

Section A

1.

(b) Grass → Grasshopper → Frog → Snake → Eagle

Explanation:
Grass → Grasshopper → Frog → Snake → Eagle
2.

(a) Consap

Explanation:
Central drug research institute, Lucknow, India has developed a spermicidal cream called Consap. It has the capability of killing the sperm released during insemination.
3.

(c) Wildlife Safari Parks

Explanation:
Wildlife Safari Parks
4.

(c) Copper-T

Explanation:
Copper-T is a contraceptive method under intrauterine contraceptive device which prevents implantation and reduces the motility of sperm. It is implanted inside the uterus and works up to five years. So, it is the best method for spacing between two children.
5.

(b) Thermophilic bacterium

Explanation:
Thermophilic bacterium
6.

(c) IARI and KVIC

Explanation:
Cattle dung is used for the production of biogas, commonly called gobar gas. The technology of biogas production from cow dung was developed in India mainly due to the efforts of the Indian Agricultural Research Institute (IARI) and Khadi and Village Industries Commission (KVIC).
7.

(b) Haemophilia and red green colour blindness

Explanation:
Haemophilia and red-green colour blindness both are a sex-linked recessive gene on X chromosome. Body height is an example of polygenic inheritance. Rhesus blood group is based on the presence or absence of Rh-protein on the surface of RBC, phenylketonuria (PKU) is a recessive autosomal variation.
8.

(d) A-electrodes, $B-NH_3 + H_2 + H_2O + CH_4$, C-cold water, D-vacuum, E-U trap

Explanation:
A-electrodes, $B-NH_3 + H_2 + H_2O + CH_4$, C-cold water, D-vacuum, E-U trap

9. (a) Interchange between producers and consumers

Explanation:

Interchange between producers and consumers

10.

- (d) Inheritance of a condition like phenylketonuria as an autosomal recessive trait

Explanation: Inheritance of a condition like phenylketonuria as an autosomal recessive trait

11.

- (b) Swiss cheese

Explanation:

Swiss cheese

12.

- (c) Escherichia coli

Explanation:

The construction of the first recombinant DNA was done by using the native plasmid of. **Escherichia coli**.

13.

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

Explanation:

Both A and R are true but R is not the correct explanation of A.

14.

- (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

Explanation:

Assertion and reason both are correct statements and reason is correct explanation for assertion.

15.

- (d) A is false but R is true.

Explanation:

A pyramid of numbers can be inverted because the number of insects feeding on a big tree is more than the number of trees on which insects are feeding.

16.

- (c) Assertion is correct statement but reason is wrong statement.

Explanation:

Assertion is correct statement but reason is wrong statement.

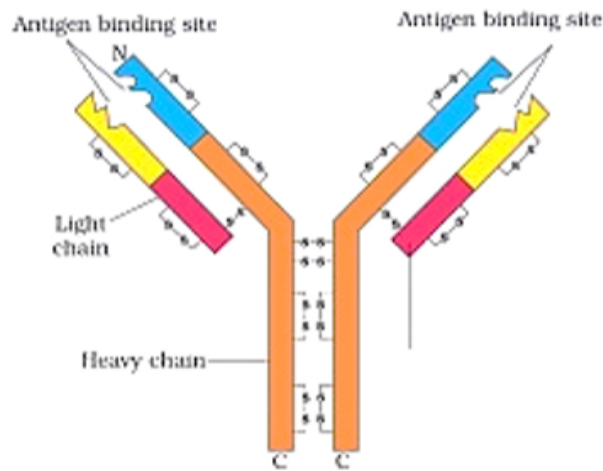
Section B

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17. a.

Humoral immune response	Cell-Mediated immune response
Mediated by B-lymphocytes	Mediated by T- lymphocytes
Antibodies are produced by B-lymphocytes in the blood.	T- cells do not secrete antibodies but help B-cells to produce them.
This is not responsible for graft rejection.	This is responsible for the graft rejection.

b.



18. i. Transcription unit



ii. RNA strand transcribed from the above transcriptional unit



19. (i) Pollen grains are produced in large quantities.

(ii) They are small, smooth and non-sticky.

20. A. = Trophoblast - Gets attached to the endometrium and draws nutritive material secreted by uterine endometrium gland.

B. = Inner cell mass - Differentiates as Embryo.

21. a. These consume the major part of organic matter in the effluent, and significantly reduce the BOD.

b. Anaerobic sludge digestors where anaerobic digestion of sludge takes place, producing 'Biogas' in the process.

OR

a. Baculoviruses / Nucleopolyhedrovirus

b. They are considered to be good bio-control agents because these viruses are excellent candidates for species-specific, narrow-spectrum insecticidal applications and show no negative impacts on plants, mammals, birds or even non-target insects and are desirable for integrated pest management.

Section C

22. a. DNA molecule

b. mRNA transcript

c. RNA polymers

d. Rho factor

23. Haemophilia is a recessive X-linked genetic type disorder. Haemophilia is more common among males than females because males only inherit one X-chromosome. There are 46 chromosomes in humans Females have XX chromosome while males have X and Y chromosome. So, male offspring inherit X-chromosome from their mother and Y-chromosome from their father. Males only have one X-chromosome and if the X-chromosome carries the mutation, this is the reason that males are suffering from haemophilia. While in females as they have two X chromosomes, and this is a recessive disorder.

24. A = +

B = +

C = Competition

D = +

E = -

F = Commensalism

25. Molecular diagnostic techniques to detect pathogens from suspected patients are as follows

i. Polymerase Chain Reaction (PCR)

ii. Recombinant DNA technology

iii. Enzyme Linked Immuno Sorbent Assay (ELISA)

The advantage of these techniques is that they help in the early detection and treatment of diseases, which is not possible by the conventional diagnosis.

26. a. Yes, We share the planet with many other organisms like plants / animals / microbes ,every species has an intrinsic value, moral duty to take care of other organism wellbeing, pass on our biological legacy in good order to future generations.
- b.
 - Regions showing very high level of species richness, high degree of endemism.
 - Accelerated habitat loss.

OR

- a.
 - **Habitat loss**- loss of habitat leads to loss of biodiversity and threatens the survival of plants and animals to extinction.
 - **Fragmentation**- animals and birds requiring large territories and certain animals with migratory habits are badly affected due to fragmentation, leading to population decline.
- b. Many commercially important species are overharvested, endangering their existence which may lead to their extinction.
27. This is a debatable point that evolution and natural selections are the end result or consequence of some other processes but themselves do not process. When we discuss the success of life on the earth then we treat evolution and natural selection as a process. But when discussions how life has evolved from simple forms then evolution and natural selection appear to results in some other processes. Among the scientific community; this issue is still a moot point.
28. During vaccination for a particular disease, an antigen or antigenic protein or pathogen which is in inactive form is introduced into the body to induce a mild immune response.
- The vaccine generates antibodies that neutralise the toxin/pathogen and produces memory B or T-cells, which recognise the pathogen in the subsequent encounters and produce antibodies.

Section D

29. i. The embryo at 64 celled stage is known as blastocyst. It comprises of an inner cell mass which is attached to embryonic pole and an outer covering of cells which is known as trophoblast. The trophoblast later forms the chorion which is part of placenta. The inner cell mass has the property to undergo unlimited symmetrical divisions without getting differentiated.
- ii. Embryo with 64 cells is called blastula (blastocyst) and has blastocyst cavity. Blastocyst is composed of an outer envelope of cells called trophoblast and inner cell mass.
- iii. Implantation is the attachment of blastocyst to the uterine wall. The portion of blastocyst where the inner cell mass is located lies against the endometrium of uterus.

OR

Zygote → Morula → Blastula → Gastrula.

30. i. A - Protein coat
- ii. B - Reverse transcriptase, X-viral RNA
- C - Viral DNA
- iii. D - Macrophages (animal or human cell)

OR

E - Macrophages and helper T-cells

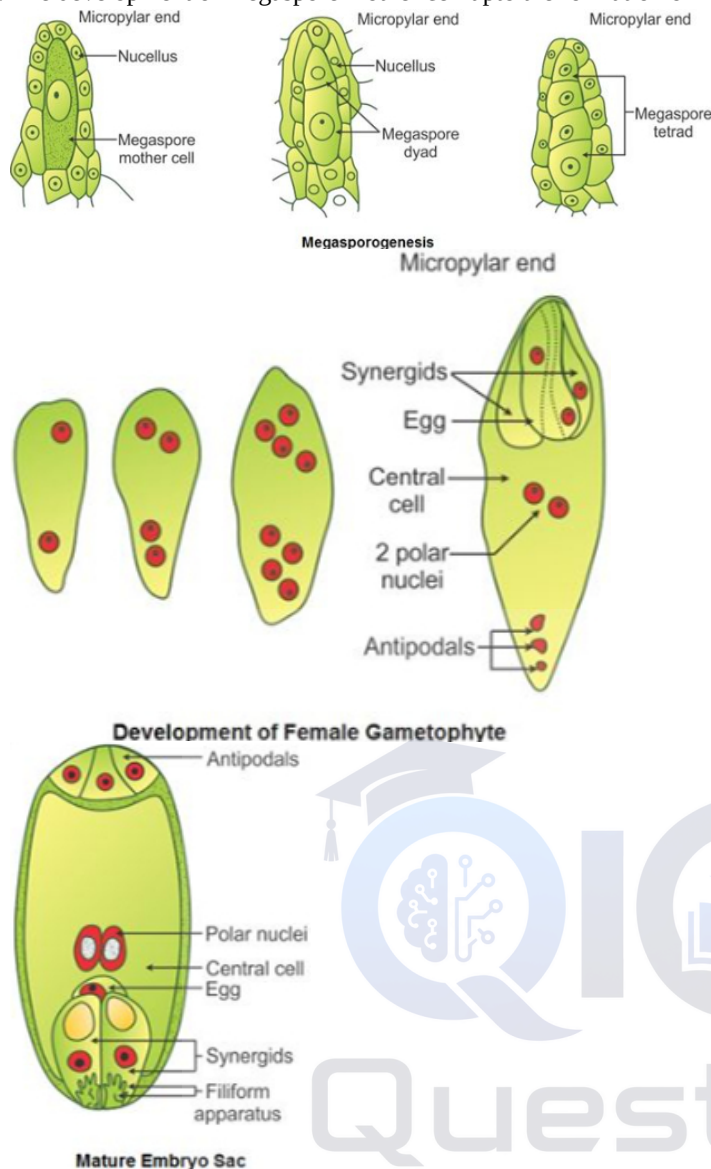
Section E

31. **Microsporogenesis** comprises the events which lead to the formation of the haploid unicellular microspores. During microsporogenesis, the diploid sporogenous cells differentiate as microsporocytes (pollen mother cells or meiocytes) which divide by meiosis to form four haploid microspores. Each diploid meiocyte gives rise to a tetrad of four haploid microspores and microsporogenesis is complete with the formation of distinct single-celled haploid microspores.

Microgametogenesis comprises events which lead to the progressive development of the unicellular microspores into mature microgametophytes containing the gametes. This phase begins with the expansion of the microspore which is commonly associated with the formation of a single large vacuole. Vacuolation is accompanied by the displacement of the microspore nucleus to an eccentric position against the microspore wall. In this position, the nucleus undergoes first pollen mitosis (pollen mitosis I) which results in the formation of two unequal cells, a large vegetative cell and a small generative cell each containing a haploid nucleus. The generative cell subsequently detaches from the pollen grain wall and is engulfed by the vegetative cell forming a unique 'cell within a cell' structure. The engulfed generative cell divides once more by mitosis (pollen mitosis II) to form the two sperm cells completely enclosed within the vegetative cell cytoplasm either before pollen is shed (tricellular pollen) or within the pollen tube (bicellular pollen).

OR

i. The development of megaspore mother cell upto the formation of mature embryo sac in flowering plant is



- ii. Geitonogamy is the transfer of pollen grains from the anther to the stigma of another flower of the same plant - xenogamy is the transfer of pollen from anther to the stigma of another plant.
- iii. Cleistogamous flowers or the flowers which never open.

32. i. One important technique in forensic science is DNA profiling, also known as DNA fingerprinting. DNA profiling analyzes specific regions of an individual's DNA to create a unique genetic profile. It is commonly used in criminal investigations to identify suspects, link evidence to a crime scene, or establish paternity.

- ii. Two additional applications of DNA fingerprinting other than its use in forensic science include the following:

Genealogy and Ancestry: DNA profiling can be used in genealogical research to trace family lineages and determine genetic relationships between individuals. It has become a popular tool for individuals interested in learning about their ancestry and building family trees.

Wildlife Conservation: DNA profiling helps in identifying and tracking endangered species, monitoring illegal wildlife trade, and investigating poaching cases. By analyzing DNA samples from animals and matching them to a database, researchers can gather valuable information about population sizes, migration patterns conservation purposes.

OR

- i.
 - X to $\bar{X}$ is $5' \rightarrow 3'$
 - No more amino acids will be added
 - as the last codon UAA is a stop codon
- ii.
 - AUG
 - Anticodon - UAC
 - methionine
- iii.
 - Charging of adopted molecule - The amino acids are activated in the presence of ATP, and linked to their cognate tRNA or the adapter molecule,

- Amino acids need to be charged so peptide bonds can be formed using this energy.

33. **Role of Heat** - In PCR (in vitro), the DNA strands are separated by heating them at 95°C for 2 minutes. Heating causes the breakdown of H-bonds between the bases of two strands leading to their unwinding.

Role of Primers - Primers are short lengths of DNA about 20bp long that are required to start DNA polymerisation in PCR. The primers hybridise to their complementary sequence on the DNA strands at 40-50°C temperature and help in DNA polymerisation.

Role of *Thermus aquaticus* - An enzyme called Taq polymerase is isolated from *Thermus aquaticus*. Since this bacterium thrives in temperature as high as 95°C, this enzyme can also tolerate high temperature without undergoing denaturation. Therefore, this enzyme is used in PCR instead of normal DNA polymerase.

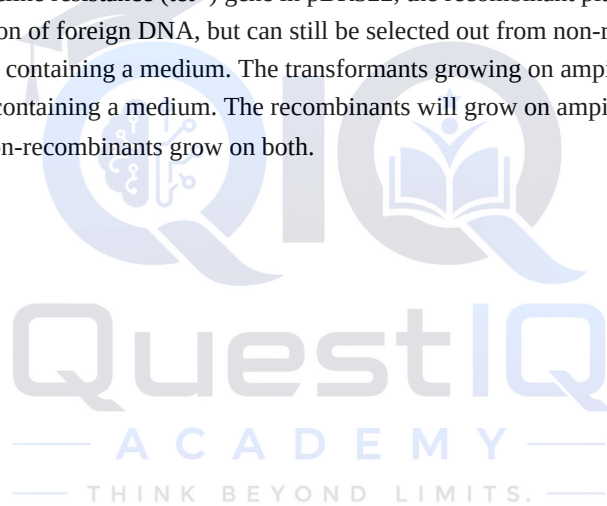
OR

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.



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