

12th
STD.

PUBLIC EXAM. - MAY 2022

PART III
BIOLOGY

TIME ALLOWED : 3.00 Hours]

(WITH ANSWERS)

[MAXIMUM MARKS : 70

Instructions: (1) Check the question paper for fairness of printing. If there is any lack of fairness, inform the Hall Supervisor immediately.

(2) Use **Blue** or **Black** ink to write and underline and pencil to draw diagrams.

Note: Candidate should answer **Part-I** (Bio-Botany) & **Part-II** (Bio-Zoology) in separate answer-books.

PART - II (BIO - ZOOLOGY)

(Marks : 35)

SECTION - 1

Note : (i) Answer **all** the questions: (8 × 1 = 8)

(ii) Choose the most appropriate answer from the given **four** alternatives and write the option code and the corresponding answer.

- A mRNA molecule is produced by :
 - Duplication
 - Replication
 - Translation
 - Transcription
- Cyclosporin - A is an immunosuppressive drug produced from :
 - Penicillium notatum
 - Aspergillus niger
 - Trichoderma polysporum
 - Monascus purpureus
- Which period was called as "Age of fishes"?
 - Devonian
 - Permian
 - Ordovician
 - Triassic
- Competition between species leads to :
 - Amensalism
 - Extinction
 - Symbiosis
 - Mutation
- Which one of the following are at high risk extinction due to habitat destruction?
 - Amphibians
 - Mammals
 - Echinoderms
 - Birds
- Which of the following phenotypes is not possible in the progeny of the parental genotypic combination $I^A I^O \times I^A I^B$?
 - A
 - AB
 - B
 - O

7. PCR proceeds in three distinct steps governed by temperature, they are in order of :

- Annealing, Synthesis, Denaturation
- Denaturation, Annealing, Synthesis
- Denaturation, Synthesis, Annealing
- Synthesis, Annealing, Denaturation

8. The matured sperms are stored in the _____.

- Epididymis
- Seminiferous tubules
- Seminal vesicle
- Vas deferens

SECTION - 2

Note: Answer **any four** of the following questions. (4 × 2 = 8)

- What is parthenogenesis? Give example.
- What is surrogacy?
- Differentiate template strand from coding strand.
- Who disproved Lamarck's theory of acquired characters? How?
- Write the symptoms of filariasis.
- What does gene therapy mean?

SECTION - 3

Note : Answer **any three** of the following questions. Q.No. 19 is compulsory. (3 × 3 = 9)

- Differentiate foeticide from infanticide.
- Autoimmune disease is a misdirected immunity response. Justify.
- When does antibiotic resistance develop?
- Differentiate Natality from Mortality.

19. In the XY chromosomal system of sex determination, males have only one 'X' chromosome, whereas females have two. How does the organism compensate for this dosage differences between the sexes?

SECTION - 4

Note: Answer the following questions (2 × 5 = 10)

20. (a) Explain the structure of Human Ovum with a neat labelled diagram.

(OR)

- (b) Write the salient features of Human Genome Project.

21. (a) Explain the structure of immunoglobulin with suitable diagram.

(OR)

- (b) Write an essay on radioactive waste management.



ANSWERS

PART - II (BIO - ZOOLOGY)

SECTION - 1

1. (d) Transcription
2. (c) Trichoderma polysporum
3. (a) Devonian
4. (b) Extinction
5. (a) Amphibians
6. (d) O
7. (b) Denaturation, Annealing, Synthesis
8. (a) Epididymis

SECTION - 2

9. (i) Development of an egg into a complete individual without fertilization is known as parthenogenesis.
 - (ii) Parthenogenesis is of two main types namely, **Natural Parthenogenesis** and **Artificial Parthenogenesis**.
 - (iii) Ex: Honey bees, Gall fly.
10. Surrogacy is a method of assisted reproduction or agreement whereby a woman agrees to carry a pregnancy for another person, who will become the newborn child's parent after birth.

11.

Template Strand	Coding Strand
1) This strand acts as a template for the mRNA synthesis during transcription.	1) The strand act as the non-template strand during transcription.
2) This strand with polarity 3' → 5'	2) Coding strand with polarity 5' → 3'
3) It has a sequence complementary to the mRNA.	3) It has a sequence similar to the mRNA.

12. (i) Lamarck's "Theory of Acquired characters" was disproved by August Weismann by the experiments on mice for twenty generations by cutting their tails and breeding them.
 - (ii) All mice born were with tail.
 - (iii) Weismann proved that change in the somatoplasm will not be transferred to the next generation but changes in the germplasm will be inherited.
13. **Symptoms of filariasis:**
- (a) The accumulation of the worms in lymph glands block the lymphatic system resulting in inflammation of the lymph nodes.
 - (b) In some cases, the obstruction of lymph vessels causes elephantiasis or filariasis of the limbs, scrotum and mammary glands.
14. Gene therapy is a corrective therapy to cure a person suffering from genetic disease.

SECTION - 3

15.

Foeticide	Infanticide
It refers to 'aborting the foetus in the mother's womb' intentionally.	It is 'killing the child after the birth'.

16. (i) Autoimmunity is due to an abnormal immune response in which the immune system fails to properly distinguish between self and non-self and attacks its own body.
- (ii) Our body produces antibodies (auto antibodies) and cytotoxic T cells that destroy our own tissues. If a disease-state results, it is referred to as auto-immune disease.
- (iii) Thus, autoimmunity is a misdirected immune response.
17. (i) Antibiotic resistance occurs when bacteria develop the ability to defeat the drug designed to kill or inhibit their growth.
- (ii) Antibiotic resistance is accelerated by the misuse and over use of antibiotics, as well as poor infection prevention control.
- (iii) Antibiotics should be used only when prescribed by a certified health professional.
- (iv) When the bacteria become resistant, antibiotics cannot fight against them and the bacteria multiply.
- (v) Narrow spectrum antibiotics are preferred over broad spectrum antibiotics.
- (vi) They effectively and accurately target specific pathogenic organisms and are less likely to cause resistance.
- (vii) "Superbug" is a term used to describe strains of bacteria that are resistant to the majority of antibiotics commonly used today.

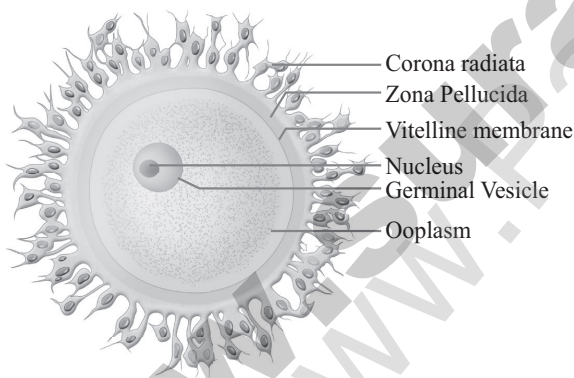
18.

S. No.	Natality	Mortality
1.	Natality is equivalent to birth rate and is an expression of the production of new individuals in the population by birth, hatching, germination (or) fission.	Mortality is the population decline factor and is opposite to natality.
2.	Natality rate expressed in crude birth rate number of organisms born per female per unit time.	Mortality is expressed as specific mortality, that is, the number of members of an original population dying after the lapse of a given time.
3.	Birth rate (b) = $\frac{\text{No. of birth per unit time}}{\text{Average population}}$	Death rate (d) = $\frac{\text{No. of deaths per unit time}}{\text{Average population}}$

19. In mammals the necessary dosage compensation is accomplished by the inactivation of one of the X chromosome in females so that both males and females have only one functional X chromosome per cell.

SECTION - 4

20. (a) (i) Human ovum is non-cleidoic, alecithal and microscopic in nature.
- (ii) Its cytoplasm is called Ooplasm contains a large nucleus called the germinal vesicle.
- (iii) The ovum is surrounded by three coverings namely an inner thin transparent vitelline membrane, middle thick zona pellucida and outer thick coat of follicular cells called corona radiata.
- (iv) Between the vitelline membrane and zona pellucida is a narrow perivitelline space.

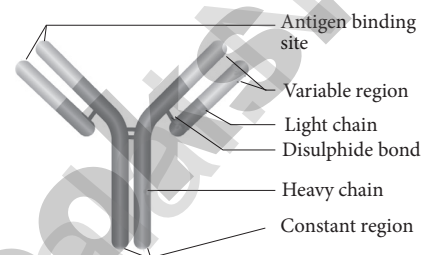


(OR)

- (b) (i) The human genome contains 3 billion nucleotide bases.
- (ii) An average gene consists of 3000 bases, the largest known human gene being dystrophin with 2.4 million bases.
- (iii) There may be 35000-40000 genes in the genome and almost 99.9 nucleotide bases are exactly the same in all people.

- (iv) The chromosomal organization of human genes shows diversity.
- (v) Functions for over 50 percent of the discovered genes are unknown.
- (vi) Chromosome 1 has 2968 genes whereas chromosome 'y' has 231 genes.

21. (a) (i) In the 1950s, experiments by **Porter and Edelman** revealed the basic structure of the immunoglobulin.
- (ii) An antibody molecule is Y shaped structure.



Structure of immunoglobulin

- (iii) It comprises of 4 polypeptide chains, **two identical light chains** (L) of molecular weight 25,000 Da (approximately 214 amino acids) and **two identical heavy chains** (H) of molecular weight 50,000 Da (approximately 450 amino acids).
- (iv) The polypeptide chains are linked together by di-sulphide (S-S) bonds.
- (v) One light chain is attached to each heavy chain two heavy chains are attached to each other to form a Y shaped structure. Hence, an antibody is represented by $H_2 L_2$.
- (vi) Each chain (L and H) has two terminals. They are C - terminal (Carboxyl) and amino or N-terminal.
- (vii) Each chain (L and H) has two regions. Variable (V) region at one end and a much larger constant (C) region at the other end.
- (viii) Antibodies responding to different antigens have very different (V) regions but their (C) regions are the same in all antibodies.

- (ix) In each arm of the monomer antibody, the V regions of the heavy and light chains combines to form an antigen – binding site shaped to 'fit' a specific antigenic determinant.
- (x) Consequently each antibody monomer has two such antigen – binding regions.
- (xi) The (C) regions that forms the stem of the antibody monomer determine the antibody class and serve common functions in all antibodies.

(OR)

- (b) Radioactive waste management involves the treatment, storage and disposal of liquid, airborne and solid effluents from the nuclear industry.

Methods of disposal of radioactive wastes are:

1. **Limit generation** - Limiting the generation of waste is the first and most important consideration in managing radioactive wastes.
2. **Dilute and disperse** - For wastes having low radioactivity, dilution and dispersion are adopted.
3. **Delay and decay** - Delay and decay is frequently an important strategy because much of the radioactivity in nuclear reactors and accelerators is very short lived.
4. **Concentrate and confine process** - Concentrating and containing is the objective of treatment activities for longer lived radioactivity.

Control and Management:

Three ways are employed to manage nuclear wastes

- (i) **Spent Fuel Pools** - The spent fuel discharged from the reactors is temporarily stored in the reactor pool. The Spent fuel rods are used in stored cooling ponds. They protect the surroundings from radiation and absorb the heat generated during radioactive decay.
- (ii) **Vitrification method** - This prevents reaction or degradation of nuclear waste for extended periods of time and encased in dry cement caskets.
- (iii) **Geological Repositories** - A deep geological repository is a nuclear waste repository excavated deep within a stable geologic environment. It is suited to provide a high level of long-term isolation and containment without future maintenance. In India, at Tarapur and Kalpakkam, a wet storage facility of Spent Fuel is the main mode of storage.



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PART - I

- Note :** (i) Answer **all** the questions: (15 × 1 = 15)
- (ii) Choose the most appropriate answer from the given **four** alternatives and write the option code and the corresponding answer.

- Radioactive wastes can be disposed off by _____.
 - composting
 - burning
 - surface impoundments
 - a deep geological repository
- In which mode of Reproduction variation are seen?
 - Asexual
 - Parthenogenesis
 - Sexual
 - Both (a) and (b)
- Which one of the following are at high risk extinction due to habitat destruction?
 - Amphibians
 - Mammals
 - Echinoderms
 - Birds
- When a Drosophila body cells contain 3 sets of autosomes and 2 X chromosomes, what will be the sex of the fly?
 - metamale
 - male
 - intersex
 - female
- The total number of nitrogenous in human genome is estimated to be about _____.
 - 35 million
 - 3.5 million
 - 3.1 billion
 - 35,000
- A contraceptive pill prevents ovulation by:
 - stimulating release of FSH and LH
 - blocking fallopian tube
 - causing immediate degeneration of released ovum
 - inhibiting release of FSH and LH
- Organisms which can survive a wide range of temperature are called _____.
 - Endotherms
 - Ectotherms
 - Stenotherms
 - Eurytherms
- B - lymphocytes are activated by:
 - Interferon
 - Antibiotics
 - Antigen
 - Antibody
- The most common substrate used in distilleries for the production of ethanol is :
 - Molasses
 - Soyameal
 - Corn meal
 - Groundgram
- Which is the correct order of action?
 - FSH → LH → Inhibin → Spermatogenesis
 - LH → Leydig cells → Testosterone → Spermatogenesis
 - TSH → FSH → Sertoli cells → Spermatogenesis
 - LTH → Sertoli cells → Androgen → Spermatogenesis
- A population will not exist in Hardy Weinberg equilibrium, if :
 - There is no migration
 - Individuals mate selectively
 - The population is large
 - There are no mutations
- ABO blood group in main is controlled by:
 - Sex-linked genes
 - Multiple alleles
 - Y-linked genes
 - Lethal genes
- Haemozoin is:
 - A toxin from plasmodium species
 - A precursor of haemoglobin
 - A toxin from haemophilus species
 - A toxin from streptococcus

14. Which one of the following is a suitable adaptation to overcome food and water scarcity?

- (a) A short reproductive period
- (b) Winter sleep
- (c) Migration
- (d) Summer sleep

15. The purpose of biological treatment of waste water is to _____.

- (a) Reduce sedimentation
- (b) Reduce BOD
- (c) Increase sedimentation
- (d) Increase BOD

PART - II

Note: Answer **any six** of the following. Questions No 24 is **compulsory**. (6 × 2 = 12)

16. What is senescent phase of life?

17. What is the composition of semen?

18. State the importance of POCSO Act.

19. What is transcription?

20. List out major gases seems to be found in the Primitive earth.

21. How does the trophozoite of Amoebiasis reach the final destination in our body?

22. Define Zymology.

23. What is Mass extinction?

24. Corona Virus is a RNA virus. Basically PCR technique is used for detecting DNA. If so, how PCR technique is used for diagnosing Corona Virus?

PART - III

Note: Answer **any six** of the following. Question Number 33 is **compulsory**. (6 × 3 = 18)

25. Differentiate foeticide and infanticide.

26. How will you prevent erythroblastosis foetalis?

27. Is vaccine available against malaria? Give reason for your answer.

28. Draw the diagram of immunoglobulin molecule and label the parts.

29. Write short note on microbial fuel cell.

30. Differentiate Eurytherms and Stenotherms.

31. Explain the three indices of species diversity.

32. How can we control eutrophication?

33. Write the differences between multipotency and oligopotency.

PART - IV

Note: Answer **all** the questions. (5 × 5 = 25)

34. (a) Describe the structure of the human uterus with a neat labelled diagram.

(OR)

(b) What are the strategies to be implemented in India to attain total reproductive health?

35. (a) Explain the role of translation components in protein synthesis.

(OR)

(b) List out the salient features of Genetic Code.

36. (a) How does Hardy -Weingberg's expression ($p^2+2pq+q^2=1$) explain that genetic equilibrium is maintained in a population? List any four factors that can disturb the genetic equilibrium.

(OR)

(b) Explain any five bacterial disease.

37. (a) Explain how innate immunity protects our body against diseases.

(OR)

(b) Explain the process of PCR technique.

38. (a) List out the essential properties of water.

(OR)

(b) How can we manage medical wastes and E-Waste?



ANSWERS

PART - I

1. (d) a deep geological repository
2. (c) Sexual
3. (a) Amphibians
4. (c) intersex
5. (c) 3.1 billion
6. (d) inhibiting release of FSH and LH

7. (d) Eurytherms
8. (c) Antigen
9. (a) Molasses
10. (b) LH → Leydig cells → Testosterone → Spermatogenesis
11. (b) Individuals mate selectively
12. (b) Multiple alleles
13. (a) A toxin from plasmodium species
14. (c) Migration
15. (b) Reduce BOD

PART - II

16. Senescent phase begins at the end of reproductive phase when degeneration sets in the structure and functioning of the body.
17. (i) Semen is a milky white fluid which contains sperms and the seminal plasma.
(ii) The seminal plasma contains fructose sugar, ascorbic acid, prostaglandins and a coagulating enzyme called vesiculase which enhance sperm mobility.
(iii) It also contains citrate, several enzymes and prostate specific antigens.
(iv) It also provides nutrients and contains chemicals that protect and activate the sperms.
18. POCSO Act (Prevention of children from sexual offences), Sexual harassment at workplace (Prevention, prohibition and redressal) Act and the changes in the Criminal law based on the recommendations of Justice Verma Committee, 2013 aims at creating a safe and secure environment for both females and males.
19. The process of copying genetic information from one strand of DNA into RNA is termed transcription.
20. (i) The primitive Earth had no proper atmosphere, but consisted of ammonia, methane, hydrogen and water vapour.
(ii) Hydrogen and oxygen were formed by splitting of water molecules by uv rays.
(iii) Ammonia & Methane in the atmosphere combined with oxygen to form carbon - dioxide and other gases.

21. Infective stage of this parasite is the trophozoite, which penetrates the walls of the host intestine (colon) and secretes histolytic enzymes causing ulceration, bleeding, abdominal pain and stools with excess mucus.
22. **Zymology** is an applied science which deals with the biochemical process of fermentation and its practical uses.
23. The earth has experienced quite a few mass extinctions due to environmental catastrophes. A mass extinction occurred about 225 million years ago during the Permian, where 90% of shallow water marine invertebrates disappeared.
24. (i) The PCR technique can also be used for amplifications of RNA in which case it is referred to as reverse transcription PCR (RT-PCR).
(ii) In this process the RNA molecules (mRNA) must be converted to complementary DNA by the enzyme reverse transcriptase. The DNA then serves as the template for PCR.
(iii) So, the RT-PCR technique is used to diagnose Corona virus.

PART - III

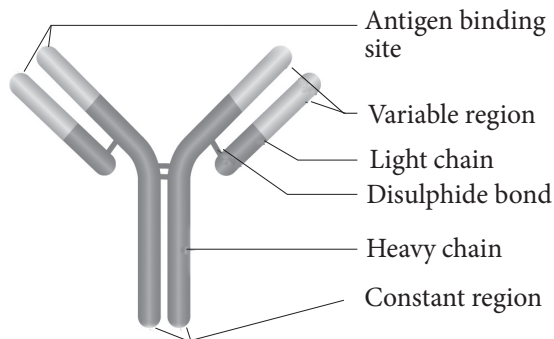
25.

Foeticide	Infanticide
It refers to 'aborting the foetus in the mother's womb' intentionally.	It is 'killing the child after the birth'.

26. (i) If the mother is Rh negative and foetus is Rh positive, anti D antibodies should be administered to the mother at 28th and 34th week of gestation as a prophylactic measure.
(ii) If the Rh negative mother delivers Rh positive child then anti D antibodies should be administered to the mother soon after delivery.
(iii) This develops passive immunity and prevents the formation of anti D antibodies in the mothers blood by destroying the Rh foetal RBC before the mother's immune system is sensitized.
(iv) This has to be done whenever the woman attains pregnancy.

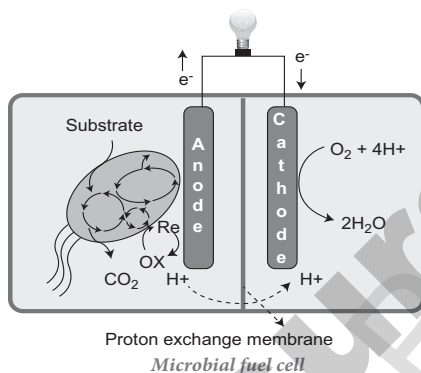
27. Malaria vaccine is used to prevent malaria. The only approved vaccine as of 2015 is RTS,S (Mosquirix). It requires four injections and has relatively low efficacy (26–50%). Due to this low efficacy, WHO does not recommend the use of RTS,S vaccine in babies between 6 and 12 weeks of age.

28.



Structure of immunoglobulin

29. **Microbial fuel cells (MFC):**



- (i) It is a bio-electrochemical system that drives an electric current by using bacteria.
- (ii) It mimicking bacterial interaction found in nature.
- (iii) MFC cells allow bacteria to oxidize and reduce organic molecules.
- (iv) Bacterial respiration is a redox reaction in which electrons are being moved around.
- (v) A MFC consists of an anode and a cathode separated by a proton exchange membrane.
- (vi) Microbes at the anode oxidize the organic fuel generating protons which pass through the membrane to the cathode.
- (vii) Electrons pass through the anode to the external circuit to generate current.

30.

Eurytherms	Stenotherms
1. Organisms which can survive a wide range of temperature	1. Organisms which can tolerate only a narrow range
2. Eg: cat, dog, tiger, human.	2. Eg: Fish, Frogs, Lizards and Snakes.

31. The three indices of diversity are - Alpha, Beta and Gamma diversity

- (i) **Alpha diversity:** It is measured by counting the number of taxa (usually species) within a particular area, community or ecosystem.
- (ii) **Beta diversity:** It is species diversity between two adjacent ecosystems and is obtained by comparing the number of species unique to each of the ecosystem.
- (iii) **Gamma diversity** refers to the diversity of the habitats over the total landscape or geographical area.

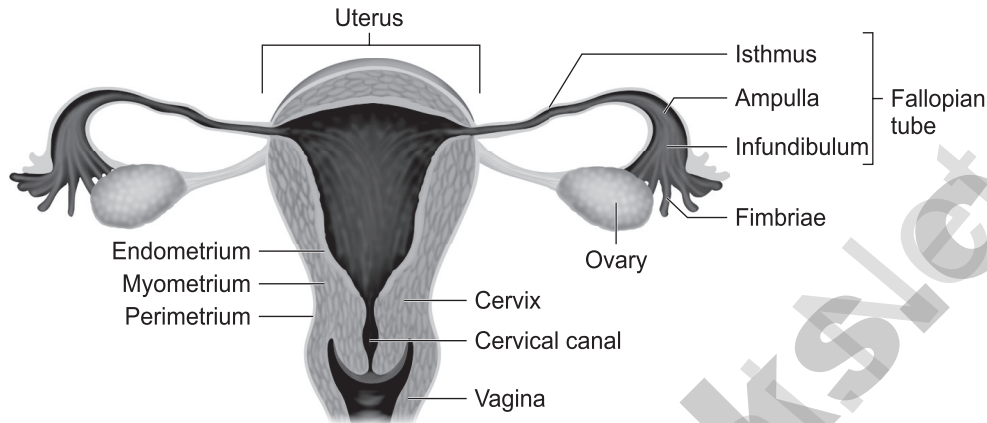
32. Eutrophication can be controlled by reducing the use of fertilizers in agricultural lands, checking the runoff from fields, planting vegetations along the stream beds there by the nutrients will be uptaken by plants.

33.

Multipotency	Oligopotency
Refers to the stem cells that can differentiate into various types of cells that are related.	Refers to stem cells that can differentiate into few cell types.
For example blood stem cells can differentiate into lymphocytes, monocytes, neutrophils etc.,	For example lymphoid or myeloid stem cells can differentiate into B and T cells but not RBC.

PART - IV

34. (a) (i) The uterus or womb is a hollow, thick-walled, muscular, highly vascular and inverted pear shaped structure lying in the pelvic cavity between the urinary bladder and rectum.



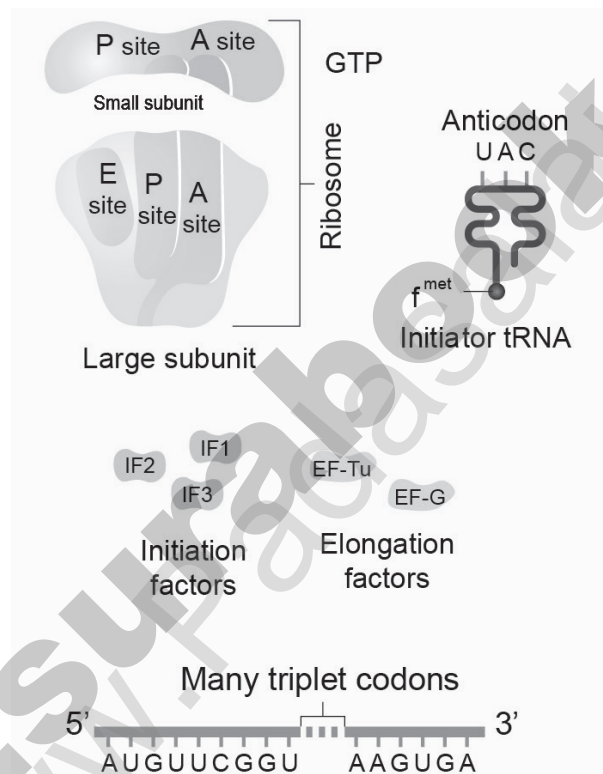
- (ii) The major portion of the uterus is the body and the rounded region superior to it, is the fundus.
- (iii) The uterus opens into the vagina through a narrow cervix. The cavity of the cervix called the cervical canal communicates with the vagina through the external orifice and with the uterus through the internal orifice. The cervical canal along with vagina forms the birth canal.
- (iv) The wall of the uterus has three layers of tissues. The outermost thin membranous serous layer called the perimetrium, the middle thick muscular layer called myometrium and the inner glandular layer called endometrium.
- (v) The endometrium undergoes cyclic changes during the menstrual cycle while myometrium exhibits strong contractions during parturition.

(OR)

- (b) These programmes are popularly named as 'Reproductive and Child Health Care (RCH). Major tasks carried out under these programmes are:
- (i) Creating awareness and providing medical assistance to build a healthy society.
- (ii) Introducing sex education in schools about adolescence and adolescence related changes.
- (iii) Educating couples about the birth control methods and family planning norms.
- (iv) Creating awareness about care for pregnant women, post-natal care of mother and child and the importance of breast feeding.
- (v) Encouraging and supporting governmental and non-governmental agencies to identify new methods and/or to improve upon the existing methods of birth control.

Health care programmes such as massive child immunization, supply of nutritional food to the pregnant women, Janani Suraksha Yojana, Janani Shishu Suraksha Karyakaram, RMNCH+A approach etc., are taken up at the national level by the Government of India.

35. (a) (i) The cellular factory responsible for synthesizing protein is the ribosome. The ribosome consists of structural RNAs and about 80 different proteins.
- (ii) The prokaryotic ribosome (70 S) consists of two subunits, the larger subunit (50 S) and smaller subunit (30 S). The ribosomes of eukaryotes (80 S) are larger, consisting of 60 S and 40 S sub units. 'S' denotes the sedimentation coefficient which is expressed as Svedberg unit (S).
- (iii) A translational unit in mRNA is the sequence of RNA that is flanked by the start codon (AUG) and the stop codon and codes for polypeptides. mRNA also have some additional sequences that are not translated and are referred to as Untranslated Regions (UTR).
- (iv) The 5' end of the mRNA of prokaryotes has a special sequence which precedes the initial AUG start codon of mRNA. This ribosome binding site is called the Shine – Dalgarno sequence or S-D sequence.



Translation components

- (v) Initiation of translation in *E. coli* begins with the formation of an initiation complex, consisting of the 30S subunits of the ribosome, a messenger RNA and the charged N-formyl methionine tRNA (f^{met} – tRNA^{f^{met}}), three proteinaceous initiation factors (IF1, IF2, IF3), GTP (Guanine Tri Phosphate) and Mg²⁺.
- (vi) Another initiation protein (IF2) then enhances the binding of charged formyl methionine tRNA to the small subunit in response to the AUG triplet.
- (vii) Once initiation complex has been assembled, IF3 is released and allows the initiation complex to combine with the 50S ribosomal subunit to form the complete ribosome (70S).
- (vii) Elongation is the second phase of translation. Once both subunits of the ribosomes are assembled with the mRNA, binding sites for two charged tRNA molecules are formed.

- (viii) The charged initiator tRNA binds to the P site.
- (ix) This step requires the correct transfer RNA, another GTP and two proteins called elongation factors (EF-Ts and EF-Tu).
- (x) Termination is the third phase of translation. Termination of protein synthesis occurs when one of the three stop codons appears in the 'A' site of the ribosome.
- (xi) The tRNA is then released from the ribosome, which then dissociates into its subunits.

(OR)

- (b) (i) The genetic codon is a triplet code and 61 codons code for amino acids and 3 codons do not code for any amino acid and function as stop codon (Termination).
- (ii) **The genetic code is universal:** All known living systems use nucleic acids and the same three base codons (triplet codon) direct the synthesis of protein from amino acids. Eg: mRNA (UUU) codon codes for phenylalanine in all cells of all organisms, except in prokaryotic, mitochondrial and chloroplast genomes.
- (iii) **A non-overlapping codon:** Same letter is not used for two different codons. Eg: Nucleotide sequence GUU GUC represents only two codons.
- (iv) **It is comma less:** The message would be read directly from one end to the other Eg: No punctuation are needed between two codes.
- (v) **A degenerate code:** More than one triplet codon could code for a specific amino acid. Eg: Codons GUU, GCU, GUA and GUG code for valine.
- (vi) **Non-ambiguous code:** One codon will code for one amino acid.
- (vii) **The code is always read in a fixed direction:** i.e. from 5' → 3' direction called polarity.
- (viii) **AUG has dual functions:** Acts as a initiator codon and also codes for the amino acid methionine.
- (ix) **Stop codons (or) termination codons:** UAA, UAG (tyrosine) and UGA (tryptophan) codons are designated as termination (stop) codons or "non-sense" codons.

36. (a) **Population of beetles:**

- (i) Appear in 2 colours and the colour is determined.
- (ii) Dark grey (black) - 'AA' and 'Aa'
- (iii) Light grey - 'aa'
- (iv) Assume, 'A' allele has a frequency (p) 0.3 and 'a' allele has a frequency (q) 0.7. Then, p+q = 1
- (v) The genotype frequency can be estimated by Hardy Weinberg equation.

$$(p + q)^2 = p^2 + 2pq + q^2$$

$$p^2 = \text{frequency of AA}$$

$$2pq = \text{frequency of Aa}$$

$$q^2 = \text{frequency of aa}$$

$$p = 0.3, q = 0.7 \text{ then,}$$

$$p^2 = (0.3)^2 = 0.09 = 9 \% AA$$

$$2pq = 2(0.3)(0.7) = 0.42 = 42 \% Aa$$

$$q^2 = (0.7)^2 = 0.49 = 49 \% aa$$

Hence the beetle population appears to be in Hardy-Weinberg equilibrium.

Four factors disturbing genetic equilibrium

- (1) Mutation
- (2) Genetic drift
- (3) Gene flow
- (4) Natural selection & Recombination

(OR)

(b)

No	Diseases	Causative agent	Site of infection	Mode of transmission	Symptoms
1	Shigellosis (Bacillary dysentery)	<i>Shigella sp.</i>	Intestine	Food and water contaminated by faeces / faecal oral route	Abdominal pain, dehydration, blood and mucus in the stools
2	Bubonic plague (Black death)	<i>Yersinia pestis</i>	Lymph nodes	Rat flea vector- <i>Xenopsylla cheopis</i>	Fever, headache, and swollen lymph nodes
3	Diphtheria	<i>Corynebacterium diphtheriae</i>	Larynx, skin, nasal and genital passage	Droplet infection	Fever, sore throat, hoarseness and difficulty in breathing
4	Cholera	<i>Vibrio cholerae</i>	Intestine	Contaminated food and water/ faecal oral route	Severe diarrhoea and dehydration
5	Tetanus (Lock jaw)	<i>Clostridium tetani</i>	Spasm of muscles	Through wound infection	Rigidity of jaw muscle, increased heart beat rate and spasm of the muscles of the jaw and face

37. (a) Innate immunity is the natural phenomenon of resistance to infection which an individual possesses right from the birth.

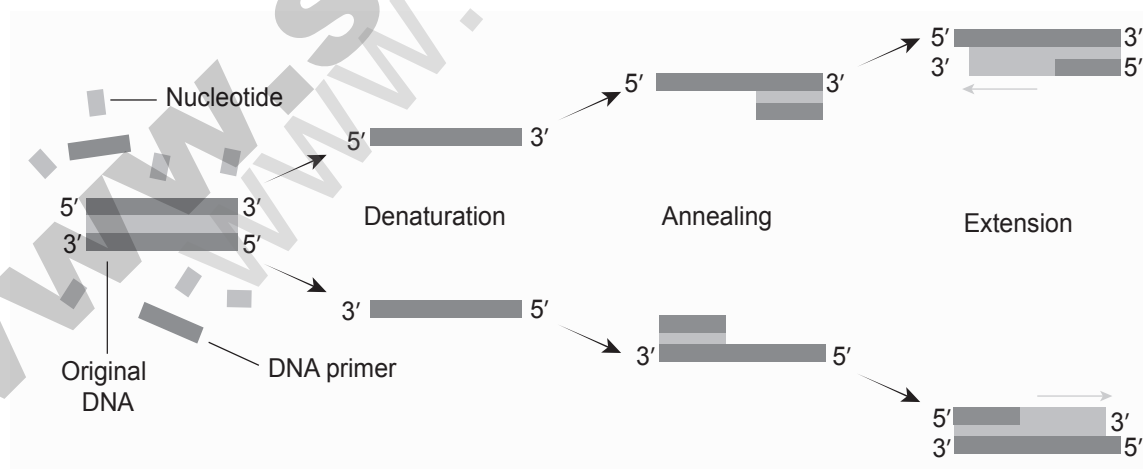
No	Type of innate immunity	Mechanism
1	Anatomical barriers	
	Skin	Prevents the entry of microbes. Its acidic environment (pH 3-5) retards the growth of microbes.

	Mucus membrane	Mucus entraps foreign microorganisms and competes with microbes for attachment.
2	Physiological barriers	
	Temperature	Normal body temperature inhibits the growth of pathogens. Fever also inhibits the growth of pathogens.
	Low pH	Acidity of gastric secretions (HCl) kills most ingested microbes.
	Chemical mediators	Lysozyme acts as antibacterial agent and cleaves the bacterial cell wall. Interferons induce antiviral state in the uninfected cells. Complementary substances produced from leucocytes lyse the pathogenic microbes or facilitate phagocytosis.
3	Phagocytic barriers	Specialized cells (Monocytes, neutrophils, tissue macrophages) phagocytose, and digest whole microorganisms.
4	Inflammatory barriers	Tissue damage and infection induce leakage of vascular fluid, containing chemotactic signals like serotonin, histamine and prostaglandins. They influx the phagocytic cells into the affected area. This phenomenon is called diapedesis.

The innate defense mechanisms are non-specific in the sense that they are effective against a wide range of potentially infectious agents. It is otherwise known as non-specific immunity or natural immunity.

(OR)

(b) The various steps involved in the production of transgenic organisms are



Steps involved in PCR

- Identification and separation of desired gene.
- Selection of a vector (generally a virus) or direct transmission.
- Combining the desired gene with the vector.
- Introduction of transferred vector into cells, tissues, embryo or mature individual.
- Demonstration of integration and expression of foreign gene in transgenic tissue or animals.

38. (a)
- (i) Water is one of the main agents in Pedogenesis (soil formation).
 - (ii) It is the medium for several different ecosystems.
 - (iii) It is present as moisture in the atmosphere and the outer layers of the lithosphere and is uneven in distribution on the Earth.
 - (iv) Water is heavier than air and imparts greater buoyancy to the aquatic medium. This enables organism to float at variable levels.
 - (v) Water has high heat capacity and latent heat, due to which it can withhold large amounts of heat. Thus, oceans and lakes tend to maintain a relatively constant temperature and the biosphere is relatively thermostable.
 - (vi) Water is physically unique because it is less dense as a solid (ice) than as a liquid.
 - (vii) When water freezes (0°C), it contracts. The maximum density of liquid water occurs at 4°C . Below that, it expands markedly. This enables ice to float on the top of water bodies.

Hence, only the surface of water bodies will freeze, while below the surface, water will be in liquid form, sustaining life.
 - (viii) Water is considered as the Universal solvent. It is the main medium by which chemical constituents are transported from abiotic components to the living components of an ecosystem.
 - (ix) Water has high surface tension. This allows pollen, dust and even water striders to remain at the surface of a water body even though they are denser than the water.

(OR)

(b) **Medical waste :**

- (i) Any kind of waste that contains infectious material generated by hospitals, laboratories, medical research centers, Pharmaceutical companies and Veterinary clinics are called medical wastes.
- (ii) Medical wastes contain body fluids like blood, urine, body parts and other contaminants, culture dishes, glasswares, bandages, gloves, discarded needles, scalpels, swabs and tissues.

Management: The safe and sustainable management of biomedical waste is the social and legal responsibilities of people working in healthcare centers.

Waste disposal: Involved by incineration, chemical disinfection, autoclaving, encapsulation, microwave irradiation are methods of waste disposals. Final disposal includes landfill and burying as per norms inside premises.

E-Waste :

- (i) Electronic waste or e-waste describes discarded electrical electronic devices as well as any refuse created by discarded electronic devices and components and substances involved in their manufacture or use.
- (ii) Their disposal is a growing problem because electronic equipment frequently contains hazardous substances. In a personal computer, for example, there may be lead (Pb) in the cathode ray tube (CRT) and soldering compound, mercury (Hg) in switches and housing, and cobalt (Co) in steel components, among other equally toxic substances.
- (iii) E-wastes are basically PCB (Polychlorinated biphenyl) based, which are non-degradable.
- (iv) Used electronics which are destined for reuse, resale, salvage, recycling, or disposal are also considered e-waste. Unauthorised processing of e-waste in developing countries can lead to adverse human health effects and environmental pollution.
- (v) Recycling and disposal of e-waste may involve significant risk to the health of workers and communities in developed countries and great care must be taken to avoid unsafe exposure in recycling operations and leaking of materials such as heavy metals from landfills and incinerator ashes.

