

1. Pushing out of full developed embryo from the uterus is called its: [1]
 - a) Conception
 - b) Oviposition
 - c) Parturition
 - d) Ovulation
2. Which of the following one is correct for a food chain? [1]
 - A. Grass-Grasshopper-Frog-Snake-Hawk
 - B. Grasshopper-Grass-Snake-Frog-Hawk
 - C. Hawk-Grasshopper-Grass-Frog-Snake
 - D. Frog-Snake-Hawk-Grasshopper-Grass
 - a) C
 - b) A
 - c) D
 - d) B
3. What do we understand by reproductive health? [1]
 - a) Total well-being in physical aspects of reproduction
 - b) All of these
 - c) The term simply refers to healthy reproductive organs with normal functions
 - d) Total well-being in emotional, behavioural and social aspects of reproduction
4. For what purposes Nucleopolyhedrovirus are being used now a days? [1]
 - a) Species-specific, narrow spectrum insecticidal applications
 - b) Non species-specific, narrow spectrum insecticidal applications
 - c) Species-specific, broad spectrum
 - d) Non species-specific, broad

insecticidal applications

spectrum insecticidal applications

5. Which one of the following is incorrect about the characteristics of protobionts (Coacervates and microspheres) as envisaged in the abiogenic origin of life? [1]
 - a) They could maintain an internal environment
 - b) They were able to reproduce
 - c) They could separate combinations of molecules from the surroundings
 - d) They were partially isolated from the surroundings
6. How has the bacterium *Bacillus thuringiensis* helped us in controlling caterpillars of insect pests? [1]
 - a) Plants contain *Bacillus thuringiensis* when eaten by the insect larvae, in the gut of the larvae the toxin is released by bacteria which killed larvae
 - b) Plants contain toxin produced by *Bacillus thuringiensis* when eaten by the insect larvae, in the gut of the larvae the toxin is released and the larvae get killed
 - c) *Bacillus thuringiensis* kill larvae by infecting them
 - d) All of these
7. A colour blind man marries a woman with normal sight who has no history of colour blindness in her family. What is the probability of their grandson being colour blind? [1]
 - a) 0.5
 - b) Nil
 - c) 1
 - d) 0.25
8. The length of mRNA that carries information of complete polypeptide synthesis is called: [1]
 - a) Muton
 - b) Codon
 - c) Operon
 - d) Cistron
9. Humans have increased extinction rate by a factor of: [1]
 - a) 10000
 - b) 100
 - c) 10
 - d) 1000
10. What is the criterion for DNA fragments movement on agarose gel during gel electrophoresis? [1]
 - a) Negatively charged fragments do not move
 - b) The smaller the fragment size, the farther it moves
 - c) Positively charged fragments move to farther end
 - d) The larger the fragment size, the farther it moves

11. The fungus *Penicillium notatum* is used to obtain the drug: [1]
 a) Penicillin b) Erythromycin
 c) Kanamycin d) Streptomycin

12. Sterilisation techniques are generally foolproof methods of contraception with the least side effects. Yet, this is the last option for couples because: [1]
 i. It is almost irreversible
 ii. The misconception that it will reduce sexual urge/drive
 iii. It is a surgical procedure
 iv. If lack of sufficient facilities in many parts of the country
 a) (ii) and (iv) b) (i), (ii), (iii) and (iv)
 c) (i) and (iii) d) (ii) and (iii)

13. **Assertion (A):** Whisky develops colour during the aging process. [1]
Reason (R): Vodka is colourless.
 a) Both A and R are true and R is the correct explanation of A. b) Both A and R are true but R is not the correct explanation of A.
 c) A is true but R is false. d) A is false but R is true.

14. **Assertion (A):** Archegonium is formed from the nucellus. [1]
Reason (R): Archegonium forms megaspore mother cell.
 a) Both A and R are true and R is the correct explanation of A. b) Both A and R are true but R is not the correct explanation of A.
 c) A is true but R is false. d) A is false but R is true.

15. **Assertion (A):** Cytoplasmic inheritance occurs only due to plasma genes. [1]
Reason (R): Plasmids are restricted to only two cell organelles, i.e., mitochondria and chloroplast.
 a) Both A and R are true and R is the correct explanation of A. b) Both A and R are true but R is not the correct explanation of A.
 c) A is true but R is false. d) A is false but R is true.

16. **Assertion (A):** Gametic isolation is common in free living aquatic forms. [1]
Reason (R): It may be seen in same species.
 a) Both A and R are true and R is the correct explanation of A. b) Both A and R are true but R is not the correct explanation of A.
 c) A is true but R is false. d) A is false but R is true.

Section B

17. Write any two ways of how genetically modified plants are found to be useful? [2]

18. Name the primary and secondary lymphoid organs. [2]
19. Name the type of inheritance in which the phenotypic and genotypic ratio are same. Also give the ratio. [2]
20. Name the organism that causes large holes in 'Swiss cheese'. How are these holes caused? [2]

OR

Microbes can be used to decrease the use of chemical fertilizers and pesticides. Explain how this can be accomplished?

21. Can we call human evolution as adaptive radiation? Why? [2]

Section C

22. Describe the various types of age pyramids. [3]
23.
 - i. In which ecosystem the pyramid of biomass inverted? [3]
 - ii. Why is it inverted? Explain.
 - iii. Name the type of pyramid that is always upright. Give reasons.
24. When a cross is made between a tall plant with yellow seeds (Tt Yy) and tall plant with green seed (Tt yy), what proportion of phenotype in the offspring could be expected to be - [3]
 - i. Tall and green
 - ii. Dwarf and green
25. Describe the three manners in which fertilization of human ovum by a sperm can be prevented. [3]
26. Refer the graph and answer the questions that follow: [3]



- i. The graph depicts which type of natural selection?
 - ii. Explain the other two effects/types of natural selection.
27. Define biosphere. What are the main sub-divisions of the biosphere? [3]

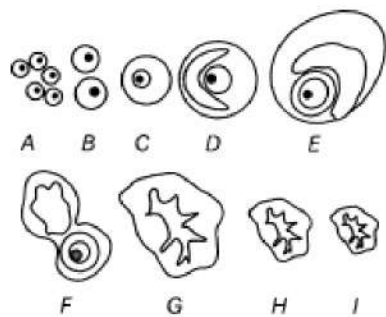
OR

Explain the levels of biodiversity at genetic, specific and ecological levels with the help of one example each.

28. What is antisense nucleic acid? [3]

Section D

29. **Read the text carefully and answer the questions:** [4]
 The following is the illustration of the sequence of ovarian events (A-I) in a humans female.



- Identify the figure that illustrates ovulation and mention the stage of oogenesis it represents.
- Name the ovarian hormone and the pituitary hormone that have caused the above mentioned event.
- Explain the changes that occur in the uterus simultaneously in anticipation.

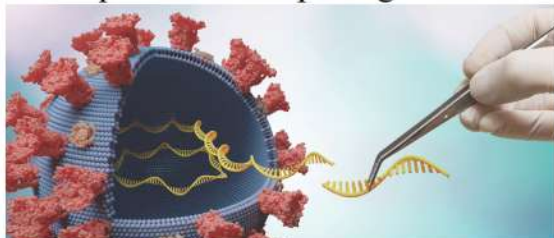
OR

Write the differences between C and H.

30. **Read the text carefully and answer the questions:**

[4]

A pathogen is defined as **an organism causing disease to its host**, with the severity of the disease symptoms referred to as virulence. Pathogens are taxonomically widely diverse and comprise viruses and bacteria as well as unicellular and multicellular eukaryotes. The immune system of a person is suppressed. He was found positive for a pathogen in the diagnostic test ELISA.



- Name the disease, the patient is suffering from.
- Which pathogen is identified by ELISA test?
- Which cells of the body are attacked by the pathogen?

OR

Suggest preventive measures of the infection.

Section E

31. How is a nucleosome formed? Draw the diagram of a nucleosome.

[5]

OR

Study the schematic representation of the genes involved in the lac operon given below and answer the questions that follows:

p	i	p	o	z	y	a
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- Identify and name the regulatory gene in this operon. Explain its role in 'switching off' the operon.

- ii. Why is lac operon's regulation referred to as negative regulation?
- iii. Name the inducer molecule and the products of the genes z and y of the operon. **OR**
- iv. Write the function of these gene products.

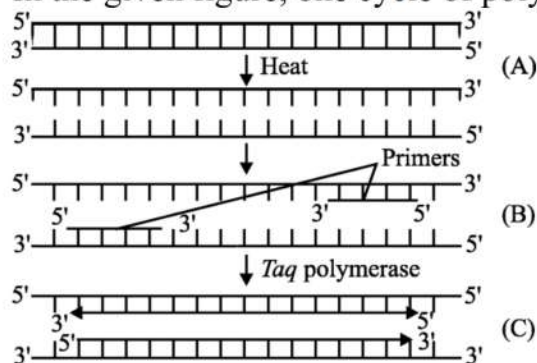
32. Draw a vertical section of maize grain label any three embryonic and three other parts. **[5]**

OR

Where does the archesporium originate in plants? Discuss the fate of archesporium.

33. The melding of a technique for repeated rounds of DNA synthesis with the discovery of a thermostable DNA polymerase has given scientists the very powerful technique known as polymerase chain reaction (PCR). PCR is based on three simple steps required for any DNA synthesis reaction: (1) denaturation of the template into single strands; (2) annealing of primers to each original strand for new strand synthesis; and (3) extension of the new DNA strands from the primers. **[5]**

In the given figure, one cycle of polymerase chain reaction (PCR) is shown:



- i. Name the steps A, B and C.
- ii. Give the purpose of each of these steps.
- iii. State the contribution of *Thermus aquaticus* in this process.

OR

Suggest and describe a technique to obtain multiple copies of a gene of interest in vitro.

SOLUTION

Section A

1. (c) Parturition
Explanation: Parturition
2. (b) A
Explanation: Grass-Grasshopper-Frog-Snake-Hawk
3. (b) All of these
Explanation: All of these
4. (a) Species-specific, narrow spectrum insecticidal applications
Explanation: Species-specific, narrow spectrum insecticidal applications
5. (b) They were able to reproduce
Explanation: They were able to reproduce
6. (b) Plants contain toxin produced by *Bacillus thuringiensis* when eaten by the insect larvae, in the gut of the larvae the toxin is released and the larvae get killed
Explanation: Plants contain toxin produced by *Bacillus thuringiensis* when eaten by the insect larvae, in the gut of the larvae the toxin is released and the larvae get killed
7. (b) Nil
Explanation: Nil
8. (d) Cistron
Explanation: Cistron
9. (d) 1000
Explanation: Various human activities like pollution, deforestation, urbanization, industrialization have increased the extinction rate of various organisms by a factor of 1000.
10. (b) The smaller the fragment size, the farther it moves
Explanation: The smaller the fragment size, the farther it moves
11. (a) Penicillin
Explanation: Penicillin
12. (b) (i), (ii), (iii) and (iv)
Explanation: (i), (ii), (iii) and (iv)
13. (b) Both A and R are true but R is not the correct explanation of A.
Explanation: At first several principles are present which makes whisky harsh and unpalatable. It must be aged to allow these principles to disappear. The whiskies are aged in charred oak containers. At first the whisky is colourless, the colour develops during the aging process. The vodka is not aged and bottled immediately after distillation and therefore it remains colourless.
14. (b) Both A and R are true but R is not the correct explanation of A.
Explanation: A single hypodermal cell in the nucellus functions as the archesporium. It becomes more prominent than its surrounding cells because of its larger size, denser cytoplasm and larger nucleus. In tenninucellate and pseudo-crassinucellate ovules the archesporial cell directly functions as megaspore mother cell whereas in crassinucellate ovules it divides periclinally, cutting an outer primary parietal cell and an inner primary sporogenous cell. The latter functions as the megaspore mother cell.
15. (c) A is true but R is false.
Explanation: A is true but R is false.
16. (c) A is true but R is false.
Explanation: In free living aquatic forms, where the fertilization is external, the gametes

produced by different species usually do not attract each other and this kind of barrier is known as gametic isolation.

Section B

17. The genetically modified plants are found to be useful as they
- reduce or minimise the use of agrochemicals, i.e. fertilisers, insecticides, herbicides, etc.
 - reduce post-harvest losses and enhance the nutritional value of the crop.
18. **Primary lymphatic organs** are where lymphocytes are formed and mature. They provide an environment for stem cells to divide and mature into B- and T- cells: There are two primary lymphatic organs: the red bone marrow and the thymus gland. The development of white blood cells (haemopoiesis) was covered briefly in the section on blood. Both T-cell and B-cells are 'born' in the bone marrow. However, whereas B cells also mature in the bone marrow, T-cells have to migrate to the thymus, which is where they mature in the thymus.
- Secondary lymphoid tissues** are arranged as a series of filters monitoring the contents of the extracellular fluids, i.e. lymph, tissue fluid and blood. The lymphoid tissue filtering each of these fluids is arranged in different ways. Secondary lymphoid tissues are also where lymphocytes are activated. These include: lymph nodes, tonsils, spleen, Peyer's patches and mucosa associated lymphoid tissue (MALT)
19. **Incomplete dominance** is a form of intermediate inheritance in which one allele for a specific trait is not completely expressed over its paired allele. A cross of two F1 hybrids, heterozygous for a single trait that displays incomplete dominance is predicted to give a **1:2:1** ratio among both the genotypes and phenotypes of the offspring
20. *Propionibacterium shermanii* is responsible for the ripening of Swiss cheese and the production of its characteristic taste and large gas bubbles. The "eye formation" are due to CO₂ bubbles that create the holes in the cheese. Contribute greatly to the taste and aroma of these types of cheeses

OR

By the use of biofertilizers and biological pest control method, the use of chemical fertilizers and pesticides can be reduced. The fertility of the soil depends not only on its chemical composition but also on the presence of useful microbes in it, which enrich the nutrient quality of the soil. The main source of biofertilizers are bacteria, fungi and cyanobacteria.

21. No, because in human evolution, brain size, skeletal structure, dietary preference and social and cultural evolution occurred while in adaptive radiation, the origin, basic structure and the development of the organs remain same only morphological changes occurs.

Section C

22. **Age pyramids are of three types:**
- Triangular age pyramids: The number of pre-reproductive individuals is very large. Number of reproductive individuals is moderate while post reproductive individuals are lower. Population is growing.
 - Bell shaped age pyramids. The number of pre-reproductive and reproductive individuals is almost equal, post reproductive individuals are comparatively fewer. The population size remains stable.
 - Urn shaped age pyramid. Proportion of reproductive age group is higher than the individuals in pre-reproductive age group. Number of post reproductive individuals is also sizeable. It is declining population with negative growth.
23. i. Pyramid of biomass is inverted in aquatic habitats.

- ii. The pyramid depends upon reproductive potential and longevity of its members. The biomass of phytoplankton is smaller than that of zooplankton and that of zooplankton less than of primary carnivores.
- iii. Pyramid of energy is always upright. It is because the producers are the only organisms which can trap solar energy and the energy always flows from producers to herbivores and then carnivores. As the energy passes to higher trophic levels, its amount decreases because of dissipation as heat, used in overcoming entropy as well as for performing various body activities.

24.

Parents	Tall Yellow Tt Yy				×	Tall Green Tt yy	
	TY	Ty	tY	ty		Ty	ty
Gametes	TY	Ty	tY	ty			
	Ty	TT Yy	TT yy	Tt Yy	Tt yy		
	ty	Tt Yy	Tt yy	tt Yy	tt yy		

Phenotypic ratio:

Tall yellow : tall green : Dwarf yellow : dwarf green

3 : 3 : 1 : 1

Tall and green = 3

Dwarf and green = 1.

25. In barrier methods, ovum and sperms are prevented from physically meeting e.g.
 1. Condoms: They are made of thin rubber / latex sheath used to cover the penis in the male or vagina and cervix in the female just before coitus so that the ejaculated semen is not released in the female reproductive tract.
 2. Diaphragms, cervical caps and vaults: These are also made of rubber, inserted into the female reproductive tract to cover the cervix during coitus. They prevent fertilization by blocking the entry of sperms through the cervix.
 3. Intra Uterine Devices (IUDs.) : These devices are inserted by doctors in the uterus through vagina. These are available as non medicated IUDs (Lippes loop), copper releasing IUDs (CuT, Cu7) and hormone releasing IUDs (LNG-20). IUDs increase phagocytosis of sperms within the uterus and suppress sperms motility
26. i. The graph depicts disruptive natural selection. This type of selection tends to eliminate intermediate types.
 - ii. The other two types of natural selection are
 - a. Directional selection - Large number of individuals acquire value other than mean character value.
 - b. Stabilizing selection - Large number of individuals acquire mean character value.
27. The entire inhabited part of the earth and its atmosphere including the living components is called the biosphere.

The three main constituents of the biosphere are:

 - i. **Hydrosphere:** It includes all the water components of oceans, seas, rivers and other inland water.
 - ii. **Lithosphere:** It comprises the solid components of the earth crust which support life.
 - iii. **Atmosphere:** It is formed of gaseous cover which envelops the hydrosphere and lithosphere.

OR

Genetic diversity: A single species shows diversity at the genetic level over its distributional range. For example, the genetic variation shows by the plant *Rauwolfia vomitoria* growing in the different Himalayan ranges might be in terms of the potency and

concentration of reserpine.

Species diversity: It is the diversity at the species level and it is affected by species richness and species evenness, For example, the Western Ghats have a greater amphibian species diversity than the Eastern Ghats.

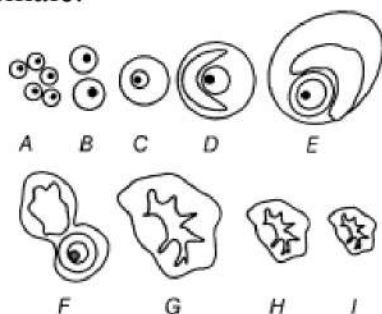
Ecological diversity: It is the diversity at the ecological level and is dependent on genetic and species diversity At the ecosystem level, India shows diversity with its deserts, rainforests, mangroves, coral reefs, and alpine meadows.

28. This is a single-stranded molecule of DNA or RNA, which base pairs with mRNA molecules and block its translation. This process of inactivation of specific m-RNA is used against viral replication and transformation of normal cells into cancerous cells and this can stop the further spread of the disease.

Section D

29. **Read the text carefully and answer the questions:**

The following is the illustration of the sequence of ovarian events (A-I) in a humans female.



- (i) Figure F illustrates ovulation. It represents the ovulatory stage of oogenesis.
(ii) Ovarian and pituitary hormones involved in causing ovulation are
Ovarian hormone Estrogen.
Pituitary hormone LH and FSH.
(iii) In anticipation of receiving the fertilised egg, the endometrium of the uterus gets thickened and also the blood supply to the endometrium increases.

OR

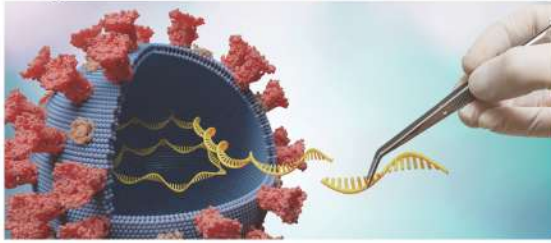
The figure C stage represents the secondary follicle and the H stage represents the degenerating corpus luteum.

Secondary follicle	Corpus luteum
It is surrounded by layers of granulosa cells and theca layer.	Layers of granulosa cells and theca cells are absent.
It contains an oocyte in the developing stage.	It does not contain oocyte as it is formed after the release of secondary oocyte.

30. **Read the text carefully and answer the questions:**

A pathogen is defined as **an organism causing disease to its host**, with the severity of the disease symptoms referred to as virulence. Pathogens are taxonomically widely diverse and comprise viruses and bacteria as well as unicellular and multicellular eukaryotes. The immune system of a person is suppressed. He was found positive for a pathogen in the

diagnostic test ELISA.



- (i) The patient is suffering from AIDS (Acquired Immuno Deficiency Syndrome).
- (ii) HIV (Human Immunodeficiency Virus) identified by the ELISA.
- (iii) Helper T-cells, macrophages, B-lymphocytes are attacked by the pathogen.

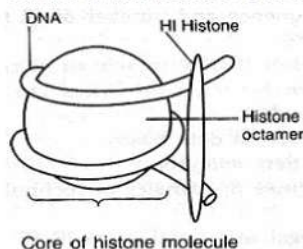
OR

Preventive measures:

- i. People should be educated about AIDS transmission.
- ii. Disposable needles and syringes should be used.
- iii. Sexual habits should be changed immediately.
- iv. High-risk groups should be discouraged from donating blood.
- v. Routine screening may be done.

Section E

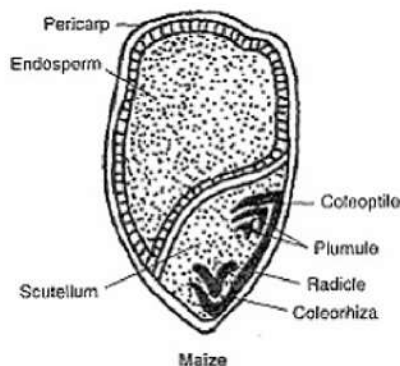
31. DNA packing in eukaryotes is carried out with the help of lysine and an Arginine rich basic protein called histones. The unit of compaction is nucleosome.
- i. Histones are organized to form a unit of eight molecules called histone octamer.
 - ii. The negatively charged DNA is wrapped around the positively charged histone octamer, form a structure called nucleosome.



OR

- i. i gene-regulatory gene.
It codes for the repressor protein of the operon, which is synthesised constitutively. The repressor has the affinity for the operator gene. It binds to the operator and prevents the RNA polymerase from transcribing the structural genes.
- ii. When repressor binds to the operator, the operon is switched off and transcription is stopped. So, it is called negative regulation.
- iii. Lactose is an inducer molecule.
Gene 'z' codes for β -galactosidase, which is responsible for the hydrolysis of lactose into galactose and glucose.
'y' gene codes for permease. It increases the permeability of the cell to lactose.

32.



OR

Archegonium is produced hypodermically in microsporangia as four strips of the archesporial cell at the four corners of a young anther or a single primary archesporial cell in the nucellus of the young ovule. The archesporial cells divide by mitotic division to form outer parietal cells/cell and inner sporogenous cells/cell. The parietal cell is present on the outer side while the sporogenous cell on the inner side. The parietal cells divide to form 3-5 layered microsporangial wall or in ovule does not divide further. The sporogenous cells divide further by mitotic division and form microspore mother cell or pollen mother cells (MMC or PMC) in the young anther. In ovule, the sporogenous cell does not divide further, and directly functions as the megaspore mother cell.

33. i. (A) Denaturation, (B) Annealing, (C) *Thermus aquaticus*.

ii. **Denaturation:** Heat denatures DNA to separate complementary strands.

Annealing: Primers hybridizes to the denatured DNA strands.

***Thermus aquaticus*:** This enzyme induces denaturation of double-stranded DNA at high temperature.

Extension: Extension of primers resulting in the synthesis of copies of the target DNA sequence.

iii. Enzyme Taq polymerase is isolated from the bacterium *Thermus aquaticus*. The function of Taq DNA polymerase in PCR reaction is to amplify the DNA for the production of multiple copies of it. Taq DNA **polymerase** is a thermostable DNA polymerase which can even work at a higher temperature.

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 in 1965.

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.