

BIOLOGY SOLUTION

SECTION A

1. Embryonic Stage No. of cells

Zygote	(a) 1
Morula	(b) 16
Blastocyst	(c) 64

2. The reduction division (that is halving of chromosomal number) takes place during gametogenesis and regaining the $2n$ number occur as a result of fertilisation.
3. The trait is autosome linked and recessive in nature. Both the parents are carrier (i.e., heterozygous) hence among offspring few show the trait irrespective of sex. The other offsprings are either normal or carrier.
4. Ectopic pregnancy, also known as tubal pregnancy, is a complication of pregnancy in which the embryo attaches outside the uterus.
5. The wasp uses the fig plant ovary for oviposition. It also uses the developing seeds of the fruit to nourish its larvae.
6. When more than two alternative forms of a gene are present on the same locus it is said to exhibit multiple allelism.
7. Trisomic and monosomy condition is resulted due to non-disjunction. It may lead to Down syndrome (47 chromosomes) or Turner syndrome (45 chromosomes).
8. Sharing of injection needles may act as a mode of transmission of certain diseases including AIDS. Thus, it is not recommended.
9. The patent was filed for Basmati rice.
10. Palm tree sap is used in making Toddy by the process of fermentation.
11. (a) The assertion is a true statement but the reason is false.

OR

- (a) Both assertion and reason are correct.
12. (a) Both Assertion and Reason are incorrect.
13. (a) Both Assertion and Reason are correct.
14. (a) Both Assertion and Reason are correct.
15. (i) (b) regulator
(ii) (d) Reduced surface area to volume ratio
(iii)(c) migration
(iv)(d) Lizard – Aestivation
(v) (a) conformer

16. (i) (a) two theca
 (ii) (b) tapetum
 (iii)(c) sporogenous tissue
 (iv)(b) microsporogenesis
 (v) (b) The Assertion is correct but the Reason is incorrect.

SECTION B

17. Significance of progesterone-estrogen combination as a contraceptive pill are as follows:
 (i) They are convenient as they need to be taken orally.
 (ii) They have least side effects and hence are user-friendly.

18.

S.No.	Genotype	Blood Group
1	$I^A I^A$	A
2	$I^A i$	A
3	$I^B I^B$	B
4	$I^B i$	B
5	$I^A I^B$	AB
6	ii	O

19. No, as GMO may pose some threat to environment or living organism. I will ask her to approach GEAC, as GEAC is responsible for approval of proposals relating to release of genetically engineered organisms and products into the environment including experimental field trials.

Values

- Sense of responsibility.
 - Understanding.
20. Successful operations were carried out so far, to donate organs from a live person or diseased person. These include organs like heart, intestine, kidneys, lungs, pancreas, grafts like bones, corneas, heart valves, skin grafts, tendon, etc. Most of the times all the donor were human beings. Scientists are working out ways to develop some healthy tissues inside animals which may serve the same function if implanted in the human body but there are risks of severe allergies and autoimmune response.

OR

Amendments to the patent bill have empowered India to prevent unauthorized exploitation of our bio-resources and traditional knowledge by other countries. This bill also considers patent terms and initiated research development in this field.

21. UGA is a stop/termination codon.
 UAA and UAG are the other codons of same category.
 These codon terminate the elongation of polypeptide chain during translation.

22. Recombinant DNA technology / Genetic engineering

Three steps are:

- Isolation of human DNA with a desirable gene.
- DNA segment is incorporated into the bacterial plasmid to form recombinant DNA.
- Recombinant DNA is introduced in a bacterial cell, which makes protein directed by human DNA.

OR

Gene cloning refers to a process in which a gene of interest is ligated to a vector. The recombinant DNA thus produced is introduced in a host cell by transformation. Each cell gets one DNA molecule and when the transformed cell grows to a bacterial colony, each cell in the colony has a copy of the gene.

23. The unlabelled areas are:

- a. Fishes
- b. Amphibians

24. (i) Population density

- (ii) Natality or birth rate
- (iii) Mortality or death rate
- (iv) Population growth
- (v) Sex ratio
- (vi) Age distribution

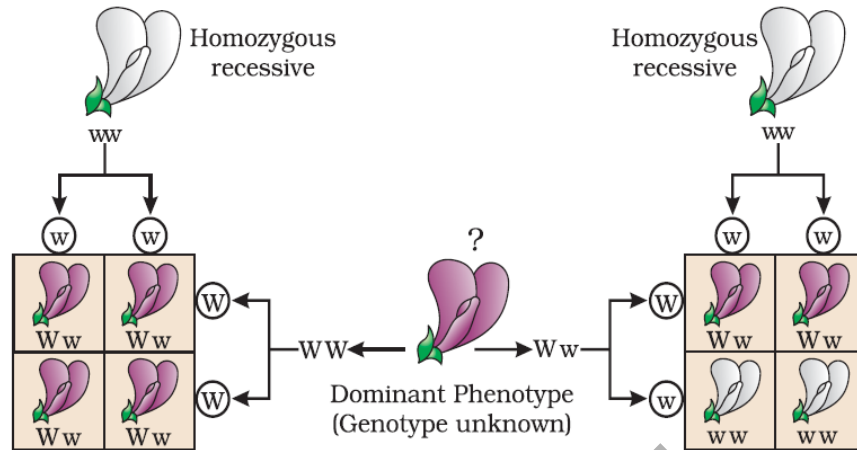
25. Some possible explanations are that the alien species may be

- (i) Vigourously growing and compete with the natural plants for minerals, water, etc.
- (ii) The less vigorous local species may be eliminated.
- (iii) Natural pests and predators of the alien species may not be present in the introduced area-leading to proliferation in their number.
- (iv) The introduced species may harm the local species by the production of chemicals (Amensalism).
- (v) The alien species by proliferation may make conditions unfavorable for the growth of local native plants. (e.g Eichornia).

SECTION C

26. Test Cross -This is a method devised by Mendel to determine the genotype of an organism. In this cross, the organism with an unknown dominant genotype is crossed with the recessive parent, instead of self-crossing.

For example, in a monohybrid cross, between violet colour flower (W) and white colour flower (w), the F_1 -hybrid was a violet colour flower. If all the F_1 -progenies are of violet colour, then the dominant flower is homozygous and if the progenies are in 1:1 ratio, then it is deciphered that dominant flower is heterozygous.



Result All flowers are violet

Interpretation Unknown flower is homozygous dominant

Half of the flowers are violet and half of the flowers are white.

Unknown flower is heterozygous

27. (i) a to a' is 5' → 3'. No more amino acid will be added to this polypeptide chain because of the encounter of stop codon, UAA.
 (ii) TCA codes for serine. Anticodon of tRNA for serine is UCA.
 (iii) The untranslated regions are required for efficient translation process. They are present before the initiation codon at the 5' end and after the stop/termination codon, at the 3' end.
28. An abnormal and uncontrolled division of cells is termed as Cancer.

The cancerous cells are different from the normal cells in the following ways.

Cancer cells	Normal cells
Cancer cells divide in an uncontrolled manner	Normal cells divide in a controlled manner.
The cells do not show contact inhibition.	The cells show contact inhibition.
Lifespan is indefinite.	Lifespan is definite.

In our body, the growth and differentiation of cells are highly controlled and regulated. The normal cells show a property called contact inhibition. The surrounding cells inhibit uncontrolled growth and division of cells. The normal cells lose this property and become cancerous cells giving rise to masses of cells called tumours. Transformation of normal cells into cancerous cells is induced by some physical, chemical and biological agents (carcinogens).

29. (i) A-AUG, B-UAA/UAG/UGA
 (ii) AUG codes for methionine. UAA/UAG/UGA does not code for any amino acid, but brings about termination of polypeptide synthesis.
 (iii) In the large subunit of ribosome, there are two sites in which subsequent amino acids bind to and come close enough for the formation of peptide bond. It is catalysed by the enzyme called peptidyl transferase.

30. The HIV virus attacks the macrophages in human body.
- RNA is replicated to form viral DNA by the enzyme reverse transcriptase.
 - Viral DNA gets incorporated into the host cell's DNA and directs the infected cells to produce viruses.
 - Macrophages continue to produce virus particles and function as HIV factories.
 - The virus particles enter helper T-lymphocytes in the blood, where they continue to replicate and produce viral progenies.
 - The number of helper T-lymphocytes progressively decreases in the body of the infected person.
 - With the decrease in number of T-cells, the immunity also decreases. The person is unable to produce any immune response even against common bacteria like Mycobacterium, parasites like Toxoplasma, viruses and fungi.

OR

AIDS (Acquired Immuno Deficiency Syndrome) is caused by the Human immunodeficiency virus (HIV).

It has the following modes of transmission:

- Unprotected sexual contact with an infected person.
- Transfusion of blood from a healthy to an infected person.
- Sharing infected needles and syringes.
- From an infected mother to a child through the placenta.

SECTION D

31. (i) Zona pellucida.
- (ii) The sperms in the female genital tract undergo activation by the secretions of the genital tract. The activated sperms undergo acrosomal reactions releasing chemicals contained in the acrosome. These chemicals act on follicle cells, corona radiata, and digest zona pellucida. The plasma membrane of the sperm fuses with the plasma membrane of secondary oocyte so that only the sperm nucleus enters the oocyte.
- (iii) It occurs in the ampullary-isthmic junction of the fallopian tube.
- Penetration of sperm nucleus induces meiotic division II to form ovum (ootid) and a secondary polar body. The fusion of the sperm with the ovum, nucleus form zygote, a process called fertilisation.
- The zygote undergoes within hours after fertilisation and the young embryo is slowly moving down the fallopian tube towards the uterus. At the end of the 4th day, the embryo reaches the uterus. It has 8-16 blastomeres and this solid mass of cells is known as morula (little mulberry) as it looks like a mulberry. The morula develops into a blastocyst (64-cells) with a cavity called blastocoel. It undergoes implantation.

OR

The female reproductive system consists of the following parts:

- (i) **Ovaries:** Ovaries are primary sex organs in the human female. These are paired organs located in the upper pelvic cavity. Each ovary is of the shape of an almond, The ovarian ligament attaches the ovary to the uterus.
- (ii) **Fallopian tubes (oviducts):** There is a pair of the oviduct is a muscular tube lined by ciliated epithelium It has three parts.
Infundibulum Ampulla Isthmus
- (iii) **Uterus:** The uterus is a large pear-shaped highly elastic median sac for the development of the embryo.
- (iv) **Vagina:** It is a long tube, that extends from the cervix to the outside of the body. It provides a passage for the menstrual flow.
- (v) **External genitalia (vulva) :** It consists of the mons pubis, labia majora, labia minora, clitoris vestibule, urethral opening, and vaginal opening.

32. (i) **Restriction endonucleases** -These are the bacterial enzymes that cut dsDNA into fragments after recognising and binding to the specific nucleotide sequences, known as recognition site. These enzymes are used to form recombinant molecules of DNA, composed of DNA from different sources.
- (ii) **Gel-electrophoresis** is the technique which allows the separation and visualisation of fragments of DNA on an agarose gel matrix.
Since the DNA fragments are negatively-charged molecules, they separate and move towards the anode (+ve) under the influence of an electric field. DNA fragments are separated on the basis of their size through the sieving effect provided by the gel.
- (iii) **Selectable markers** in pBR322 help in identification and selection of transformants. pBR322, an *E. coli* cloning vector has two antibiotic resistance genes, i.e. for ampicillin and tetracycline, which act as a selectable marker. When a foreign DNA is ligated at the site of tetracycline resistance (tet^R) gene in pBR322, the recombinant plasmid will lose tetracycline resistance due to insertional inactivation of foreign DNA, but can still be selected out from non-recombinants by placing the transformants on ampicillin containing a medium. The transformants growing on ampicillin containing medium are then transferred on tetracycline containing a medium. The recombinants will grow on ampicillin containing medium but not on tetracycline one whereas non-recombinants grow on both.

OR

Polymerase Chain Reaction (PCR) is a technique to obtaining multiple copies of a gene of interest in vitro. This technique amplifies DNA through a simple enzymatic reaction. This technique was developed by Kary Mullis.

The basic requirements of a PCR are the following:

- (i) DNA template
- (ii) Primers
- (iii) Enzyme-Taq polymerase

Amplification of recombinant DNA gene is done using Polymerase Chain Reaction (PCR). It is carried out in the following steps:

(i) Denaturation - The double-stranded DNA is denatured by applying high temperature of 95°C for 15 seconds. Each separated strand acts as a template.

(ii) Annealing - Two sets of primers are added, which anneal to the 3' end of each separated strand.

(iii) Extension - DNA polymerase extends the primers by adding nucleotides complementary to the template provided in the reaction. Taq polymerase is used in the reaction, which can tolerate heat. All these steps are repeated many times to get several copies of the desired DNA.

33. (i) The category of microbes naturally occurring in sewage and making it less polluted are bacteria and fungi, wherein masses of bacteria get associated with filaments of fungi to form a mesh-like structure called flocs.
- (ii) The different steps involved in secondary or biological treatment of sewage :
- The secondary treatment of sewage is also called biological treatment because, in this treatment, sewage is subjected to biodegradation. It means that it involves the participation of microorganisms. The process of secondary treatment involves the following steps:
- (a)** Primary effluent is passed into large aeration tanks with constant mechanical agitation and air supply. This allows vigorous growth of useful aerobic microbes into flocs (masses of bacteria and fungi filaments).
- (b)** These microbes consume a major part of organic matter in the effluent while growing. This reduces the BOD of the effluent.
- (c)** When BOD of sewage gets reduced, it is passed into the settling tank. The bacterial flocs settle in the tank and the sediment is called activated sludge. A small amount of activated sludge is pumped back into the aeration tank to serve as inoculum.
- (d)** The remaining major part of the sludge is pumped into large tanks called anaerobic sludge digesters, where other kinds of bacteria, which grow anaerobically, digest the bacteria and the fungi in the sludge. During this process, bacteria produce a mixture of gases, such as methane, hydrogen sulphide and carbon dioxide, which form biogas. The effluent from secondary treatment is generally released into natural water bodies. It helps to reduce water pollution and water-borne diseases.

OR

- (i) The uses of respective organism are as follows:
- (a) Making of curd
 - (b) Fermented beverage
 - (c) Acts as an immunosuppressive agent during organ transplants
 - (d) Production of biogas
 - (e) Biological control of pests and diseases
 - (f) Used as Biofertilizer
- (ii) Biofertilizers are organisms that enrich the nutrient quality of the soil. It involves the selection of beneficial micro-organisms that help in improving plant growth through the supply of plant nutrients. These are introduced to seeds, roots, or soil to mobilize the availability of nutrients by their biological activity. Thus, they are extremely beneficial in enriching the soil with organic nutrients. Biofertilizers are cost-effective and eco-friendly. The main sources of biofertilizers are bacteria, fungi and cyanobacteria.