-linked recessive inheritance pattern.

OR

Haemophilia is a sex-linked recessive disorder. The females have XX chromosomes and the males have XY chromosomes. If one of the two X chromosomes is normal, she remains a carrier and not diseased. Female will be haemophilic only when both the X chromosomes carry the haemophilia gene and this is possible only when the mother is a carrier and father is haemophilic.

Haemophilic patients suffer from non-stop bleeding and no clotting in case of injury.

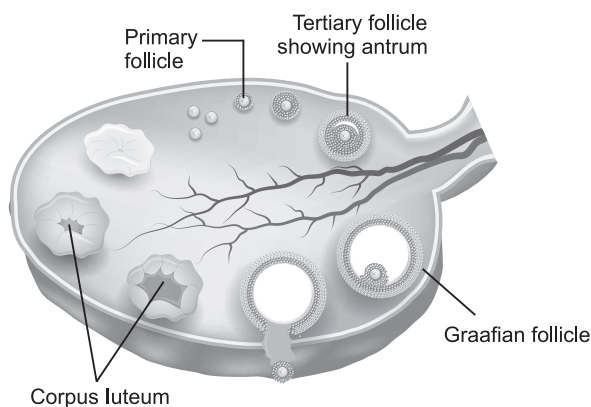
30. (a) The boy when encounters a pathogen for the first time, his body produces antibodies that results in the memory of the first encounter, to protect the body in future.
 (b) This is because of presence of antibodies developed during primary.
 (c) The exaggerated response of the immune systems to certain antigens (allergens) present in the environment is the cause of this type of response.

OR

- (c) B cells

SECTION-E

31. (a)



- (b) The gonadotropins are luteinizing hormone (LH) and follicle stimulating hormone (FSH). Both LH and FSH increase during follicular phase and stimulate follicular development and secretion of estrogen by the growing follicles. There is rapid secretion of LH (LH surge) during middle of the cycle. On 14th day these induce rupture of Graafian follicle and the ova is released.

OR

Fertilisation takes place in ampullary-isthmic junction.

- The mitotic division starts as the zygote moves through the isthmus of the oviduct called cleavage towards the uterus and forms 2, 4, 8, 16 daughter cells called blastomeres.
- The embryo with 8 to 16 blastomeres is called a morula.
- The morula continues to divide and transforms into blastocyst as it moves further into the uterus. The blastomeres in the blastocyst are arranged into an outer layer called trophoblast and an inner group of cells attached to trophoblast called the inner cell mass.
- The trophoblast layer then gets attached to the endometrium and the inner cell mass gets differentiated as the embryo. After attachment, the uterine cells divide rapidly and covers the blastocyst. As a result, the blastocyst becomes embedded in the endometrium of the uterus This is called implantation and it leads to pregnancy.

32. (a) The shaded portions are introns and unshaded portions are exons.
- (b) The primary RNA contains both introns and exons. By the mechanism of splicing, introns are removed and exons are joined to form functional *mRNA* after capping and tailing. Gene expression is the process by which the information encoded in a gene is turned into a function. This mostly occurs via the transcription of RNA molecules that code for proteins or non-coding RNA molecules that serve other functions.
- (c) In prokaryotes, the structural gene is continuous and is not differentiated into exons and introns unlike eukaryotes. In prokaryotes, transcription is followed by translation without RNA splicing mechanism.

OR

- (a) The molecule 'X' is repressor. It gets inactivated when lactose (inducer) binds with the repressor molecule.
- (b) *z* gene codes for β -galactosidase.
- (c) Transcription of the gene stops when lactose is absent and thus repressor is free to bind with the operator.
- (d) In the complete absence of expression of *lac* operon, permease will not be synthesised which is essential for transport of lactose from medium into the cells. And if lactose cannot be transported into the cell, then it cannot act as inducer. Hence, cannot relieve the *lac* operon from its repressed state. Therefore, *lac* operon is always expressed.
33. Some strains of *Bacillus thuringiensis* produce proteins that kill some insects like lepidopterans (tobacco budworm, armyworm), coleopterans (beetles) and dipterans (flies, mosquitoes). *B. thuringiensis* forms protein crystals which contain a toxic insecticidal protein. Bt toxins are initially inactive protoxins but after ingestion by the insect their inactive toxin becomes active due to the alkaline pH of the gut, which solubilises the crystals. The activated toxin binds to the surface of midgut epithelial cells thus creating pores which causes cell swelling and lysis, further leading to death of the insects.

Specific Bt toxin genes obtained from *Bacillus thuringiensis* are used in several crop plants like cotton. The toxin is coded by a gene called *cry* which is of various types. For example, proteins encoded by the genes *cryIAc* and *cryIAb* control the cotton bollworms and that of *cryIIAb* control corn borer.

Bt tobacco was first cultured to kill hornworm (*Manduca sexta*).

OR

- (a) Earlier, insulin was extracted from pancreas of slaughtered cattle and pig. This insulin is not in use as some patients developed allergic reaction to this foreign protein.
- (b) Eli Lilly used the following procedure for insulin synthesis:
- Two DNA sequences corresponding to A and B chains of insulin were prepared.
 - These sequences were then introduced in plasmids of *E. coli*.
 - The two insulin chains are produced separately.

- (iv) The two chains are extracted and combined by creating disulphide bonds to form the assembled mature molecule of insulin.
- (c) The pro-hormone produced in the human body has an extra stretch of C-peptide.



SAMPLE PAPER – 8

SECTION–A

1. (a) (i) and (iv)
2. (d) Glutamic acid is substituted by valine in the β -globin chain at the sixth position.
3. (b)

(b)	Thalassemia—an autosome linked recessive blood disorder	Sickle cell anaemia—an autosome linked recessive trait
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4. (c) (i) Promoter site, (ii) Sigma factor (iii) RNA polymerase
5. (c) 40,000 bp and $13,600 \times 10^{-9}$ m
6. (c) Weismann – Theory of continuity of germplasm.
7. (d) homologous organs.
8. (d) (A) Morphine *Papaver somniferum* Sedative and pain killer
9. (c) the patient shows behavioural and social maladjustment
10. (d) *amp'*–, *tet*^R-antibiotic resistance genes
11. (c) *Bacillus thuringiensis* – insecticide
12. (d) IgG
13. (c) A is true but R is false.
14. (b) Both A and R are true and R is not the correct explanation of A.
15. (b) Both A and R are true and R is not the correct explanation of A.
16. (c) A is true but R is false

SECTION–B

17. (i) *a* = Endothecium, *b* = Middle layers, *c* = Tapetum
 (ii) Tapetum provides nourishment to the developing pollen grains. The tapetal cells also secrete Ubisch granules that provide sporopollenin and other materials for exine formation.
18. The milk produced during the initial few days of lactation is called colostrum. It contains several antibodies (IgA) absolutely essential, to develop passive immunity in the new-born babies. It also contains nutrients such as calcium, fats, lactose. Breast feeding also develops a bond between mother and child.

OR

The three hormones produced in women only during pregnancy are:

- (a) Human chorionic gonadotropin (hCG)
- (b) Human placental lactogen (hPL)
- (c) Relaxin

The levels of progesterone and estrogen increase during pregnancy.

- 19.** RNA is more labile and prone to degradation (owing to the presence of 2'-OH group in its ribose).

Hence heat-killed S-strain may not have retained its ability to transform the R-strain.

- 20.** The two types of immunity a human baby is born with are innate and passive/acquired immunity.

Innate immunity is a non-specific type of defence that provides barrier to the entry of antigens.

Passive immunity is a pathogen-specific type of defence in which readymade antibodies are directly given to protect body against foreign agents. The foetus receives antibodies through the placenta.

- 21.** (a) Exonuclease removes nucleotides from the ends of DNA whereas endonuclease cuts at specific positions within DNA at specific positions.
- (b) Restriction endonuclease recognises and cuts specific palindromic nucleotide sequences in the DNA.

SECTION-C

- 22.** (a) A—Morula; B—Blastocyst
C—Inner cell mass; D—Trophoblast

(b) The trophoblast layer gets attached to the endometrium and the inner cell mass gets differentiated as the embryo.

- 23.** (a) The four major causes of increasing population are:

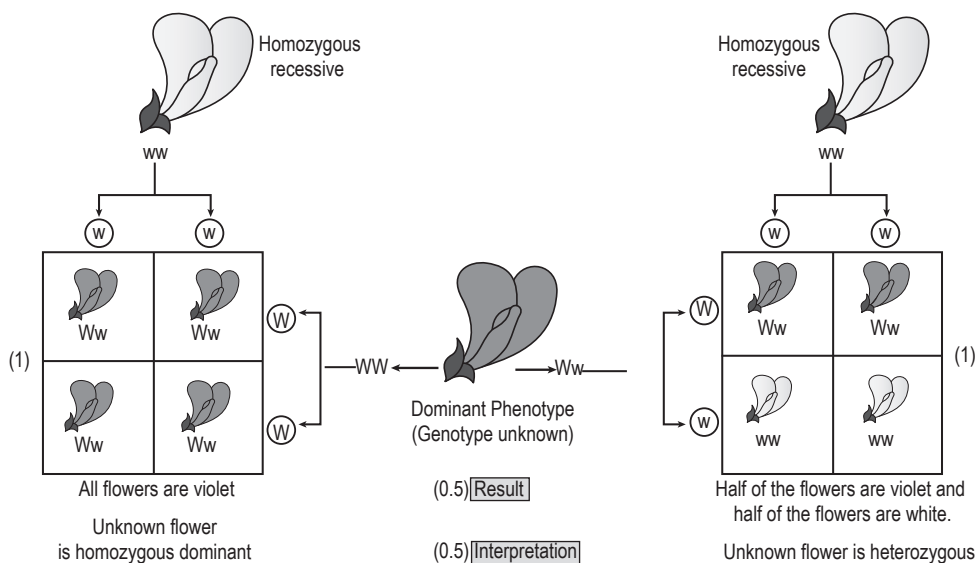
- (i) Immigration
- (ii) Illiteracy
- (iii) Resource (food and space) availability
- (iv) Early marriages

(b) The most common methods to control population explosion is

- (i) to encourage small families about different control measures such as contraceptives.
- (ii) people need to be educated about the consequences of having too many children.



24. The genotype of the pea plant can be found out by test cross.



25. Disturbance in Hardy-Weinberg equilibrium is an indicator of change of frequency of allele in a population, resulting in evolution.

It is caused by any of the following factors:

- Genetic drift
- Gene flow or gene migration
- Mutation
- Genetic recombinations
- Natural selection

OR

The nature builds some pressure on the population of a species and as a result few individuals are eliminated and few adapt to adjust with changes and become fit. This biological phenomenon is called natural selection.

Differences between natural selection and artificial selection

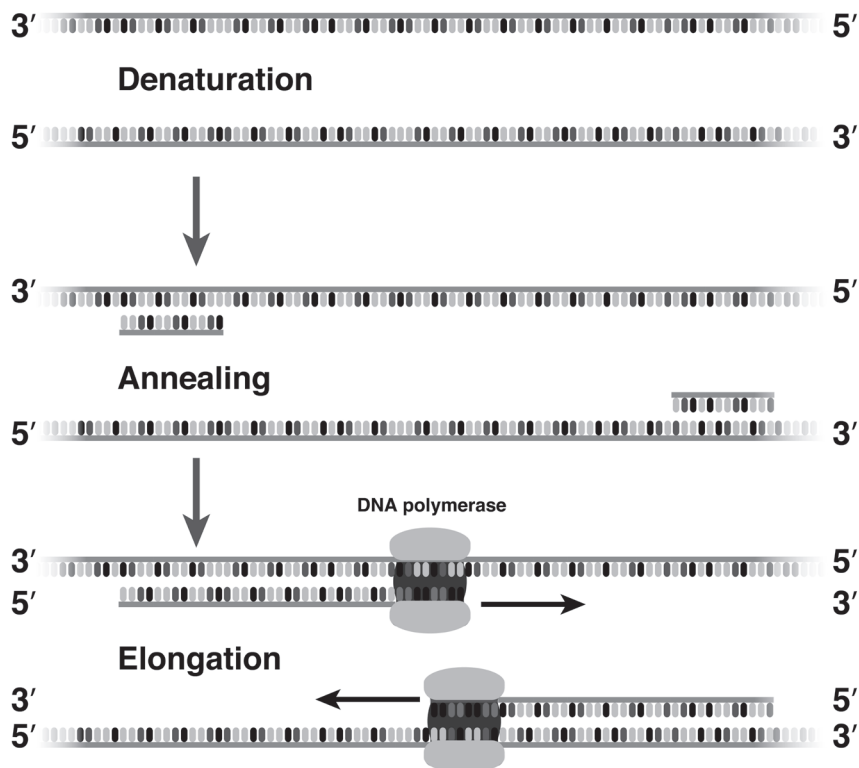
S. No.	Natural selection	Artificial selection
(a)	It is a natural phenomenon.	It is the practice done by man.
(b)	As a result only fit individuals increase in a population.	As a result commercially high yielding and disease resistance varieties increase.

Artificial selection have been operated in the followings cases:

Plants: Cabbage, wheat.

Animals: High milk yielding varieties of cows.

26. • Flocs are masses of semi - decayed organic matter along with decomposer microbes which are surrounded by slime. They separate the organic matter from waste water.
- Flocs settle down in secondary tanks and take part in the formation of sludge.
 - They can be used as inoculum in biological treatment of waste water as well as source of biogas and manure.
27. (a) RT-PCR stands for Real Time-Polymerase Chain Reaction/Reverse Transcriptase-Polymerase Chain Reaction.
- (b) There are three steps in PCR:
- Denaturation: DNA strands are separated by heating.
 - Annealing: Two primers are joined to complementary region of DNA,
 - Extension: Using thermostable DNA Polymerase or Taq Polymerase deoxynucleotides are added to the primers.
- (The process is repeated many times/amplification)



28. Preparation of two DNA sequences corresponding to A, and B chains of human insulin (using rDNA technology)



Introduction in plasmids of *E.coli*.



Chain A and B were separately produced



Chain A and B were extracted



Both chains were combined by creating di-sulphide bonds to form human insulin.

(Same marking to be followed when explained with the help of Storyboard.)

SECTION-D

29. (a) Seminal analysis is done for determining the sperm morphology, sperm count, quantity of semen and pH of semen.

(b) Low FSH value indicates low rate of formation of ovarian follicles.

(c) Follicular phase

OR

(c) Progesterone

30. L : Conformers,

M : Regulators

(a) To regulate the body temperature – M/Regulators

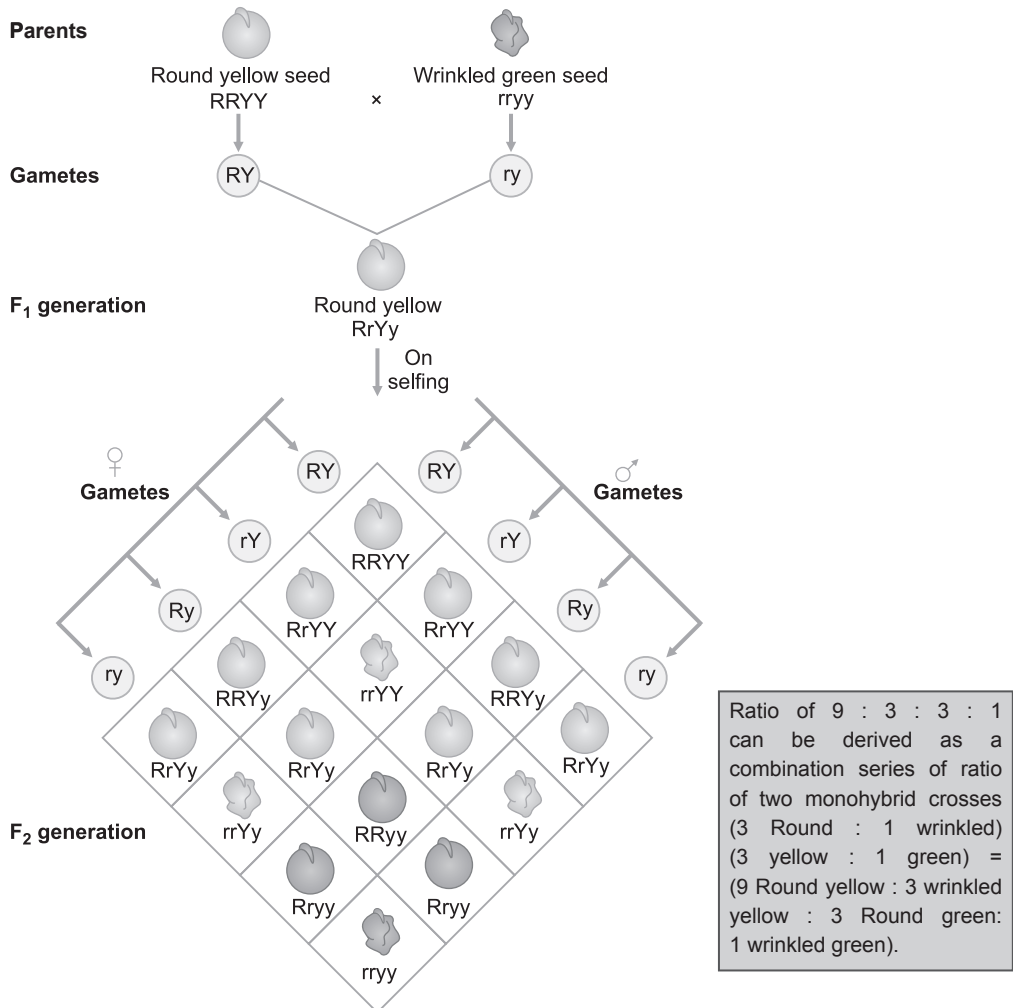
(b) To keep their body temperature constant by behavioural response for coping with variations in environment– L/Conformers

OR

(b) To avoid the stress in environment by escaping in time - N/Suspenders

SECTION-E

31.



Phenotypic ratio— Round yellow : Round green : Wrinkled yellow : Wrinkled green
9 : 3 : 3 : 1

Genotypic ratio— 1 : 2 : 2 : 4 : 1 : 2 : 1 : 2 : 1

Fig. Results of a dihybrid cross where the two parents differed in two pairs of contrasting traits: seed colour and seed shape

- (a) Phenotype of F₁-progeny: Round seeds that are yellow in colour
- (b) Genotype of F₁-progeny: RrYy
- (c) Gamete genotypes of F₁-progeny: RY, Ry, rY and ry
- (d) Phenotypic ratio of F₂ population: 9 : 3 : 3 : 1.

Nine round-yellow seeds; three round-green seeds; three wrinkled-yellow seeds; one wrinkled-green seed.

(e) Phenotypic ratio of yellow seed to green seed and round seed to wrinkled seed in F_2 population:

Yellow seed to green seed = 3 : 1

Round seed to wrinkled seed = 3 : 1

OR

(a) The three different allelic forms are: $I^A, I^B, I^O/i$.

The alleles which are able to express themselves independently, even when present together are called co-dominant alleles and this biological phenomenon is called co-dominance.

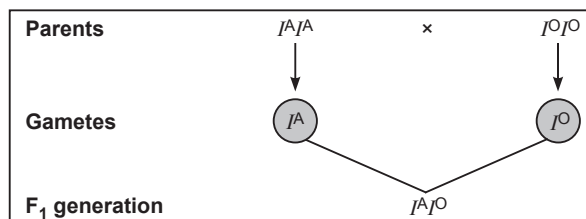
For example, ABO blood grouping in humans.

- ABO blood groups are controlled by gene I . Gene I has three alleles I^A, I^B and I^O/i .
- I^A and I^B produce RBC surface antigens which are sugar polymers A and B, respectively, whereas i does not produce any antigen.
- I^A and I^B are dominant over i hence I^A and I^B are dominant alleles and i is recessive allele as in $I^A i$ and $I^B i$.
- When I^A and I^B are present together, both express equally and produce both the surface antigens A and B, hence show co-dominance.
- Since humans are diploid, each person possesses any two of the three ' I ' gene alleles, resulting into six different genotypic combinations and four phenotypic expressions.

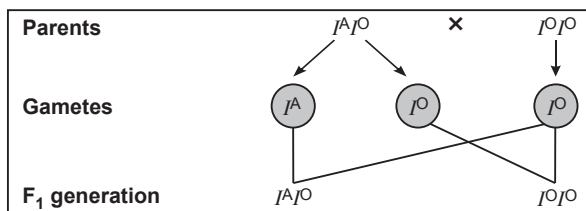
Genetic basis of blood groups in human population

Allele from Parent 1	Allele from Parent 2	Genotype of offspring	Blood groups of offspring	Antigen present	Antibody
I^A	I^A	$I^A I^A$	A	A	B
I^A	I^B	$I^A I^B$	AB	A and B	No antibody
I^A	i	$I^A i$	A	A	B
I^B	I^B	$I^B I^B$	B	B	A
I^B	i	$I^B i$	B	B	A
i	i	$i i$	O	No antigen	Both A and B

(b) (i) Yes; when both the parent are homozygous.



(ii) Yes; when the woman is heterozygous.



32. Disease: Cancer

Probable Causes: Physical/ Environmental- Exposure to X – rays/ gamma rays/ UV rays;

Chemicals–Nicotine in tobacco/ other carcinogens

Biological– Viral oncogenes/ Mutations

Detection and diagnosis:

1. Cancer detection is based on biopsy and histopathological studies of the tissue; blood and bone marrow tests for increased cell counts in the case of leukemias. In biopsy, a piece of the suspected tissue cut into thin sections is stained and examined under microscope (histopathological studies) by a pathologist.
2. Techniques like radiography (use of X-rays), CT (computed tomography) and MRI (magnetic resonance imaging) are very useful to detect cancers of the internal organs. Computed tomography uses X-rays to generate a three dimensional image of the internals of an object. MRI uses strong magnetic fields and non-ionising radiations to accurately detect pathological and physiological changes in the living tissue.
3. Antibodies against cancer-specific antigens are also used for detection of certain cancers.
4. Techniques of molecular biology can be applied to detect genes in individuals with inherited susceptibility to certain cancers. (*any three methods*)

OR

Disease : AIDS (Acquired Immuno Deficiency Syndrome)

Pathogen : Human Immuno deficiency virus (HIV).

Reason : Due to decrease in the number of helper T-lymphocytes, the person starts suffering from infections that could have been otherwise overcome such as those due to bacteria especially *Mycobacterium*, viruses, fungi and even parasites like *Toxoplasma*.

The path of this pathogen and its spread and effect on the human body:

- After getting into the body of the person, the virus enters into macrophages where RNA genome of the virus replicates to form viral DNA with the help of the enzyme reverse transcriptase.
- This viral DNA gets incorporated into host cell's DNA and directs the infected cells to produce virus particles.

- The macrophages continue to produce virus and in this way acts like a HIV factory.
- Simultaneously, HIV enters into helper T-lymphocytes (TH), replicates and produce progeny viruses.
- The progeny viruses released in the blood attack other helper T-lymphocytes. This is repeated leading to a progressive decrease in the number of helper T lymphocytes in the body of the infected person.
- During this period, the person suffers from bouts of fever, diarrhoea and weight loss.

33. (a) (i) a is $S = CA^Z$

b is $\log S = \log C + Z \log A$

(ii) Slope is Z (regression coefficient). Its normal value ranges from 0.6 to 1.2.

(iii) In frugivorous birds and mammals, value of $Z = 1.15$

(b) Reasons for greater diversity of animals are:

(i) Animals are mobile and can avoid predator or unfavourable event.

(ii) Well developed nervous system to receive stimuli against external factors and respond to them.

OR

(a) The graph Y depicts the tropical region as there is not much temperature variation and temperature is high. The graph X shows temperate region as temperature changes with season.

(b) Region Y (tropical) will have greater biodiversity because of less variation in temperature and more rainfall.

(c) (i) Yes, India has greater ecosystem diversity than Norway because of following reasons.

	India (Tropical Region)	Norway (Temperate Region)
1.	This region is less seasonal and the seasons are more constant.	This region is more seasonal and the seasons are less constant.
2.	Species diversity increases as we move towards equator.	Species diversity decreases as we move away from equator.
3.	The climate in this region promotes niche specialisation resulting in greater biodiversity.	The climate in this region do not promote niche specialisation resulting in lower biodiversity.

(ii) Genetic diversity refers to the variation within a species over its distributional range.

Species diversity refers to the variation at a species level.



SAMPLE PAPER – 9

SECTION–A

1. (c)

(c)	Blastocyst	Fertilised egg	Unfertilised egg
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2. (d) Deviation from 9 : 3 : 3 : 1 ratio because of linkage of genes
3. (d) (i), (ii) and (iv)
4. (d) (i)-continuous synthesis, (ii)-discontinuous synthesis, (iii)-3' end, (iv)-5'end
5. (d) 0 : 1 : 31
6. (b) (A) — (i) convergent, (B) — (i) oxygen, (ii) nucleosides
7. (b) both the extreme forms of a trait
8. (a) A—(iv), B—(iii), C—(ii), D—(i)
9. (a) Physiological barriers
10. (a) Algae — Methylase
11. (a) When a piece of RNA that is complementary in sequence is used to stop expression of a specific gene.
12. (b) bollworms
13. (a) Both A and R are true and R is the correct explanation of A.
14. (a) Both A and R are true and R is the correct explanation of A.
15. (a) Both A and R are true and R is the correct explanation of A.
16. (a) Both A and R are true and R is the correct explanation of A.

SECTION–B

17. In apple only the thalamus (along with ovary) portion contributes to fruit formation. Therefore, it is a false fruit. Mango develops only from the ovary, therefore it is a true fruit. Banana develops from ovary but without fertilisation. The method is known as parthenocarpy. Since there is no fertilisation, no seeds are formed in banana.
18. The secretion of the acrosome help the sperm enter into the cytoplasm of ovum through zona pellucida and the plasma membrane. This induce the completion of second meiotic division of the secondary oocyte, forming second polar body and a haploid ovum. Soon the haploid nucleus of the sperm and that of the ovum fuse together to form a diploid zygote.
19. According to Chargaff's rule

$$\frac{A}{G} = \frac{T}{G} = 1$$

G = C, G = 410, hence C = 410

$$\begin{aligned} G + C &= 410 + 410 \\ &= 820 \end{aligned}$$

$$\begin{aligned}
 \text{So,} \quad A + T &= 1500 - 820 \\
 &= 680 \\
 \text{As, } A = T, \text{ So} \quad T &= \frac{680}{2} = 340 \\
 \text{So,} \quad \text{Pyrimidines} &= C + T \\
 &= 410 + 340 = 750
 \end{aligned}$$

OR

Since RNA was unstable and prone to mutations, DNA evolved from RNA with chemical modifications that makes it more stable.

DNA has double stranded nature and has complementary strands. These further resist changes by evolving a process of repair.

20. Lymph nodes trap microorganisms or other antigens. These trapped antigens activate lymphocytes present in the lymph and cause an immune response.
21. The experiment will not likely be affected as recombinant DNA molecule is circular and closed, with no free ends. Hence, it will not be a substrate for exonuclease enzyme which removes nucleotides from the free ends of DNA.

SECTION-C

22. (a) Since reproductive process such as pollination and fertilisation are independent of water, seed formation is more dependable.
- (b) Seeds have better adaptive strategies for dispersal to new habitats and help the species to colonise in other areas.
- (c) As they have sufficient food reserves young seedlings are nourished until they are capable of photosynthesis on their own.
- (d) The hard seed coat provides protection to the young embryo.
- (e) Being products of sexual reproduction, they generate new genetic combinations or variations.

OR

Apomixis is a type of asexual reproduction that mimics sexual reproduction to form seeds without fertilisation.

In apomictic seeds, parental characters are maintained in the progeny/offspring as there is no meiosis or segregation of characters.

If desired hybrid seeds are made apomictics the farmers can keep on using the hybrid seeds to raise new crops year after year.

23. (a) Intra uterine devices (IUDs)
 - These devices are inserted by doctors in the uterus through vagina.
 - There are three types of IUDs available:
 - (i) Non-medicated IUDs: These increase phagocytosis of sperms within the uterus, e.g., Lippes loop.

(ii) Copper releasing IUDs: Along with phagocytosis of sperms, the copper ions released suppress sperm motility and fertilising capacity of sperms, e.g., CuT, Cu 7, Multiload 375.

(iii) Hormone releasing IUDs: These make the uterus unsuitable for implantation and the cervix hostile to sperms, e.g., Progestasert, LNG-20.

(b) Advantages of *Saheli*:

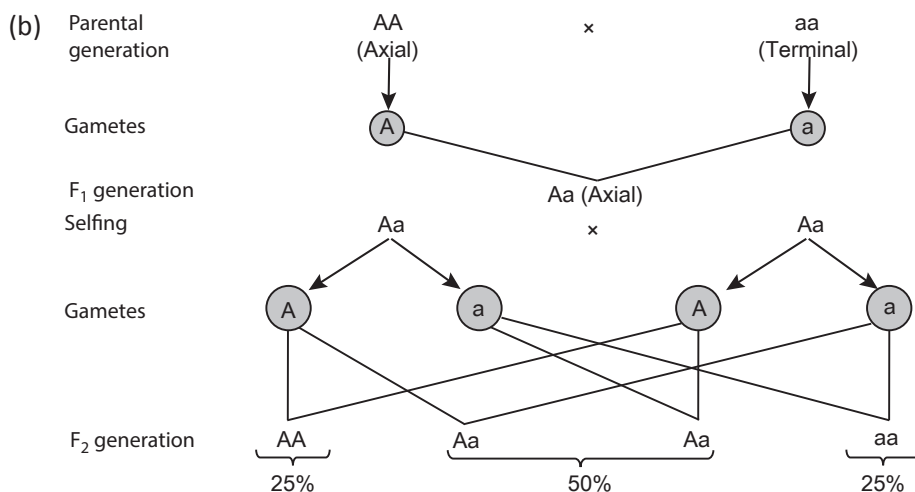
(i) It is non-steroidal

(ii) It is taken only once a week

(iii) It has high contraceptive value

(iv) It has less side effects.

24. (a) Axial position



(c) $AA = \frac{25}{100} = \frac{1}{4}$, $Aa = \frac{50}{100} = \frac{1}{2}$, $aa = \frac{25}{100} = \frac{1}{4}$

25. (a) Differences between analogous and homologous structures

S.No.	Analogous structures	Homologous structure
(i)	These are anatomically not similar but perform similar functions.	These are anatomically similar but perform different functions.
(ii)	They are a result of convergent evolution.	They are a result of divergent evolution.

(b) Wings of butterfly and birds.

Tubers of sweet potato and potato.

26. (a) Biogas is a mixture of inflammable gases like methane, carbon dioxide and hydrogen.

(b) Methanogens grow anaerobically and help in breakdown of cellulosic material to produce large amount of methane, carbon dioxide and hydrogen and so it is suitable for biogas production.

27. (a) pBR322 is a cloning vector.

(b) *rop* codes for the proteins involved in the replication of the plasmid.

(c) amp^R is antibiotic resistance gene. It is a selectable marker which is resistant to the antibiotic ampicillin.

tet^R is antibiotic resistance gene which is resistant to tetracycline.

28. ■ Strategy based on the process of RNA interference (RNAi)—as a method of cellular defence can be used.
- This method involves silencing of a specific *mRNA* due to a complementary *dsRNA* molecule that binds to and prevents translation of the *mRNA* (silencing).
 - The source of this complementary RNA can be from an infection by viruses having RNA genomes or mobile genetic elements (transposons) that replicate via an RNA intermediate.
 - Using *Agrobacterium* vectors, nematode-specific genes are introduced into the host plant. The introduction of DNA produces both sense and anti-sense RNA in the host cells.
 - Two RNA's being complementary to each other form a double stranded (*dsRNA*) that initiate RNAi and thus, silence the specific *mRNA* of the nematode.
 - As a consequence, the parasite cannot survive in a transgenic host expressing specific interfering RNA. The transgenic plant therefore gets protected from the parasite.

SECTION-D

29. (a) The signal from the fully developed foetus and placenta or the foetal ejection reflex induces mild uterine contraction. The hormone released is oxytocin.
- (b) Placenta produces several hormones like human chorionic gonadotropin (hCG), human placental lactogen (hPL), estrogens, progesterones that are essential to maintain pregnancy. This way placenta acts as an endocrine tissue.
- (c) true

OR

- (c) Oxytocin is responsible for uterine contraction. If the amount of oxytocin is low the baby will not be expelled out of the uterus.
30. (a) Biocontrol includes preservation of natural enemies (predators and parasitoids) that are already established in an area.
- (b) The nymph and adult stages are the most effective to eradicate mosquitoes.
- (c) Malaria and yellow fever

OR

(c) Dragonflies help to decrease the probability of diseases spread by vectors.

SECTION-E

31. (a) The unborn foetus is suffering from Down's syndrome. It is caused by the trisomy of chromosome 21. The trisomy is caused by the non-disjunction of chromosome 21.

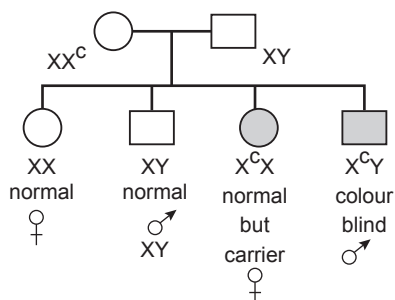
- (b) The symptoms include:
- Short stature with small round head
 - Partially open mouth with protruding furrowed tongue
 - Broad palm with characteristic palm crease
 - Slow mental development
- (c) Chromosomal disorders are due to excess, absence or abnormal arrangement of one or more chromosomes. Mendelian disorders are due to alteration or mutation in single gene.

OR

- (a) The pedigree exhibits autosomal recessive inheritance.
- (b) Phenylketonuria
- (c) The genotypes of parents are:

Mother \longrightarrow XX^c as her father is colour blind.

Father \longrightarrow XY



All daughters are normal visioned and 50% of sons are likely to be colour blind.

32. (a) Yes, so that it does not become a habit by repeated use. Consumption of drugs may cause harmful effects.

(b)

Drug	Source	Danger
Cocaine	<i>Erythroxylum coca</i>	Affects central nervous system and interferes with transport of dopamine.
Opioids/Heroin/Smack	Latex of <i>Papaver somniferum</i> (poppy plant)	Slows down body functions.
Cannabinoids	<i>Cannabis sativa</i>	Affects cardiovascular system

- (c) Awareness can be promoted by organising poster making competitions, street plays, talks by experts and interviews of experts.

OR

- (a) Tetanus antitoxins/Tetanus toxoid.
- (b) The preformed antibody injected act on the pathogen immediately to provide protection.

(c) This injection was given against tetanus and it provides passive immunity.

(d) B-lymphocytes produce antibodies to fight pathogen.

T-lymphocytes do not produce antibodies but help B cells to produce them. They can also destroy pathogen directly.

33. There are three main reasons for conserving the biodiversity:

- **The narrowly utilitarian argument** says that humans derive countless direct economic benefits from nature food (cereals, pulses, fruits), firewood, fibre, construction material, industrial products (tannins, lubricants, dyes, resins, perfumes) and products of medicinal importance. More than 25 per cent of the drugs currently sold in the market worldwide are derived from plants and 25,000 species of plants contribute to the traditional medicines used by native peoples around the world.
- **The broadly utilitarian argument** says that biodiversity plays a major role in many ecosystem services that nature provides. The fast dwindling Amazon forest is estimated to produce, through photosynthesis, 20 per cent of the total oxygen in the earth's atmosphere. Pollination (without which plants cannot give us fruits or seeds) is another service, ecosystems provide through pollinators layer—bees, bumble bees, birds and bats. Other benefits of nature is like the aesthetic pleasures of walking through thick woods, watching spring flowers in full bloom.
- **The ethical argument** for conserving biodiversity relates to what we owe to millions of plant, animal and microbe species with whom we share this planet. Philosophically or spiritually, we need to realise that every species has an intrinsic value, even if it may not be of current or any economic value to us. We have a moral duty to care for their well-being and pass on our biological legacy in good order to future generations.

The ways in which tiger population is increased in our country is by *in-situ* conservation-biodiversity hotspots were created.

OR

(a) (i) ***In situ*** conservation (On-site conservation): This approach involves protection of species in their natural habitat.

(a) Biodiversity hotspots

- These are regions of high levels of species richness and high degree of endemism.
- Endemic species are species confined only to a limited region.
- There are 34 hotspots in the world.
- In India, the three hotspots are Western Ghats and Sri Lanka, Indo–Burma and Himalaya.
- Biodiversity hotspots cover less than 2% of earth's land area, but they harbour large number of species. Thus, they could reduce mass extinction by 30%.

(b) Protected areas

- India has 14 biosphere reserves, 90 national parks and 448 wildlife sanctuaries.
- Jim Corbett National Park was the first to be established in India.

(c) Ramsar sites

- **Ramsar sites** are wetlands which are considered to be of international importance.
- **Ramsar Convention (1971)** is an international treaty for the conservation and sustainable utilisation of wetlands.
- Ramsar convention works for (a) conservation and use of wet lands, (b) recognition of fundamental ecological functions of wetlands and their cultural, economic, scientific and recreational value.
- There are 26 Ramsar sites in India. Some of these are Ashtamudi wetland (Kerala), Sambhar lake, Rudrasagar lake, Chilika lake, Bhitakanika wetland (Odisha).
- Wetlands include marshes, lakes, coral reefs, etc.

(d) Sacred groves

- These are forest patches set aside for worship. All the trees and wildlife within are given total protection by tribal people.
- Large number of rare and threatened plants can be found in these regions.
- Some of the sacred groves in India are as follows:
 - Khasi and Jaintia Hills in Meghalaya
 - Western Ghat regions of Karnataka and Maharashtra
 - Aravalli Hills of Rajasthan
 - Sarguja, Chanda and Bastar areas of Madhya Pradesh.

(ii) Ex situ conservation (Off-site conservation)

- This approach involves placing threatened animals and plants in special care units for their protection.
- India has 35 botanical gardens and 275 zoological parks where animals which have become extinct in wild are maintained.
- By using cryopreservation (preservation at -196°C) technique, sperms, eggs, animal cells, tissues and embryos can be stored for long period in genes banks, seed banks, etc.
- Plants are propagated *in vitro* using tissue culture methods (micropropagation).
- It is the desirable approach when urgent measures to save extinction are required.

Table 13.1: Differences between *in situ* conservation and *ex situ* conservation

S. No.	<i>In situ</i> conservation	<i>Ex situ</i> conservation
(i)	It is the conservation and protection of biodiversity in its natural habitat.	It is the conservation of selected threatened plant and animal species in places outside their natural habitat.
(ii)	Population is conserved in the surroundings where they have developed their distinctive features.	Population is conserved under simulated conditions that closely resemble their natural habitats.
(iii)	<i>E.g.</i> , national parks, biosphere reserves, wildlife sanctuaries, etc.	<i>E.g.</i> , botanical gardens, zoological parks, wildlife safari, gene banks, etc.

- (b) Commensalism because *Ophrys* employs sexual deceit to get pollination by species of bee as petal of its flower bears resemblance to female of the bee in size, colour and markings and so male bee is attracted to what it perceives as female; pseudo copulates with the flower and thus pollinates it. If the female bee's colour patterns change even slightly due to any reason during evolution, pollination success will be reduced unless the orchid flower co-evolves to maintain the resemblance of its petal to the female bee.



SAMPLE PAPER – 10

SECTION–A

- (b) completion of meiosis II
- (c) Affected individual is a female with Down's syndrome
- (b) Male 16, female 32
- (c) Translation - elongation
- (d) 3' – CCAAATTGCT – 5'
- (b)

(b)	Sweet potato and potato	Convergent evolution
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- (a) 42%
- (c)

(c)	It remains throughout life.	It can either be short lived or life long.
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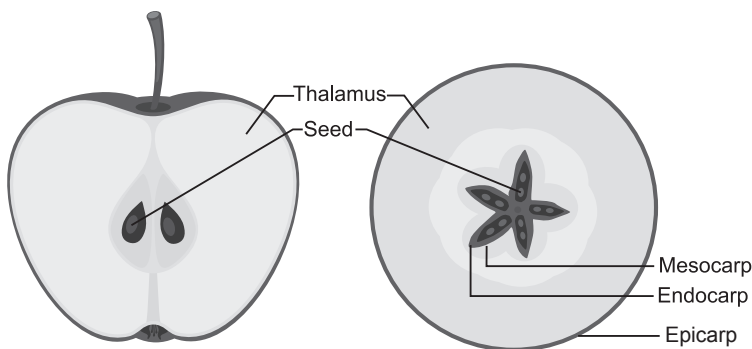
- (a) Difficulty in respiration, fever, chills, cough, headache
- (d) All of these
- (a)

(c)	Cotton boll destroyed by bollworms	Mature cotton boll
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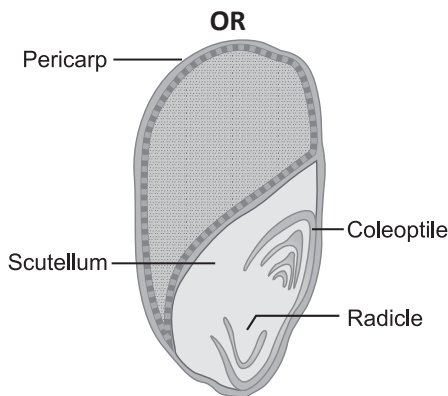
12. (a) An RNA virus that synthesises DNA during infection
13. (a) Both A and R are true and R is the correct explanation of A.
14. (a) Both A and R are true and R is the correct explanation of A.
15. (b) Both A and R are true and R is not the correct explanation of A.
16. (d) A is false but R is true.

SECTION-B

17.



In apple, the thalamus also contributes to fruit formation. Therefore, it is called as false fruit.



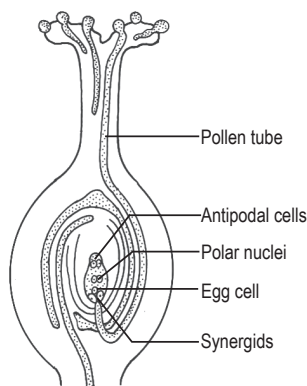
V.S. of maize grain

18. The human testes need lower temperature, 2 – 2.5°C less than the body temperature, for the formation of sperms which is provided outside the body.
Testes are present in scrotal sac or scrotum.
19. Retrovirus/ Adenoviruses/Papilloma Virus/Cauliflower mosaic virus/Tobacco mosaic virus
20. (a) Antibody: IgE; chemicals: Histamine and serotonin
(b) Drugs: Antihistamine, adrenalin, steroids. (*Any one*)
21. The most commonly used bioreactor is stirred-tank bioreactor.
A stirred-tank bioreactor is usually cylindrical and have a stirrer which mixes the reactor

contents evenly and makes oxygen available throughout the bioreactor. Optimum conditions of temperature, pH and foam control are provided.

SECTION-C

22.



(Any four labels)

23. (a) **IVF/In vitro fertilisation:** It is the fertilisation of gametes outside the body in almost similar conditions as that in the body.

(b) **ET/Embryo transfer:** Embryos formed by fusion of gametes is transferred into reproductive tract or uterus.

24. Failure of segregation of chromatids during cell division cycle results in the gain or loss of a chromosome(s).

Disorder involving an autosome.

Down's syndrome: The cause is the presence of an additional copy of the chromosome number 21 (trisomy of 21).

The affected individual has

- Short-stature with small round head,
- Furrowed tongue and partially open mouth,
- Broad palm with characteristic palm crease,
- Physical, psychomotor and mental development is retarded. (Any one symptom)

Disorder involving a sex chromosome:

Klinefelter's syndrome: This is caused due to the presence of an additional copy of X-chromosome resulting into a karyotype of 47, XXY.

Such an individual

- has overall masculine development,
- feminine development is also expressed by the development of breast (Gynaecomastia), are sterile. (Any one symptom)

OR

- (a) (i) point mutation/single base substitution
(ii) point mutation/single base deletion

- (b) (i) 5 amino acids
(ii) 4 amino acids

25. (a)

S. No.	<i>Homo erectus</i>	<i>Homo habilis</i>
(i)	Brain capacity 900 cc.	Brain capacity 650–800 cc.
(iii)	(Probably) ate meat.	(Probably) did not eat meat.

(b) Silurian → Carboniferous → Jurassic

26. (a) Dung, water

(b) Methanogens act on dung and water mixture anerobically.

(c) Methane, carbon dioxide

27. (a) The strand having the polarity 3'→5' is transcribed because RNA polymerase polymerises nucleotides only in 5'→3' direction.

(b) AUG initiates protein synthesis and UGA terminates protein synthesis.

28. Specific Bt toxin genes were isolated from *Bacillus thuringiensis* and were incorporated into cotton plant. It is coded by the genes cryIAc and cryIIAb that control the cotton bollworms. *Bacillus* forms protein crystals that contain a toxic insecticidal protein. Once an insect ingest the inactive toxin, it is converted into an active form. The toxin in the form of crystals gets solubilised due to alkaline pH in the gut. The activated toxin binds to the surface of gut epithelial cells and perforate the walls causing the death of insect larva.

SECTION-D

29. (a) Each primary spermatocyte will undergo meiosis-I and meiosis-2 which will result in 4 spermatozoa. So, 300 million spermatazoa will be produced by $300 \text{ million}/4 = 75 \text{ million}$ spermatocytes.

(b) (i) Since replication has occurred by this stage, so $46 \times 2 = 92$ chromatids will be present in primary oocyte.

(ii) Meiosis-I is completed by this time, so $92/2 = 46$ chromatids will be present in first polar body.

OR

(b) Two

(c) During the passage of zygote from fallopian tube to the uterus.

30. (a) Crocodiles are conformers. They cannot maintain their internal environment, therefore, they have to stay in sun when the temperature is low.

(b) They lose body heat very fast, so they minimise their movement to slow down the metabolic rate.

- (c) The most viable survival methods would be:
- (i) By hiding in tall grasses and reeds to provide a cover in cold.
 - (ii) Soaking in the sun in the daytime.

OR

It is not feasible for crocodiles to survive in the Tundra region. They are animals adapted to the temperature and environment of Tropical region, they would not be able to adapt to low temperature and dry environment of Tundra region for long.

SECTION–E

- 31.** Such type of inheritance is called polygenic inheritance.

Let us assume skin colour is controlled by three genes, say A, B, C. Dominant forms (A, B, C) are responsible for dark skin colour and recessive forms (a, b, c) for light skin colour. The genotype with all dominant alleles (AABBCC) will be darkest skin colour and with recessive alleles (aabbcc) will be lightest skin colour. The genotypes (AaBbCc) will be of intermediate skin colour, i.e., with three dominant alleles and three recessive alleles.

OR

- (a) Differences between Mendelian disorder and chromosomal disorder

S. No.	Mendelian disorder	Chromosomal disorder
(i)	This disorder is mainly due to alteration or mutation in the single gene.	This disorder is caused due to absence or excess or abnormal arrangement of one or more chromosomes.
(ii)	This follows Mendel's principles of inheritance.	This does not follow Mendel's principles of inheritance.
(iii)	This may be recessive or dominant in nature	This is always dominant in nature.
(iv)	For example, haemophilia, sickle-cell anaemia.	For example, Turner's syndrome.

- (b) Two chromosomal aberration-associated disorders are Down's syndrome and Klinefelter's syndrome.
- (c) **(i) Down's syndrome:** The individuals have overall masculine development but they express feminine development like development of breast, i.e., gynaecomastia. They are sterile.
- (ii) Klinefelter's syndrome:** The females are sterile as ovaries are rudimentary. Other secondary sexual characters are also lacking.
- 32.** (a) The issue of puberty and adolescence need to be addressed effectively with the respective age group because many changes take place in the body during adolescence of which they are supposed to be aware of.
- (b) To bring in awareness about their reproductive health and its effect on their physical, emotional and social being.
- (c) To address the increase in sex abuse and sex crimes in our country.

- (d) Myths and misconceptions related to reproductive issues need to be cleared at the right time.

OR

- (a) (i) Vaccines are weakened or inactivated pathogens or proteins introduced into a person to provide protection against a disease.
 (ii) Vaccination provides immunisation after a time gap.
 (iii) The vaccine generates memory B- and T-cells that recognise the pathogen on subsequent exposure and produce an intense immune response.

(b)

S. No.	Active Immunity	Passive Immunity
(i)	It is usually long-lasting.	It lasts for shorter period of time.
(ii)	It produces an immunological memory.	It does not produce an immunological memory.
(iii)	When the antigens enter the body antibodies and other specialised lymphocytes are produced. For e.g. producing antibodies by the body to kill the bacterial infection once, the bacteria enters the body.	Antibodies are introduced from an external source. For e.g. Mother introduces antibodies to a fetus through the placenta and to an infant via mother's milk.
(iv)	There are no-side effects	It may cause reactions
(v)	Immunity does not occur immediately.	Immunity develops immediately.

33. (a) Biodiversity increases from poles to equator. This is because of the following reasons:
 (i) Solar energy exposure is greatest at the equator and decreases towards the poles.
 (ii) Regions at the equator are more constant and less seasonal.
- (b) The graph signifies that within a region, species richness increases with increased explored area but up to a limit.
- (c) Certain regions have been declared as "hot spots" for maximum protection of these regions which have high levels of species richness and high degree of endemism.
 Western Ghats and Sri Lanka and Himalayas are two examples of hot-spots.

OR

- (a) The equation of the curve 'a' is $S = CA^z$.
 (i) Within a region, species richness increases with increasing explored area but only up to a limit.
 (ii) Relationship between species richness and area for a wide variety of taxa turns out to be rectangular hyperbola.
- (b) 0.2 is obtained in studies regardless of the taxonomic group and the region 1.2 is obtained if species area relationship is analysed among very large areas like the entire continents.

SAMPLE PAPER – 11

SECTION–A

- (c) FSH, estrogen, progesterone
- (d) 60
- (b) 50%
- (b) A is having 2'–OH group which makes it more reactive and structurally unstable, whereas B is having 2'–H group which makes it less reactive and structurally stable.
- (c) large loops held by the proteins.
- (c)

(c)	Cosmozoic theory	Life came from outer space
-----	------------------	----------------------------
- (d) $p^2 + 2pq + q^2 = 1$
- (d) gut of mosquito
- (d) Ascariasis – abdominal pain and internal bleeding
- (b) Denaturation, primer annealing, extension
- (d) PCR – Polymerase Chain Reaction
- (b) Corn borer
- (a) Both A and R are true and R is the correct explanation of A.
- (d) A is false but R is true.
- (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.

SECTION–B

- To maintain hybrid characters (year after year in a desired plant) and to avoid buying hybrid seeds every year (expensive seeds) farmers prefer using apomictic seeds.
- The reasons behind this embarrassment are illiteracy, their conservative attitude, misconceptions, social myths and generation gap.
- (a) Degenerate—When same amino acids are coded by more than one codon.
(b) Universal—A particular codon codes for same amino acid in all organisms except in mitochondria and few protozoa.

OR

DNA polymorphism is applicable in genetic mapping and DNA finger printing.

20.

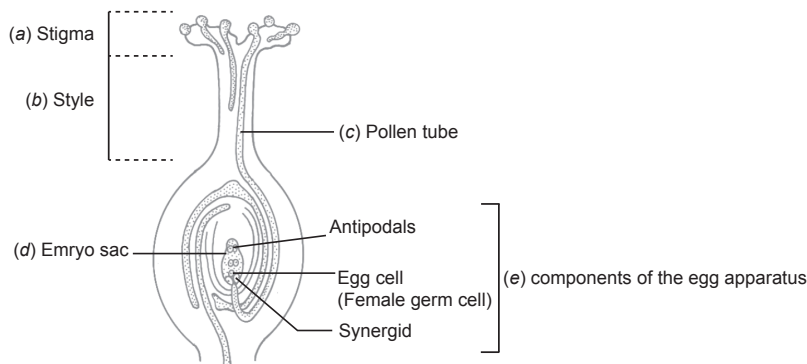
	Opioids	cannabinoids
(a) Specific receptor site in human body	Central nervous system and gastro-intestinal tract.	Brain
(b) Mode of action in human body	Slows down body function.	Effects cardiovascular system

21. The given bioreactor is the simple stirred tank bioreactor.

Its purpose is large scale production of recombinant protein or enzymes, using microbial plants/animals/human cells.

SECTION-C

22.



23. (i) In this method, ova from the wife/donor (female) and the sperms from the husband/donor (male) are collected and induced to form zygote under simulated conditions in the laboratory. This process is called ***in vitro* fertilisation (IVF)**.

(ii) The zygote or early embryo with up to 8 blastomeres is transferred into the fallopian tube (process is called zygote intra fallopian transfer or ZIFT) and if embryo with more than 8 blastomeres is transferred into the uterus (process is called intra uterine transfer or IUT).

(iii) Gamete Intra Fallopian Transfer (GIFT)

- It is the transfer of an ovum collected from a donor into the fallopian tube of another female who cannot produce one, but can provide suitable environment for fertilisation and further development of the embryo.

(iv) Intra Cytoplasmic Sperm Injection (ICSI)

- It is a procedure to form an embryo in the laboratory by directly injecting the sperm into an ovum. The embryo is later transferred by ZIFT or IUT.

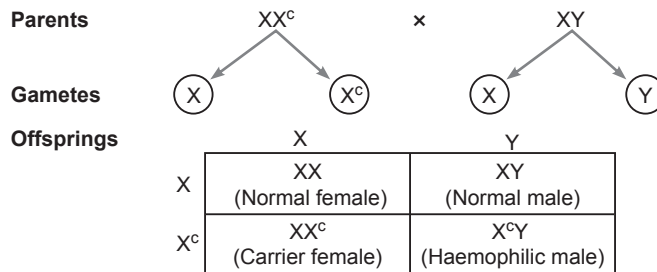
(v) Artificial Insemination (AI)

- In this method, the semen collected either from the husband or a healthy donor is artificially introduced into the vagina or into the uterus (**intra uterine insemination** or **IUI**).
- This technique is used in cases where the male is unable to inseminate sperms in the female reproductive tract or due to very low sperm counts in the ejaculation.

(Any three)

24. Mother is carrier XX^c

Father is XY .



Normal daughter—25%

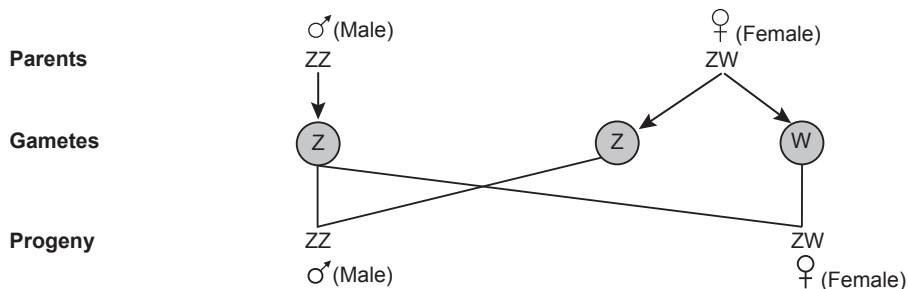
Normal son—25%

Carrier daughter—25%

Haemophilic son—25%

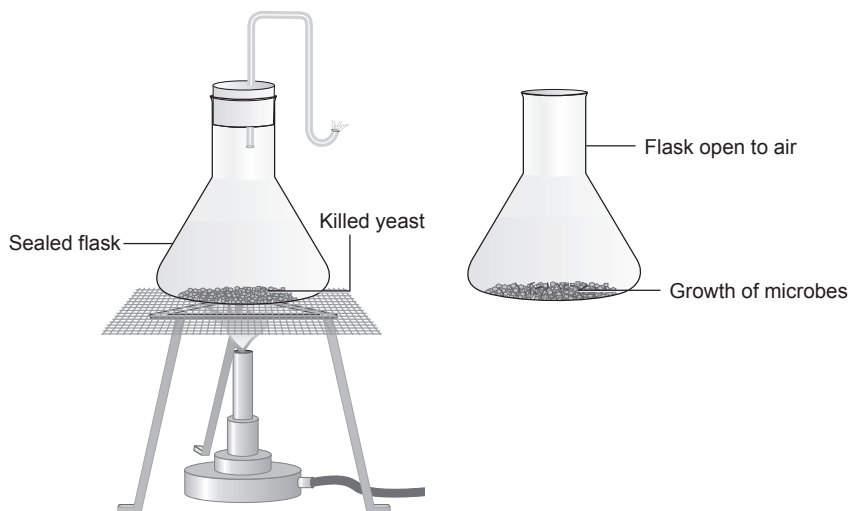
OR

In birds, female heterogamety is observed. They exhibit ZW type of sex determination.



In humans, male heterogamety is observed. They exhibit XY type of sex determination.

25. Two pre-sterilised flasks with killed yeast were taken. One of the flask was sealed, and the other was open to air. Differential growth of life were observed in the two flasks. Life was found only in the open flask.



26. (a) *Lactobacillus* (b) *Trichoderma polysporum*
 (c) Fungus (d) Penicillin
27. (a) Primary vigorous growth of useful aerobic microbes into flocs.
 (b) The sediment formed is called activated sludge. Some of it is pumped back into the aeration tank to serve as the inoculum.
 (c) During this digestion, a mixture of gases such as methane, hydrogen sulphide and carbon dioxide are formed. These gases form the biogas.
28. (a)

Pro-insulin	Mature insulin
In mammals, including humans, insulin is synthesised as a prohormone (like a pro-enzyme, the pro-hormone also needs to be processed before it becomes a fully mature and functional hormone) which contains an extra stretch called the C peptide.	The C peptide is not present in the mature insulin and is removed during maturation into insulin.

- (b) In 1983, Eli Lilly an American company prepared two DNA sequences corresponding to A and B, chains of human insulin and introduced them in plasmids of *E.coli* to produce insulin chains. Chains A and B were produced separately, extracted and combined by creating disulfide bonds to form human insulin.

SECTION-D

29. (a) LH surge is essential for the events leading to ovulation.
 (b) (i) 5th day to 12th day of the cycle: Follicular phase (Proliferative phase).
 (ii) 14th day of the cycle: Ovulatory phase (release of ovum) followed by luteal phase.
 (c) The high levels of progesterone and estrogens during pregnancy suppress the release of gonadotropins required for the development of new follicles. Therefore, new cycle cannot be initiated.

OR

When the LH level comes down the level of progesterone increases and endometrium starts thickening.

30. (a) A—Natality
 (b) B—Emigration
 (c) $N_{t+1} = N_t + [(B + I) - (D + E)]$

OR

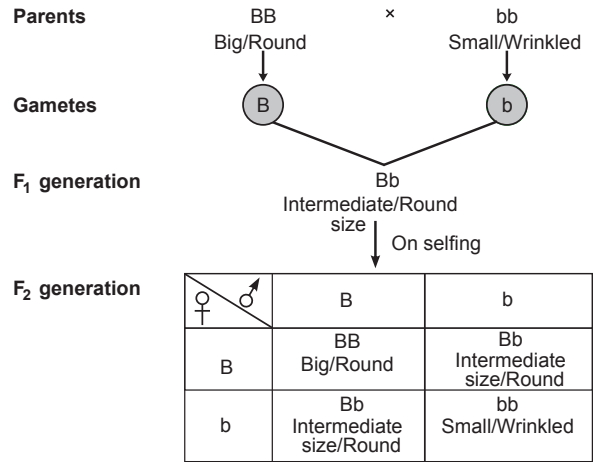
If the couples do not have more than one child, then the natality will decrease. This would lead to decrease in the population density as

Population density = Number of live births/Number of people in an area.

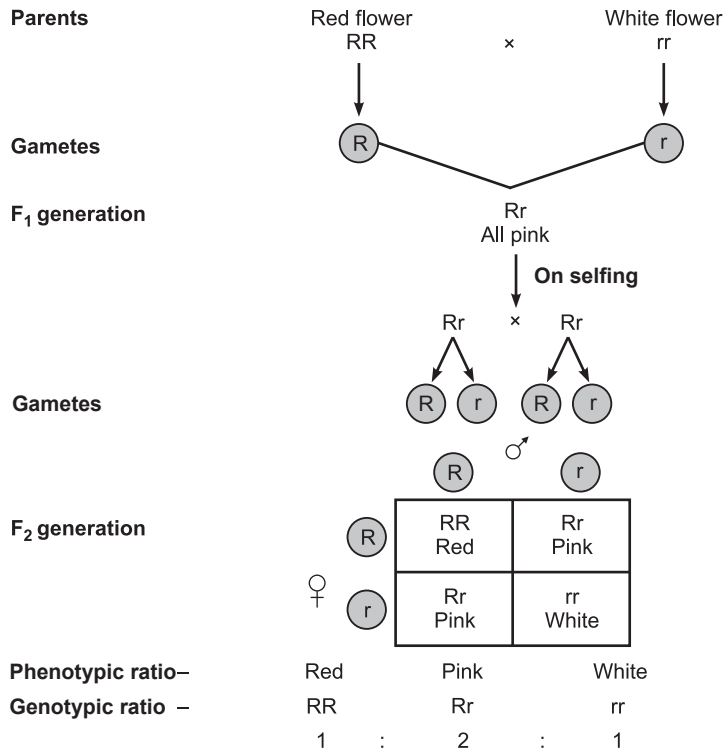
SECTION-E

31. A single gene controls the size of the starch grains and seed shape of *Pisum sativum*.

With respect to size of starch grains it shows 3 forms—big, Intermediate and small as in incomplete dominance but with respect to seed shape it follows Mendelian law of Dominance showing either round or wrinkled.



OR



Monohybrid cross in snapdragon, where one allele is incompletely dominant over the other allele

Comment: This is a case of Mendelian deviation and that shows incomplete dominance as red and white both are not expressed but produce pink trait in F₁. Here, both the genotypic and phenotypic ratio are 1 : 2 : 1.

32. (a) AIDS is caused by the Human Immunodeficiency virus.
- (b) Vaccines prevent microbial infections by initiating production of antibodies against these antigens to neutralise the pathogenic agents during later actual infection.
The vaccines also generate memory B and T-cells that recognise the pathogen quickly on subsequent exposure.
- (c) Normal cells show a property called contact inhibition by virtue of which contact with other cells inhibits their uncontrolled growth. Cancer cells appear to have lost this property.
These cells grow very rapidly, invading and damaging the surrounding normal tissues. Cells sloughed from such tumours reach distant sites through blood, and wherever they get lodged in the body, they start a new tumour there. This property is called metastasis.
- (d) Acid in the stomach and saliva in the mouth act as physical barriers to protect body.

OR

- (a) (i) Tobacco in cigarettes contains a large number of chemical substances including nicotine, an alkaloid.
(ii) Nicotine stimulates adrenal gland to release adrenaline and nor-adrenaline into blood circulation, both of which raise blood pressure and increase heart rate.
(iii) Smoking is associated with increased incidence of cancers of lung, urinary bladder, throat and oral cavity.
(iv) It is responsible for bronchitis and emphysema.
(v) It is associated with increased risk of coronary heart disease, gastric ulcer, etc.
(vi) Smoking increases carbon monoxide (CO) content in blood and reduces the concentration of haem-bound oxygen. This causes oxygen deficiency in the body.
- (b) Smoking increases the carbon monoxide (CO) content in the blood which has greater affinity to haemoglobin than oxygen. CO forms a stable bond with haemoglobin and does not allow binding of oxygen. Smoking also damages alveolar walls, which reduces respiratory surface (emphysema).
33. (a) Alexander von Humboldt. He observed that within a region, species richness increased with increasing explored area but only up to a limit.
- (b) (i) The slopes regression lines are similar when unaffected distribution in an area is analysed.
(ii) The slope of regression is steeper when we analyse the species-area relationship among very large areas like entire continent.
Z (slope of the line) is the regression co-efficient.
- (c) If species richness is more, *i.e.*, in the range 0.62-1.2.
- (d) (i) $S = CA^Z$
(ii) $\log S = \log C + Z \log A$

OR

- (a) Lichens.
- (b) Mosses and ferns are few as they need humid conditions in forests that are fast disappearing.
- (c) Fungi are able to sustain themselves as a large population because of their wider adaptability to the changing environmental conditions and they grow on dead organic matter.
- (d) Most advanced group is of angiosperms and most primitive group is of fungi.



SAMPLE PAPER – 12

SECTION–A

- 1. (a) zygote, nucellus and endosperm
- 2. (a) Lippe's loop
- 3. (b) Autosomal recessive
- 4. (c) the young ones are protected inside the mother's body and are looked after they are born leading to more chances of survival
- 5. (a) A–3, B–5, C–4, D–2, E–1
- 6. (b) inhalation of seasonal pollen
- 7. (c) A–(iv), B–(iii), C–(ii), D–(i)
- 8. (b) The center of flocs will become anoxic, which would cause death of bacteria and eventually breakage of flocs.
- 9. (c) DNA ligase
- 10. (c) Recognition sites – points where restriction enzymes work (ans)
- 11. (b) Adenosine deaminase
- 12. (b) phytoplankton, free-floating hydrophytes, rooted hydrophytes, sedges, grasses and trees.
- 13. (c) A is true but R is false.
- 14. (c) A is true but R is false.
- 15. (d) A is false but R is true.
- 16. (a) Both A and R are true and R is the correct explanation of A.

SECTION–B

- 17. The oral pills comprises: Either progestogens alone or progestogen – estrogen combinations. *Saheli* is a non-steroidal preparation. It inhibits ovulation and implantation. It also alters the quality of cervical mucus to prevent/retard the entry of sperms.

(b) The trophoblast layer gets attached to the endometrium and the inner cell mass gets differentiated as the embryo.

24. (a) **Dominance:** The alleles I^A and I^B both are dominant over allele i as I^A and I^B form antigens A and B , respectively, but i does not form any antigen.

Multiple allelism: It is the phenomenon of occurrence of a gene in more than two allelic forms on the same locus. In ABO blood group in humans, one gene I has three alleles I^A , I^B and I^O/i .

Co-dominance: It is the phenomena in which both alleles express themselves when present together. We inherit any two alleles for the blood group. When the genotype is $I^A I^B$ the individual has AB blood group since both I^A and I^B equally influence the formation of antigens A and B .

- (b) (i) $I^A i$ — A blood group.
(ii) ii — O blood group.

25. (a)

Amino acid	Phe	Val
DNA Code in Gene	AAA	CAC
Codon in mRNA	(i) UUU	(ii) GUG
Anticodon in tRNA	(iii) AAA	(iv) CAC

- (b) (i) A polypeptide containing 14 different amino acids = $14 \times 3 = 42$ base pairs.
(ii) 14 different types of RNA are needed for the synthesis of polypeptide.

26. (a) At the time of processing C-peptide is removed.

(b) The American company used recombinant DNA technology.

(c) The polypeptides of functional insulin are held by disulfide bonds.

27. (a) Since small animals have a larger surface area relative to their volume, they tend to lose body heat very fast when it is cold outside; then they have to expend much energy to generate body heat through metabolism. This is the main reason why very small animals are rarely found in polar regions.

(b) Mammals from colder climates generally have shorter ears and limbs to minimise heat loss. (This is called the Allen's Rule.)

(c) This is because in the low atmospheric pressure of high altitudes, the body does not get enough oxygen. But gradually we get acclimatised and stop experiencing altitude sickness.

28. (a) The gradual and fairly predictable change in the species composition of a given area is called ecological succession.

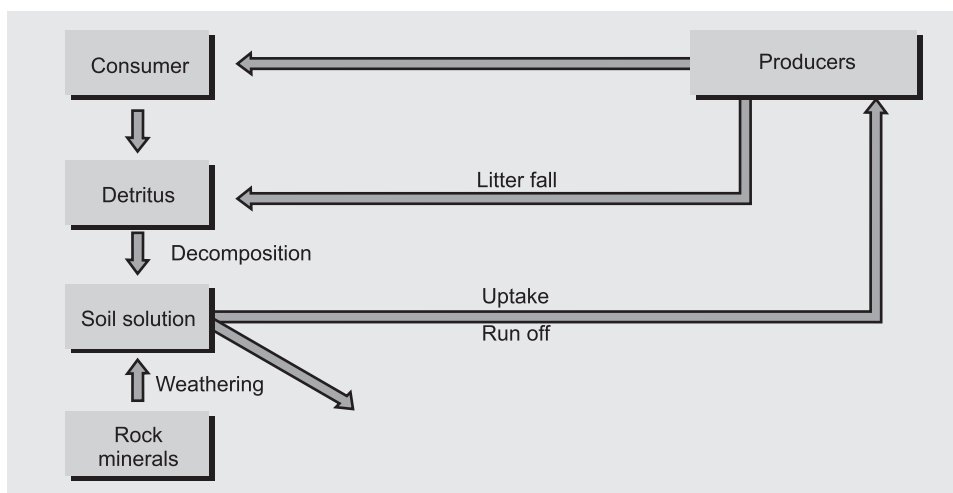
(b)

S. No.	Primary succession	Secondary succession
(i)	It takes place in area where no living organism ever existed.	It takes place in area which have lost all life forms due to destruction and flood.

(ii)	The invading species are either lichens (on rocks) or phyto planktons (in water).	The invading species depend on the condition of soil, availability of water and type of seed.
(iii)	Rate of succession is slow.	Rate of succession is faster.
(iv)	Climax is slow to reach. Example: Newly cooled lava/bare rocks/ newly created ponds or reservoir.	Climax is reached faster. Example: Abandoned farm lands/burnt or cut forests/lands that have been flooded.

Since soil is already present, the rate of succession is much faster and hence, climax is also reached more quickly.

OR



SECTION-D

29. (a) This is due to a disturbance in coordinated regulation of expression of sets of genes associated with organ development or due to mutations.
- (b) An inducer prevents the binding of repressor to operator and starts transcription i.e., lactose here.
- (c) (i) – TACG – (ii) – UACG –

OR

- (c) It will have no effect on the lac operon.
30. (a) The two different DNA molecules will have compatible ends to recombine.
- (b) Restriction enzyme cuts the DNA of the vector and then ligates the gene of interest into the DNA of the vector.
- (c) Two fragments will be formed which are:
 5' ATTTTGAG 3' 5'GATCCGTAATGTCCT 3'
 3' TAAACTCCTAG 5' .3'GCATTACAGGA 5'

OR

*Bam*H1 site will affect tetracycline antibiotic resistance gene, hence the recombinant plasmids will lose tetracycline resistance due to inactivation of the resistance gene.

Recombinants can be selected from non recombinants by plating into a medium containing tetracycline, as the recombinants will not grow in the medium because the tetracycline resistance gene is cut.

SECTION-E

31. (a) Hormone 'X': Luteinising hormone.

Hormone 'Y': Follicle stimulating hormone.

(b) (i) FSH is secreted by the anterior pituitary which stimulates the ovarian follicle to secrete estrogen, which in turn stimulates the proliferation of the endometrium of the uterine wall.

(ii) Both LH and FSH attain a peak level in the middle of cycle (about 14th day). Rapid secretion of LH leading to its maximum level during the mid-cycle called LH surge induces rupture of Graafian follicle and thereby the release of ovum (ovulation).

(iii) The remaining cells of ovarian follicles are stimulated by the LH to transform into corpus luteum. The corpus luteum secretes large amount of progesterone which is essential for maintenance of the endometrium.

(c) The target cells of luteinising hormone (LH) in males are the Leydig cells and in females are the mature growing follicles.

LH in males stimulates the Leydig cells (interstitial cells) of testes to synthesise and secrete androgens which in turn stimulate the process of spermatogenesis. LH in females stimulate the ovulation (release of ovum) and transformation of Graafian follicle into corpus luteum to secrete progesterone which prepares the endometrium to receive and implant blastocyst.

OR

(a) Halving of chromosomal number takes place during gametogenesis by meiosis and regaining the $2n$ number occur as a result of fertilisation by fusion of male and female gametes.

(b) A : The spermatogonia or male germ cells undergo meiotic divisions leading to sperm formation.

D : Sertoli cells provide nutrition to the germ cells.

(c) Provide energy for the movement of sperm tail.

(d) Spermatogenesis is initiated at the age of puberty by the gonadotropin releasing hormone (GnRH) secreted by the hypothalamus.

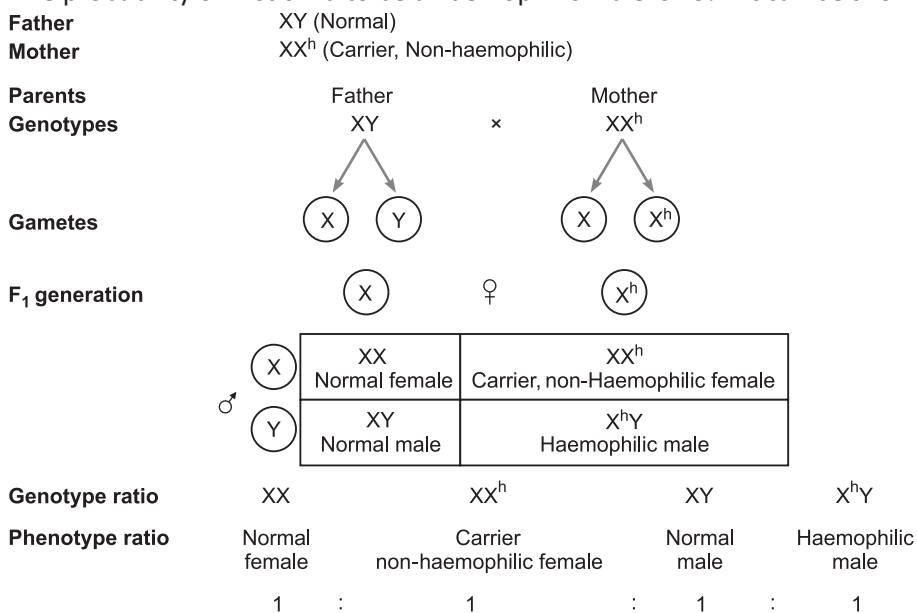
The increased levels of GnRH stimulate the anterior pituitary which then secretes the FSH (follicle stimulating hormone) and LH (luteinising hormone). FSH stimulates Sertoli cells to secrete some factors which help in spermiogenesis.

LH acts on the Leydig cells and causes the secretion of androgens, i.e., testosterone from the testes which in turn stimulate the process of spermatogenesis.

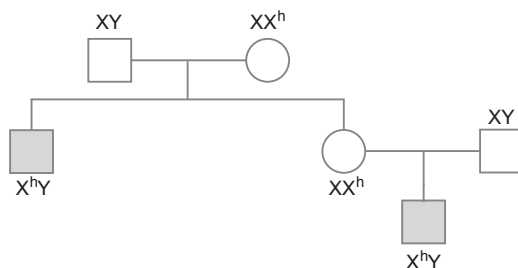
32. (a) When the genes are linked.
 (b) Frequency of recombination will be higher.
 (c) True breeding lines are plants which have undergone continuous self-pollination for several generations. These are homozygous for traits.
 (d) Linkage and crossing over is alternative to each other because the linkage is the tendency of genes to stay together throughout transmission, but crossing over is the interchange of parts of homologous chromosomes that results in variation.

OR

- (a) Genotypes of member 4 – XX or XX^h
 Genotypes of member 5 – X^hY
 Genotypes of member 6 – XY
 (b) The probability of first child to be a haemophilic male is 25%. It can be shown as:



(c) (i)



- (ii) This disease shows sex-linked recessive inheritance pattern.

33. Disease: Cancer

Probable Causes: Physical/ Environmental- Exposure to X – rays/ gamma rays/ UV rays;

Chemicals–Nicotine in tobacco/ other carcinogens

Biological– Viral oncogenes/ Mutations

Detection and diagnosis:

1. Cancer detection is based on biopsy and histopathological studies of the tissue; blood and bone marrow tests for increased cell counts in the case of leukemias. In biopsy, a piece of the suspected tissue cut into thin sections is stained and examined under microscope (histopathological studies) by a pathologist.
2. Techniques like radiography (use of X-rays), CT (computed tomography) and MRI (magnetic resonance imaging) are very useful to detect cancers of the internal organs. Computed tomography uses X-rays to generate a threedimensional image of the internals of an object. MRI uses strong magnetic fields and non-ionising radiations to accurately detect pathological and physiological changes in the living tissue.
3. Antibodies against cancer-specific antigens are also used for detection of certain cancers.
4. Techniques of molecular biology can be applied to detect genes in individuals with inherited susceptibility to certain cancers. (*any three methods*)

OR

- (i) (a) A normal cell has the ability to contact inhibition which inhibits its division after contact with other cells. When this ability is lost in a cell, it becomes cancerous.
- (b) (i) Biopsy: It's a piece of the suspected tissue is cut into thin section stained and studied.
(ii) Histopathology: It's a piece of suspected tissue is examined under a microscope by a pathologist.
(iii) MRI: It uses strong magnetic fields and non-ionising radiations, accurately detect pathological and physiological changes in the tissues.
- (c) Radiotherapy and chemotherapy.



SAMPLE PAPER – 13

SECTION–A

1. (a) The flower type which survived is cleistogamous and it always exhibits autogamy.
2. (b) Ascariasis Ascariasis
3. (c) 2 red : 2 pink
4. (d) (i) and (iv)
5. (d) (ii) and (iv)

6. (d) Cell-mediated immune response
7. (c) A—(iii), B—(iv), C—(i), D—(ii)
8. (d) increasing its resistance to insects
9. (a) formation of phosphodiester bond between two DNA fragments
10. (c) Extension of primer end on the template DNA
11. (c) either RNA or DNA
12. (c) Desert
13. (d) A is false but R is true.
14. (c) A is true but R is false.
15. (a) Both A and R are true and R is the correct explanation of A.
16. (c) A is true but R is false.

SECTION-B

17. A polypeptide of 24 amino acids will be formed as UAA is a stop codon which will prevent further translation.

OR

Amniocentesis is a foetal sex determination test based on the chromosomal pattern in cells extracted from the amniotic fluid, surrounding the developing embryo. Amniocentesis is used for sex determination, which most people go for, to kill female foetus. Therefore, it has been banned.

18. Frequency of B allele = all of BB + $\frac{1}{2}$ of Bb = 22 + 31 = 53%
 Frequency of b allele = all of bb + $\frac{1}{2}$ of Bb = 16 + 31 = 47%.
19. At collection points A and B, the BOD level is high due to high organic pollution caused by sugar factory and sewage discharge.
 At the collection point C, the water was released after secondary treatment/ biological treatment (where vigorous growth of useful aerobic microbes into flocs consume the major part of the organic matter present in the river water or effluent due to sugar factory and sewage discharge).
20. Selectable marker helps to select the host cells which contain the vector transformants and eliminate the non-transformants.
21. Some possible reasons are:
- Speciation is generally a function of time, unlike temperate regions subjected to frequent glaciations in the past, tropical latitudes have remained relatively undisturbed for millions of years and thus, had a long evolutionary time for species diversification.
 - Tropical environments, unlike temperate ones, are less seasonal, relatively more constant and predictable. Such constant environments promote niche specialisation and lead to a greater species diversity.
 - There is more solar energy available in the tropics, which contributes to higher productivity; this in turn might contribute indirectly to greater diversity.

(Any two reasons)

- (c) The separated DNA fragments are separated by elution. The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece.
27. Graph A depicts exponential growth/geometric growth, due to unlimited resources and absence of checks or environmental resistances.
Graph B shows extinction, due to lack of resources and environmental resistances.
28. A given species may occupy more than one trophic level in the same ecosystem (in different food chains) at the given time. If the function of the mode of nutrition of species changes, its position shall change in the trophic levels. The same species can be at primary consumer level in one food chain and at secondary consumer level in another food chain in the same ecosystem at the given time.

SECTION-D

29. (a) DNA polymerase is highly specific to recognise only deoxyribonucleoside triphosphates. Therefore it cannot hold RNA nucleotides.
(b) DNA dependent DNA polymerase. It catalyses polymerisation in $5' \rightarrow 3'$ direction only.
(c) DNA polymerase is involved in continuous replication of DNA strand. The polarity of template strand is $3' \rightarrow 5'$.
30. (a) *B. thuringiensis* forms protein crystals which contain a toxic insecticidal protein.

OR

- (a) Bt toxins are initially inactive prototoxins when present in the bacteria but after ingestion by the insect they become active due to the alkaline pH of the insect's gut.
- (b) (i) Chemical pesticides had harmful side-effects on human health as they get deposited in the body. GM crops are safer because they do not use any chemicals.
(ii) RNA interference process is used for pest resistance against a nematode *Meloidogyne incognita*. In this process specific mRNA is silenced due to binding by a complementary dsDNA.

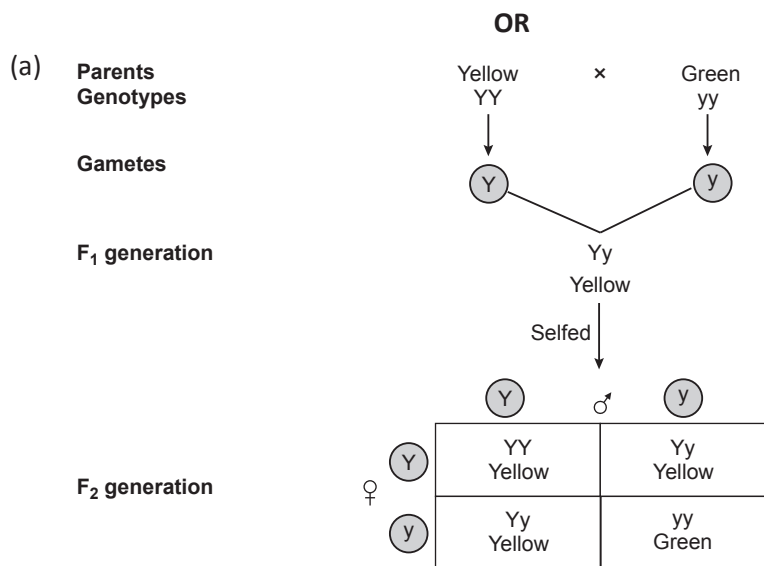
SECTION-E

31. (a) Spermatids undergo spermiogenesis.
(b) **Spermiogenesis:** It is the transformation of spermatids into spermatozoa or sperms.
Spermiation: It is the release of sperms from the sertoli cells in the seminiferous tubules.
(c) One primary spermatocyte undergoes meiosis to form four sperms. So, primary spermatocyte will produce 200 sperms.

OR

- (c) (i) Two
(ii) During the passage of zygote from fallopian tube to the uterus.

32. (a) Reason for selecting *Drosophila melanogaster* (fruit fly):
- They could be grown on simple synthetic medium in the laboratory.
 - They complete their life cycle in two weeks.
 - A single mating could produce a large number of progeny.
 - There was clear differentiation of the sexes, *i.e.*, male and female flies are easily distinguishable.
 - It has many types of hereditary variations that can be seen with low power microscopes.
- (b) Morgan and his group found that when genes are grouped on the same chromosome, some genes are tightly linked or associated and show little recombination. F_2 generation ratio deviated from 9 : 3 : 3 : 1. When the genes are loosely linked they show higher percentage of recombination. Morgan hybridised yellow bodied and white eyed females with brown bodied and red eyed males (wild type) (cross-A) and inter-crossed their F_1 progeny.



F_2 Phenotypic ratio = 3 : 1; F_2 Genotypic ratio = 1 : 2 : 1

- (b) **Law of Dominance:** In a contrasting pair of factors, one member of the pair dominates (dominant) the other is recessive.
- Law of Segregation:** Factors or allele of pair separate from each other such that gamete receives only one of the two factors.
- (c) Phenotypic ratio of F_2 in monohybrid cross is 3 : 1 whereas in a dihybrid cross the phenotypic ratio is 9 : 3 : 3 : 1.
33. (a) α -interferon stimulates T cells and other immune system cells to attack the cancer. It can also encourage cancer cells to send out chemicals that attract immune system cells to them.

- (b) The inherited cancer genes may or may not express themselves. They would require a trigger—external or internal—for them to express themselves and become malignant. Once they are active, they enter the blood stream and the lymphatic system where they continue to divide and spread.
- (c) (i) All humans have cellular oncogenes or proto-oncogenes, but only a few suffer from cancer because cancer only occurs on activation of oncogenes. This activation is induced by carcinogens which can be physical, chemical or biological. The chemical carcinogens present in tobacco and smoke have been identified as a major cause of lung cancer.

(ii) **Differences between benign and malignant tumours**

S. No.	Benign tumour	Malignant tumour
(i)	It is a non-cancerous tumour.	It is a cancerous tumour.
(ii)	Benign tumour does not show metastasis and is non-invasive.	It shows metastasis and thus invades other body parts.
(iii)	It stops growth after reaching a certain size.	Malignant tumour shows indefinite growth as proliferating cells, called Neoplastic or tumor cells, grow rapidly, invade and damage other tissues.
(iv)	Limited adherence occurs amongst cells of benign tumour.	There is no adherence amongst cells. They tend to slip past one another.
(v)	It is less fatal to the body.	It is more fatal to the body.

OR

- (a) His condition is drug dependence. It is the tendency of the body to manifest a characteristic and unpleasant withdrawal syndrome if regular dose of drugs is abruptly discontinued. Because of perceived benefits, drugs are frequently used repeatedly from which the person may not be able to get out.

Following measures can be taken to overcome this problem:

- (i) Education and counseling to face problems and stresses and to channelise the energy into healthy pursuits like reading, music, yoga and other extracurricular activities.
- (ii) Seeking help from parents to guide the person appropriately and immediately.
- (iii) Seeking professional and medical help to the person to get rid of the problem completely with sufficient efforts and will power (*any two*).
- (b) It is the state experienced by addicts when their regular dose of alcohol/drug is abruptly discontinued. It is often characterised by anxiety, shakiness, nausea and sweating.



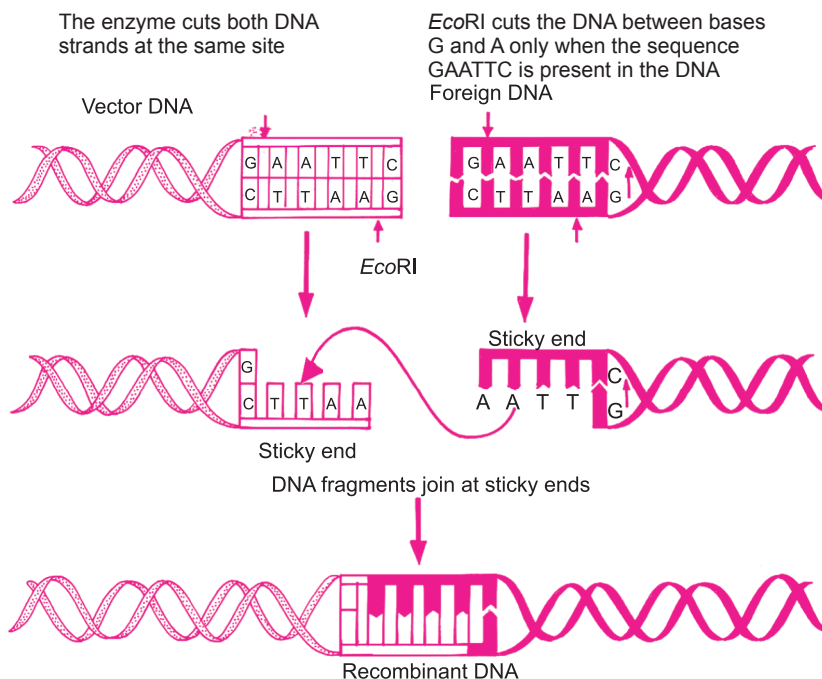
SECTION–A

1. (c) 500
2. (c) not cause significant change in growth rate
3. (b) (ii), (iii), (iv), (v)
4. (b) they share a common ancestor
5. (d) IgG
6. (c) Shaking hands with infected persons
7. (b) stable particles
8. (c) vitamin B12
9. (d) Ethidium bromide stained DNA can be seen under exposure to UV light.
10. (a) Gel electrophoresis
11. (d) The inactive protoxin gets converted into active form in the insect gut.
12. (a) A community and the abiotic environment comprise an ecosystem.
13. (d) A is false but R is true.
14. (c) A is true but R is false.
15. (a) Both A and R are true and R is the correct explanation of A.
16. (a) Both A and R are true and R is the correct explanation of A.

SECTION–B

17. Two reasons for increase in population are:
 - (i) A rapid decline in death rate, maternal mortality rate and infant mortality rate.
 - (ii) Increase in number of people in reproductive age.Two steps for checking population explosion:
 - (i) Statutory raising of marriageable age of the females to 18 years and males to 21 years.
 - (ii) Incentives given to couples with small families.
18. (a) and (b) are analogous organs.
(c) and (d) are homologous organs.
19. **Microbes used as biofertilisers:** Bacteria/Cyanobacteria/Blue Green Algae
 - *Rhizobium/Azospirillum/Azotobacter/Nostoc/Anabaena/Oscillatoria*/or any other correct example
 - Fixes atmospheric nitrogen into organic form/Enrich Nitrogen content of soil/Increases soil fertility
20. *EcoRI* is a restriction endonuclease. It cuts the strand of DNA a little away from the centre of the palindrome sites, but between the same two bases on the opposite strands. This leaves

single stranded portions at the ends. These are overhanging stretches called sticky ends on each strand.



SECTION-C

21. Criteria for determining biodiversity hot spots are:

- High levels of species richness.
- High degree of endemism.

Hotspots in India—Western Ghats, Himalaya

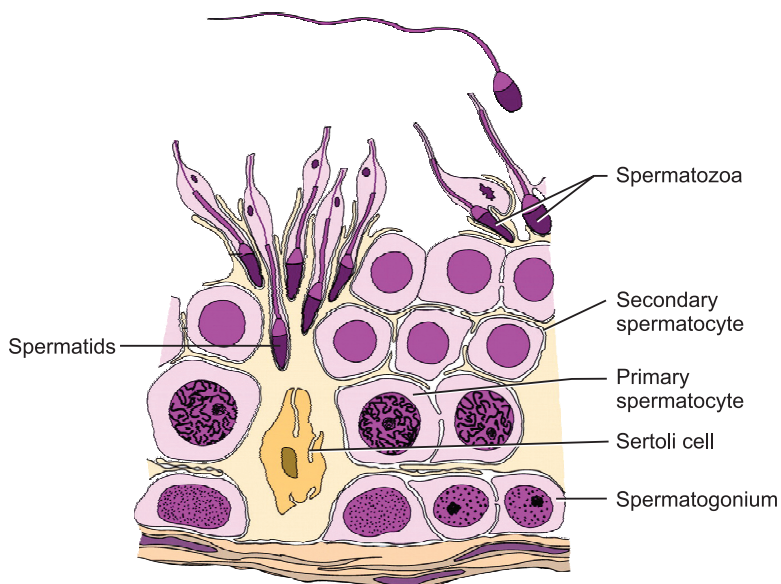
OR

S. No.	<i>In-situ</i> Conservation	<i>Ex-situ</i> Conservation
(i)	Threatened or endangered plants and animals are provided with urgent measures to save from extinction within their natural habitat and they are protected and allowed to grow naturally.	Threatened animals and plants are taken out from their natural habitat and placed in a setting where they can be protected and given care.
(ii)	Example: Wildlife sanctuaries/national parks/biosphere reserves/sacred groves.	Example: Botanical gardens/zoological gardens/seed banks/pollen banks/gene banks.

22. Pollen has an outer layer called exine which is made of sporopollenin.

It is the most resistant organic material known. It can withstand high temperature, strong acids and alkali as well. No enzyme that degrades sporopollenin is so far known.

23. (i)



(a) Cells that divide by mitosis to increase their number—Spermatogonia

(b) Cells that undergo Meiosis I—Primary spermatocytes

(c) Cells that undergo Meiosis II—Secondary spermatocytes

(d) Cells that help in the process of spermiogenesis—Sertoli cells

(ii) **Role of Leydig cells:** They synthesise and secrete testicular hormones called androgens.

24. (a)

Sex determination in human	Sex determination in honey bee
The sex determining mechanism in case of humans is XY type. Out of 23 pairs of chromosomes present, 22 pairs are exactly same in both males and females; these are the autosomes. A pair of X-chromosomes are present in the female, whereas X and Y chromosome is present in male.	The female have 32 chromosomes and males have 16 chromosomes. This is called haplo-diploid sex determination system.
<p>Parents ♂ $44A + XY$ ♀ $44A + XX$</p> <p>Gametes $22A + X$ $22A + Y$ $22A + X$</p> <p>Offsprings ♀ $44A + XX$ ♂ $44A + XY$</p>	<p>Parent Female 32 Male 16</p> <p>↓ Meiosis ↓ Mitosis</p> <p>Gametes 16 16 16</p> <p>F₁ Male 16 Female 32</p>

(b) In both the cases the gametes formed have half the number of chromosomes, i.e., they are haploid in nature.

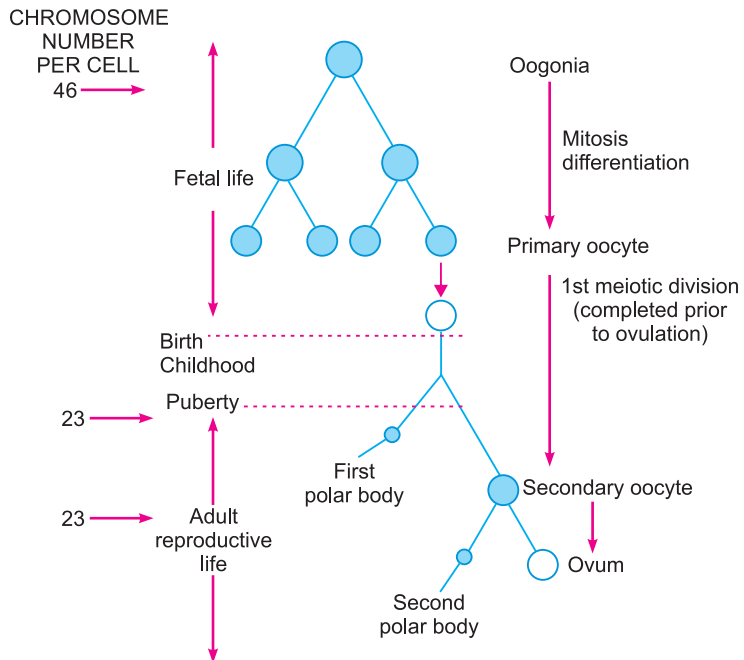
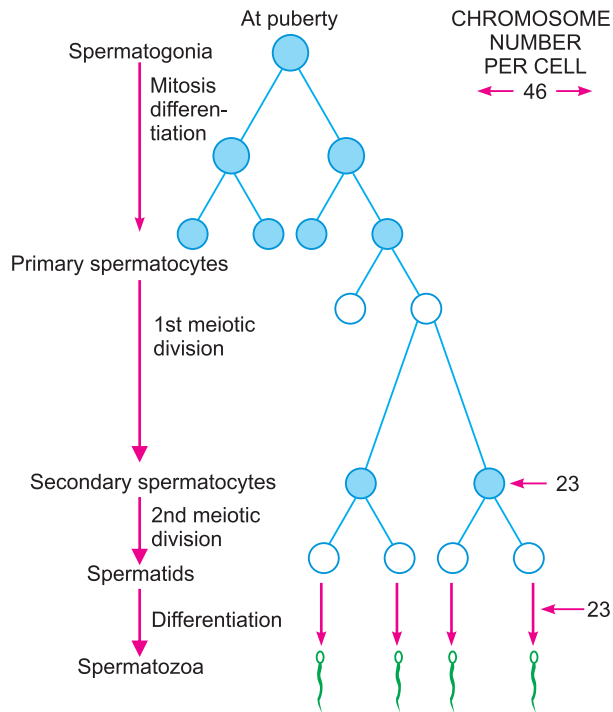
25. (a) Polarity from a to a' is $5' \rightarrow 3'$.
No more amino acid will be added to this polypeptide chain.
- (b) TCA; anticodon is UCA.
- (c) The untranslated sequence of bases are required for efficient translation process. They are present before the start codon at the $5'$ -end and after the stop codon at $3'$ -end.
26. (a) **ori**: Ori 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. It is also responsible for controlling the copy number of the linked DNA.
- (b) **amp^R**: The ligation of alien DNA is carried out at a restriction site present in any antibiotic resistance gene.
- (c) **rop**: It codes for the proteins involved in the replication of the plasmid.
27. The interaction between the species is mutualistic. In Petri dish-III it can be seen that both their growth has increased considerably when together. This can only be possible if both the species are helping each other in growth.
28. (a) ● Detritus rich in nitrogen decomposes faster. These are water-soluble substances like sugar.
● Factors enhancing rate of decomposition: Warm temperature, moist environment, availability of oxygen.
- (b) **Humification**: Accumulation of dark coloured amorphous substance called humus which is resistant to microbial action and undergoes decomposition at a very slow rate.
Mineralisation: Humus is further degraded by microbes releasing inorganic nutrients.

SECTION-D

29. (a) When the inducer comes in contact with repressor, it is inactivated.
- (b) When lactose is lacking or absent, the transcription of *lac* mRNA stops.
- (c) β -galactosidase.
- OR**
- (c) lactose or allolactose acts as an inducer here, it binds with the repressor here to deactivate it so it cannot bind with the operator.
30. (a) Saline solution does not have any effect in lowering the blood cholesterol whereas RNAi treatment lowers the blood cholesterol with time.
- (b) RNA interference (RNAi) takes place in all eukaryotic organisms as a method of cellular defense..
- (c) The specific RNA is silenced by complementary dsRNA. dsRNA binds and prevents translation of mRNA.
- OR**
- (c) RNAi is also useful in some prokaryotic organisms.

SECTION-E

31.



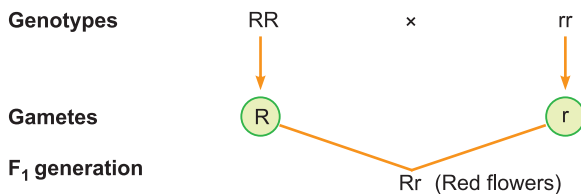
OR

- Rapid release of luteinising hormone ruptures Graafian follicle and release ovum (ovulation).
- Corpus luteum secretes large amount of progesterone hormone that is essential for maintenance of the endometrium required for implantation of blastocyst leading to pregnancy.
- Placenta produces several hormones like human chorionic gonadotropin (hCG), human placental lactogen (hPL). Relaxin is also produced during later phase of pregnancy. Level of other hormones like estrogens, progestogens, cortisol, prolactin and thyroxine also increases which is essential for supporting foetal growth, metabolic changes in mother and maintenance of pregnancy.
- Parturition signals originate from the fully developed foetus and the placenta induce mild uterine contractions which triggers release of oxytocin from pituitary. Oxytocin acts on the uterine muscle causing stronger uterine contractions.
- Mammary glands undergo differentiation during pregnancy and produce milk by lactation. Secretion and storage of milk occurs under influence of hormone. Prolactin secreted by anterior lobe of pituitary. Ejection of milk is stimulated by oxytocin from posterior lobe of pituitary.

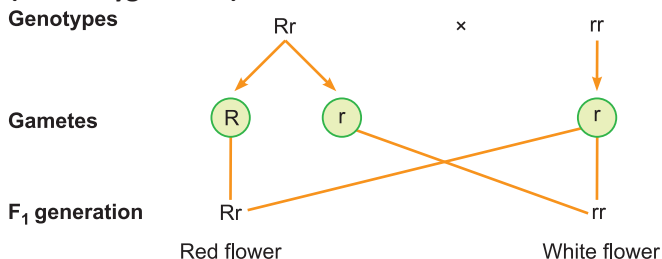
32. A test cross is required to find out the genotype of both the plants.

(a) Garden pea

(Homozygous red)

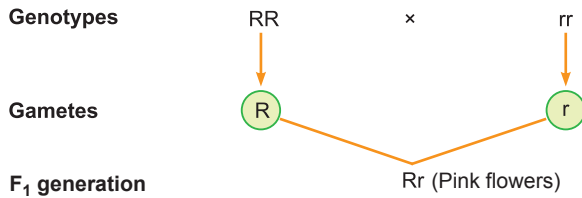


(Heterozygous red)



If the F₁ generation plants have all red flowers, the genotype of the parent plant will be homozygous dominant and if the F₁ generation plants have red and white flowers in the ratio of 1 : 1, then the genotype of the parent plant is heterozygous dominant. This inheritance follows the Mendelian law of dominance.

(b) In snapdragon:

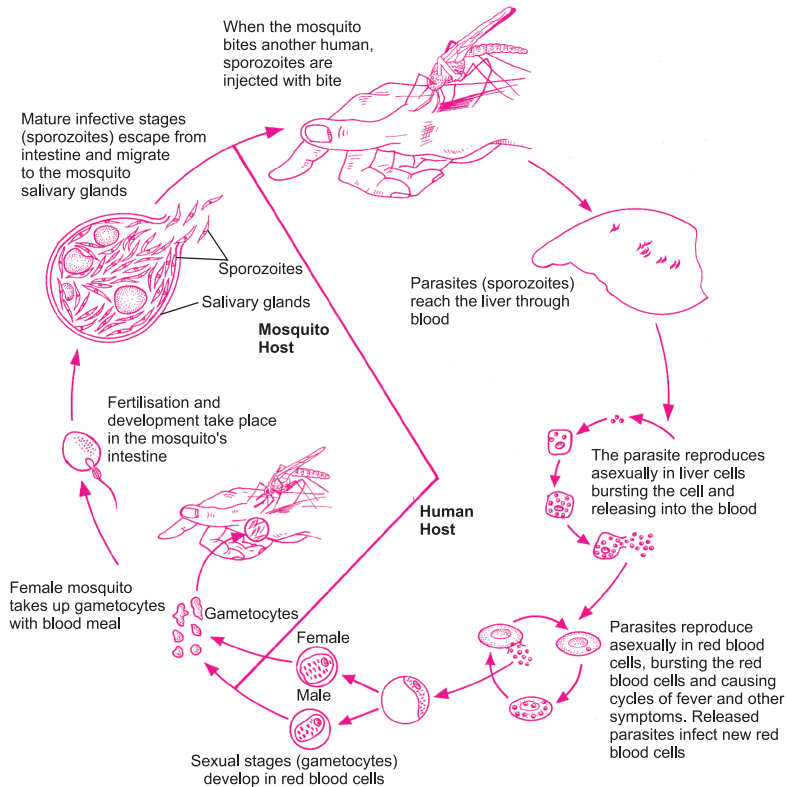


The parent plant will be homozygous for flower colour because a heterozygous plant will have pink flowers due to the phenomenon of incomplete dominance.

OR

- (a) Short stature/small round head/furrowed tongue/partially open mouth/mental development retarded.
- (b) Both
- (c) Klinefelter's syndrome
- (d) Male
- (e) (i) Sterile ovaries;
(ii) Lack of secondary sexual characters.
- (f) Female

33.



Stages:

- (a) The stage in which the parasite enters in the body of humans through saliva of mosquito—sporozoite stage.
- (b) Asexual reproduction of sporozoites in liver cells, resulting into bursting of those cells and releasing outside into the blood.
- (c) Sporozoites infect RBCs, cause them to get burst and represented by repeated cycles of fever. Released parasites also infect other RBCs.
- (d) Parasites then follow sexual stage in RBCs which is called as ring signet stage and appears as a ring inside the RBCs under microscope. Usually presence of malarial parasite in humans is identified by pathologists by this stage.
- (e) Female mosquito takes up gametocytes with the blood of host. Fertilisation and development takes place in the intestine of mosquito.
- (f) From intestine, parasite comes to the salivary glands from where it reaches to human body and that is how the cycle continues.

OR

- (a) Taking smack is considered as abuse because it is highly addictive. It is a depressant and slows down body functions. It causes psychological and physical dependence.
- (b) Its chemical name is diacetylmorphine and is obtained from poppy plant, *Papaver somniferum*.
- (c) Drugs taken intravenously (direct injection into the vein using a needle and syringe) are much likely to acquire serious infections like AIDS and hepatitis B. The viruses, which are responsible for these diseases are transferred from one person to another by sharing infected needles and syringes.
- (d) The withdrawal symptoms are:
 - (i) Anxiety
 - (ii) Shakiness
 - (iii) Nausea
 - (iv) Sweating



SAMPLE PAPER – 15

SECTION–A

1. (b)

(b)	3	3	2
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2. (c) (i) and (iv)
3. (d) $Aa \times aa$
4. (d) saltation
5. (c) toxin released from Plasmodium infected cells
6. (b) metastasis
7. (d) Activated sludge-sediment in settlement tanks of sewage treatment plant is a rich source of aerobic bacteria.
8. (d) oxygen consumption
9. (d) Availability of 'Thermostable' DNA polymerase
10. (d) availability of oxygen throughout the process
11. (c) removed during maturation of proinsulin to insulin
12. (c) (ii) and (iii)
13. (c) A is true but R is false
14. (a) Both A and R are true and R is the correct explanation of A.
15. (b) Both A and R are true and R is not the correct explanation of A
16. (b) Both A and R are true and R is not the correct explanation of A.

SECTION–B

17. Two reasons for increase in population are:
- (i) A rapid decline in death rate, maternal mortality rate and infant mortality rate.
 - (ii) Increase in number of people in reproductive age.
- Two steps for checking population explosion:
- (i) Statutory raising of marriageable age of the females to 18 years and males to 21 years.
 - (ii) Incentives given to couples with small families.
18. **Convergent evolution:** When more than one adaptive radiation appeared to have occurred in an isolated geographical area and two or more groups of unrelated animals resemble each other for similar mode of life or habitat, it is called convergent evolution, *e.g.*, Australian marsupials, placental mammals.
- Divergent evolution:** In some animals, the same structures developed along different directions due to adaptations to different needs. This is known as divergent evolution. For

example, forelimbs of whales, bats, cheetah and human perform different functions but have similar anatomical structure with similar bones arranged in similar segments.

19. *Trichoderma* act as biocontrol agent for several plant pathogens. *Trichoderma* produces immunosuppressive agent—Cyclosporin A.

20. Pest resistant plants

- It can be prevented by using RNA interference (RNAi) process which is checked by silencing of specific mRNA due to a complementary dsRNA.
- dsRNA binds and prevents translation of the mRNA (silencing).
- The source of this dsRNA could be from an infection by viruses having RNA genomes or mobile genetic elements (transposons) which replicate through an RNA intermediate.

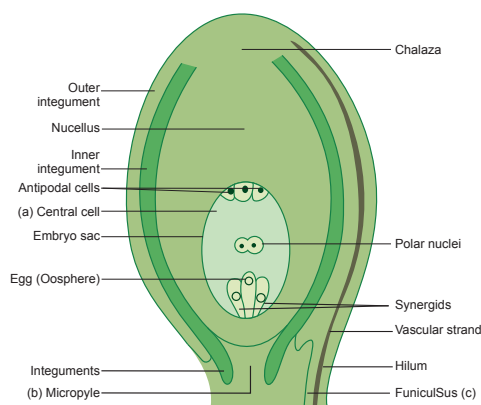
OR

- dsRNA binds and prevents translation of the mRNA (**silencing**).
- By using *Agrobacterium* vectors, nematode-specific genes were introduced into the host plants which produce both sense and anti-sense RNA in the host cells.
- These two RNAs are complementary to each other and form a double-stranded RNA (dsRNA) that initiates RNAi and hence silence the specific mRNA of the nematode.
- The parasite cannot survive in the transgenic host, so protects the plants from pests.

21. More biodiversity is found in the tropics. This is because tropical regions remain undisturbed from frequent glaciations as in polar regions. Also, the tropics are less seasonal/more constant.

SECTION-C

22.



23. The secretion of gonadotropins (LH and FSH) increases gradually during the follicular phase, and stimulates follicular development as well as secretion of estrogens by the growing follicles. Rapid secretion of LH leading to its maximum level during the mid-cycle, called LH surge, induces rupture of Graafian follicle and thereby the release of ovum (ovulation). The

corpus luteum secretes large amounts of progesterone which is essential for maintenance of the endometrium.

24. This law states that when two alternative forms of a trait or character (genes or alleles) are present in an organism, only one factor expresses itself in F_1 progeny and is called dominant while the other that remains masked is called recessive.

Mendel crossed tall and dwarf pea plants to study the inheritance of one gene. He collected the seeds produced as a result of this cross and grew them to generate plants of the first hybrid generation (F_1 generation). Mendel observed that all the F_1 progeny plants were tall. Mendel then self-pollinated the tall F_1 plants and found that in the F_2 generation some of the offspring were 'dwarf'; the character that was not seen in the F_1 generation was now expressed. The proportion of plants that were dwarf were $1/4$ th of the F_2 plants while $3/4$ th of the F_2 plants were tall. Based on these observations, Mendel proposed his law of dominance.

OR

Haemophilia	Thalassemia
<ul style="list-style-type: none"> ● This sex linked recessive disease, which shows its transmission from unaffected carrier female to some of the male progeny has been widely studied. ● In this disease, a single protein that is a part of the cascade of proteins involved in the clotting of blood is affected. Due to this, in an affected individual a simple cut will result in non-stop bleeding. ● The heterozygous female (carrier) for haemophilia may transmit the disease to sons. The possibility of a female becoming a haemophilic is extremely rare because mother of such a female has to be at least carrier and the father should be haemophilic 	<ul style="list-style-type: none"> ● It is an inherited autosomal recessive disorder of blood. ● Symptoms include fatigue, anaemia, weakness, paleness and slow growth. ● A child who inherits two thalassemia trait genes - one from each parent - will have the disease. A child of two carriers has a 25 percent chance of receiving two trait genes and developing the disease, and a 50 percent chance of being a thalassemia trait carrier.

25. (a) Nucleosome
 (b) a —Histone octamer, b —DNA, c — H_1 histone
 (c) In bacterial cell, DNA in nucleoid is organised in large loops held together by proteins.
26. (a) Since DNA fragments are negatively charged molecules they move towards the anode (positive rod) under an electric field through a medium/matrix.
 (b) Agarose gel.
 (c) The separated DNA fragments can be visualised only after staining the DNA with ethidium bromide followed by exposure to UV radiation. It is visible as orange coloured bands.
27. (a) Amensalism
 (b) Predation

Justifications:

- (a) It is the nature's way of transferring energy fixed by plants to higher trophic levels/ conduits for energy transfer.
 - (b) Keep prey population under control.
 - (c) Predators help in maintaining species diversity in a community, by reducing the intensity of competition among competing prey species.
28. (a) B—Stable population, C—Declining population
- (b) The pyramids are plotted on the basis of age distribution of male and female of human population.

SECTION-D

29. (a) (c) uniform width throughout DNA.
- (b) In HIV single stranded RNA is converted to double stranded DNA.
 - (c) Histones are positively charged basic proteins. The negatively charged DNA is wrapped around the positively charged histone octamer to form nucleosome.

OR

P- nucleosome

Q-DNA

30. (a) To maintain the cells in their physiologically most active log/exponential phase.
- (b) Optimum conditions for achieving desired products are temperature, pH, substrate, salts, vitamins, oxygen.

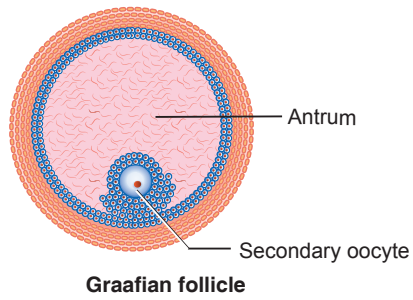
OR

In bioreactors large volume of culture can be processed which results in higher yields of the desired specific products (protein/enzyme). The entire process takes place under the controlled conditions of temperature, pH and raw materials.

SECTION-E

31. (a) Menstrual Phase
- The menstrual flow results due to breakdown of endometrial lining of uterus and its blood vessels, that are discharged through vagina.
 - The unfertilised egg and soft tissues are discharged.
 - It lasts for 3–5 days. It occurs only if released ovum is not fertilized.
- (b) Primary follicle grows into Graafian follicle under the influence of LH and FSH leading to regeneration of endometrium (under the influence of estrogen).
- (c) Graafian follicle ruptures to release the ovum (secondary oocyte) and remaining parts of the Graafian follicle gets transformed into corpus luteum.

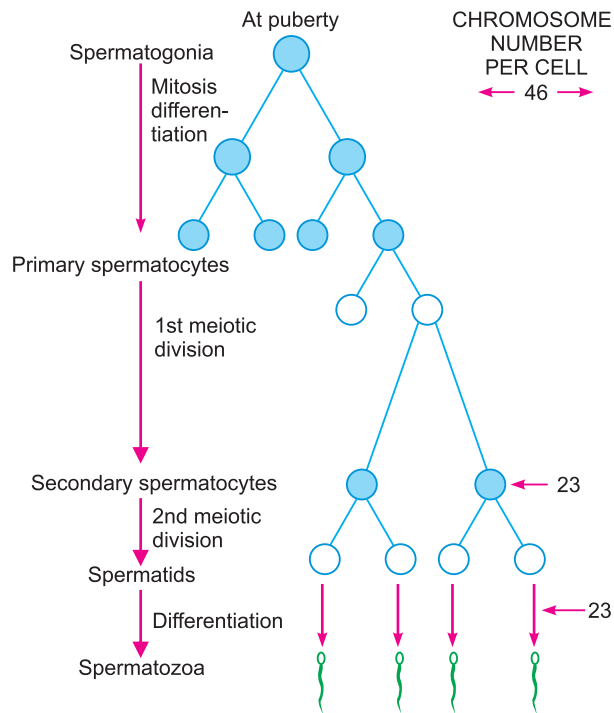
(d)



Graafian follicle

OR

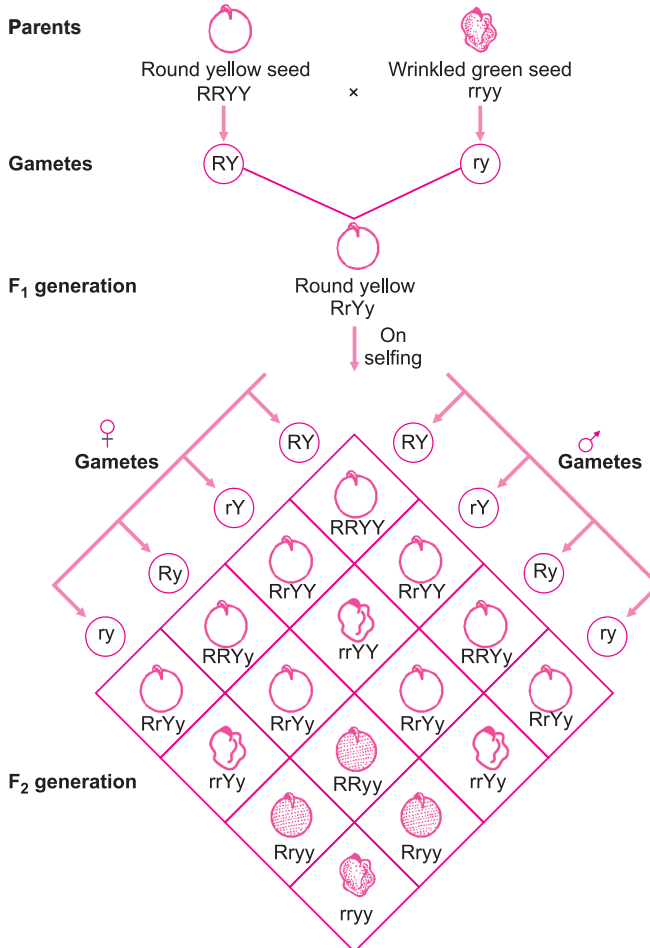
(a) Spermatogenesis occur in seminiferous tubules.



(b) The path of spermatozoa is as follows:

Seminiferous tubules → Rete testis → Vasa efferentia → Epididymis
→ Vas deferens → Ejaculatory duct

32.



Phenotypic ratio— Round yellow : Round green : Wrinkled yellow : Wrinkled green
9 : 3 : 3 : 1

(a) Law of Independent Assortment. The law states that ‘when two pairs of traits are combined in a hybrid, segregation of one pair of characters is independent of the other pair of characters’.

(b) (i) $rrYy, rRYY$

(ii) $RRyy, RrYy$

OR

(a) Both are caused due to alteration or mutation, in a single gene and follow Mendelian pattern of inheritance.

Symptoms:

Thalassemia: anaemia (caused due to defective/abnormal Hb).

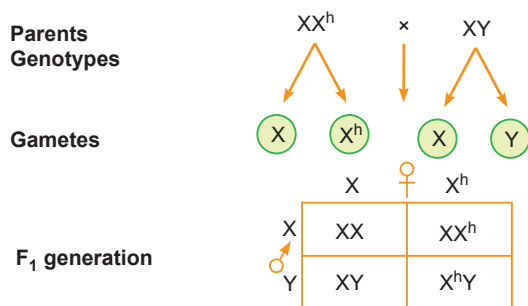
Haemophilia: non-stop bleeding even in minor injury.

Pattern of inheritance:

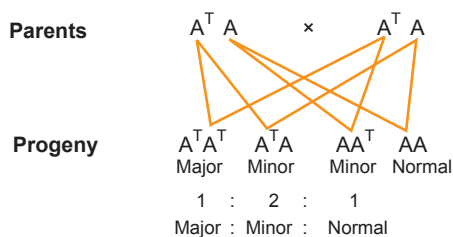
Thalassemia: autosomal recessive inheritance pattern inherited from heterozygous/parent carrier.

Haemophilia: X-linked recessive inheritance inherited from a haemophilic father/carrier mother (females are rarely haemophilic).

Cross for haemophilia:



Cross for thalassemia:



Thalassemia is an autosome-linked recessive blood disease. Its inheritance is like Mendelian inheritance pattern.

(b) XX^h and XY

33. (a) Plant source of cocaine is *Erythroxylum coca*. It has a potent stimulating action on central nervous system, producing a sense of euphoria and increased energy. Excessive dosage of cocaine causes hallucinations.
- (b) Sharing of needles can transmit diseases like HIV, AIDS, Hepatitis B or C from infected to non-infected individuals.
- (c) Useful drug—morphine, Harmful drug—heroin.
- (d) Smoking increases the carbon monoxide (CO) content in the blood which has greater affinity to haemoglobin than oxygen. CO forms a stable bond with haemoglobin and does not allow binding of oxygen. Smoking also damages alveolar walls, which reduces respiratory surface (emphysema).

OR

- (a) A—Gametocytes of *Plasmodium* enter the mosquito when it bites a malarial patient and feed on blood.
- (b) C—Fertilisation. It occurs in the intestine of mosquito.
- (c) B—Salivary gland of the female *Anopheles* mosquito. These release sporozoites of *Plasmodium*.

- (d) Sexual reproduction occurs in mosquito and asexual reproduction takes place in human body.
- (e) The name of the toxin is haemozoin. Parasites after entering the fresh RBCs take 48 to 72 hours to complete the erythrocytic cycle, rupturing the erythrocytes. They then burst to release toxic substance called haemozoin and the symptoms like chill and high fever occurs periodically.

