# Previous Year Paper

## 22nd May 2023 (Shift 1)

**Q1.** `Pomato' is an example of:
(a) Single Cell Protein
(b) Somaclonal Variation
(c) Meristem Cultured Plant
(d) Somatic hybrids

**Q2.** Match **List-I** with **List-II**:

| List-I | | List-II | |
|---|---|---|---|
| (A) | Rheumatoid arthritis | (I) | Primary lymphoid organ |
| (B) | AIDS | (II) | Antibody mediated immune response |
| (C) | Thymus | (III) | Immuno deficiency disease |
| (D) | B-Lymphocytes | (IV) | Auto-immune disease |

Choose the **correct** answer from the options given below:
(a) (A)-(IV), (B)-(I), (C)-(III), (D)-(II)
(b) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)
(c) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)
(d) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)

**Q3.** Which of the following is NOT a characteristic of an ideal contraceptive?
(A) It should be user friendly
(B) It should be easily available
(C) It should be irreversible
(D) It should be with no or least side effects

Choose the **correct** answer from the options given below:
(a) (A) and (C) only
(b) (C) only
(c) (B) and (D) only
(d) (D) only

**Q4.** The process through which spermatids are transformed into spermatozoa (sperms) is known as:
(a) Spermatogenesis
(b) Spermiogenesis
(c) Spermiation
(d) Spermatogonia

**Q5.** Which Of the following is/ are NOT the step(s) used in separation and isolation of DNA fragments by gel electrophoresis technique:
(A) Staining with ethedium bromide
(B) Exposure to UV Radiation
(C) Cutting DNA fragments into small pieces by using restriction endonuclease
(D) Denaturation of DNA fragments

Choose the **correct** answer from the options given below:
(a) (D) only
(b) (B) and (C) only
(c) (B) only
(d) (A) and (D) only

**Q6.** The secondary ecological succession begins in an area, where:
(a) Species invade a bare land/rock
(b) Vegetation has been grazed by Cattles
(c) Natural biotic communities have been destroyed
(d) Natural biotic communities are flourishing

**Q7.** External fertilisation takes place in:
(a) Lizard
(b) frog
(c) Eagle
(d) Blue whale

**Q8.** Arrange the given steps in plant breeding systematically.
(A) Evaluation and selection of parents
(B) Germplasm collection
(C) Selection and testing of superior recombinants
(D) Cross hybridisation among the selected parents

Choose the **correct** answer from the options given below:
(a) (A), (B), (C), (D)
(b) (B), (A), (D), (C)
(c) (B), (C), (A), (D)
(d) (A), (B), (D), (C)

**Q9.** If 50,000 J energy available to primary producer, then energy available to tertiary consumer will be:
(a) 5 J
(b) 50 J
(c) 500 J
(d) 5000 J

**Q10.** In angiosperms during micorsporogenesis, meiosis occurs in:
(a) Microspore mother cells
(b) Endothecium
(c) Pollen grains
(d) Tapetum

**Q11.** In which stage of sewage treatment, large amount of air is pumped into it?
(a) Both Primary and Secondary Treatments
(b) Only Primary Treatments
(c) Only Secondary Treatments
(d) After Secondary Treatments

**Q12.** Which one of the following is also called 'Terror of Bengal'?
(a) *Parthenium*
(b) Water Hyacinth
(c) *Vallisneria*
(d) *Hydrilla*

**Q13.** Which of the following is a complementary sequence of 5' ---- GAATTC ---- 3'?
(a) 3' ---- GAATTC ---- 5'
(b) 5' ---- CTTAAG ---- 3'
(c) 3' ---- CTTAAG ---- 5'
(d) 5' ---- GAATTC ---- 3'

**Q14.** Which one of the following has a large reservoir of erythrocytes?
(a) Liver
(b) Spleen
(c) Heart
(d) Bone marrow

**Q15.** Match **List-I** with **List-II**:

| List-I | | List-II | |
|---|---|---|---|
| (A) | Lamarck | (I) | Natural selection |
| (B) | Darwin | (II) | Work on populations |
| (C) | Thomas Malthus | (III) | Mutation |
| (D) | Hugo deVries | (IV) | Use and disuse of organs |

Choose the **correct** answer from the options given below:
(a) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)
(b) (A)-(IV), (B)-(I), (C)-(II), (D)-(III)
(c) (A)-(II), (B)-(I), (C)-(III), (D)-(IV)
(d) (A)-(I), (B)-(III), (C)-(IV), (D)-(II)

**Q16.** Identify the correct options with respect to the salient features of DNA.
(A) The two polynucleotide chains are coiled in a left-handed fashion
(B) Adenine forms three hydrogen bonds with thymine
(C) The distance between a base pair in a DNA helix is approximately 0.34 nm
(D) The plane of one base pair stacks over the other in double helix

Choose the **correct** answer from the options given below:
(a) (A), (B), (C), (D)
(b) (A), (B), (C)
(c) (C), (D)
(d) (A), (D)

**Q17.** The role of restriction enzyme in recombinant DNA technology is:
(a) Join sticky ends of DNA strand
(b) Make cut in RNA strand
(c) Cutting DNA at specific point
(d) Joining and Cutting of RNA strand

**Q18.** Sickle cell anaemia is:
(a) An autosome linked recessive disease
(b) An autosome linked dominant disease
(c) Sex linked recessive disease
(d) Mineral deficiency disease

**Q19.** Match **List-I** with **List-II**:

| List-I | | List-II | |
|---|---|---|---|
| (A) | Leydig Cell | (I) | GnRH |
| (B) | Hypothalamus | (II) | Androgens |
| (C) | Growing follicle | (III) | Progesterone |
| (D) | Corpus Luteum | (IV) | Estrogen |

Choose the **correct** answer from the options given below:
(a) (A)-(II), (B)-(I), (C)-(IV), (D)-(III)
(b) (A)-(I), (B)-(III), (C)-(II), (D)-(IV)
(c) (A)-(III), (B)-(II), (C)-(I), (D)-(IV)
(d) (A)-(II), (B)-(I), (C)-(III), (D)-(IV)

**Q20.** Which of the following is not a benefit of genetically modified plants/crops?
(a) Tolerant to abiotic stresses
(b) Pest resistance
(c) Lower yield
(d) Enhanced nutritional value

**Q21.** Oparin and Haldane's theory of chemical evolution of life was experimentally supported by:
(a) Landsteiner and Weiner
(b) Hardy and Weinberg
(c) Oparin and Sydney Fox
(d) Miller and Urey

**Q22.** An individual with 44 + XO karyotype is suffering from which of the following disorder?
(a) Down's Syndrome
(b) Turner's Syndrome
(c) Klinefelter's Syndrome
(d) Haemophilia

**Q23.** Various types of skin colour in humans is an example of '
(a) Pleiotropy
(b) Incomplete dominance
(c) Polygenic inheritance
(d) Co-dominance

**Q24.** Match **List-I** with **List-II**:

| List-I (Molecule) | | List-II (Application) | |
|---|---|---|---|
| (A) | Statin | (I) | Immunosuppressive agent |
| (B) | Streptokinase | (II) | Detergent formulations |
| (C) | Cyclosporin A | (III) | Blood-cholesterol lowering agent |
| (D) | Lipase | (IV) | Clot buster |

Choose the **correct** answer from the options given below:
(a) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)
(b) (A)-(II), (B)-(I), (C)-(III), (D)-(IV)
(c) (A)-(I), (B)-(II), (C)-(IV), (D)-(III)
(d) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

**Q25.** The mathematical expression that represents the logistic growth in a population is :
(a) $^{dN}/_{dt} = rN\left(\frac{K}{K-N}\right)$
(b) $^{dN}/_{dt} = rN\left(\frac{K-n}{K}\right)$
(c) $^{dN}/_{dt} = rN$
(d) $^{dN}/_{dt} = rN(K-N)$

**Q26.** Match **List-I** with **List-II**:

| List-I | | List-II | |
|---|---|---|---|
| (A) | Clesitogamous flowers | (I) | Water pollinated flowers |
| (B) | *Vallisneria* | (II) | Tallest flower |
| (C) | *Amorphophallus* | (III) | Dioecious |
| (D) | Papaya | (IV) | Do not open at all |

Choose the **correct** answer from the options given below:
(a) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)
(b) (A)-(III), (B)-(I), (C)-(II), (D)-(IV)
(c) (A)-(II), (B)-(IV), (C)-(III), (D)-(I)
(d) (A)-(IV), (B)-(I), (C)-(II), (D)-(III)

**Q27.** Which of the following plant was introduced in India because of its beautiful flower and shape of leaves?
(a) Bamboo
(b) Neelakuranji
(c) Water Hyacinth
(d) *Dahlia*

**Q28.** Choose the correct sequence of events involved in the process of RNA interference.
(A) dsRNA silences the mRNA produced by nematode
(B) Using *Agrobacterium* vector nematode specific genes are introduced into the host plant
(C) Two strands of RNA being complementary to each other form dsRNA
(D) DNA is introduced in such a way that it produces both sense and antisense RNA in the host

Choose the **correct** answer from the options given below:
(a) (C), (A), (D), (B)
(b) (C), (A), (B), (D)
(c) (B), (D), (C), (A)
(d) (A), (C), (D), (B)

**Q29.** Arrange the given steps of DNA fingerprinting in sequence.
(A) Transferring of separated DNA fragments on nitrocellulose membrane
(B) Isolation of DNA and digestion by restriction endonuclease
(C) Hybridisation using VNTR Probe
(D) Separation of isolated DNA fragments by Gel Electrophoresis

Choose the **correct** answer from the options given below:
(a) (C), (B), (A), (D)
(b) (B), (D), (A), (C)
(c) (C), (D), (A), (B)
(d) (C), (D), (B), (A)

**Q30.** Which one of the following is the cause of extinction of Stellar's Sea Cow and Passenger Pigeon?
(a) Alien species invasion
(b) Over-exploitation
(c) Deforestation
(d) Co-extinction

**Q31.** Increase in concentration of toxicant in the aquatic food chain is:
(a) Bio-fortification
(b) Bio-magnification
(c) Eutrophication
(d) Conservation

**Q32.** A wheat field is inoculated with bacterium *Azotobacter*. Choose the correct option(s) as a result of inoculation.
(A) The soil will get enriched in potassium
(B) The soil will get enriched in nitrogen
(C) There will be no effect on soil fertility
(D) Wheat production will increase

Choose the **correct** answer from the options given below:
(a) (A) and (C) only
(b) (C) and (D) only
(c) (B) and (D) only
(d) (A) and (B) only

**Q33.** Oral contraceptive pills used by the females for birth control are combinations of the following hormones:
(a) Progestogen-estrogen
(b) Oxytocin-Progestogen
(c) FSH-LH
(d) Testosterone-estrogen

**Q34.** Match **List-I** with **List-II**:

| List-I Microbe | | List-II Application | |
|---|---|---|---|
| (A) | *Bacillus thuringiensis* | (I) | Alcohol |
| (B) | *Saccharomyces cerevisiae* | (II) | Immuno-suppressant |
| (C) | *Trichoderma polysporum* | (III) | Insecticide |
| (D) | *Aspergillus niger* | (IV) | Citric acid |

Choose the **correct** answer from the options given below:
(a) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)
(b) (A)-(II), (B)-(I), (C)-(III), (D)-(IV)
(c) (A)-(I), (B)-(II), (C)-(IV), (D)-(III)
(d) (A)-(III), (B)-(I), (C)-(II), (D)-(IV)

**Q35.** Which of the following used hides to protect their body and buried their dead?
(a) *Homo habilis*
(b) *Neanderthal man*
(c) *Homo erectus*
(d) *Australopithecines*

**Q36.** Which of the following is NOT a cause of biodiversity loss due to human activities?
(a) Habitat loss and fragmentation
(b) Over-exploitation
(c) Alien species invasions
(d) Meteorite Impact

**Q37.** The interaction between sea anemone and clown fish is:
(a) Commensalism
(b) Mutualism
(c) Amensalism
(d) Competition

**Q38.** Match **List-I** with **List-II**:

| **List-I Name** | | **List-II Functions** | |
|---|---|---|---|
| (A) | mRNA | (I) | amino acid carrier |
| (B) | rRNA | (II) | structural and catalytic role during translation |
| (C) | tRNA | (III) | Gene |
| (D) | cistron | (IV) | template for protein synthesis |

Choose the **correct** answer from the options given below:
(a) (A)-(IV), (B)-(II), (C)-(III), (D)-(I)
(b) (A)-(II), (B)-(I), (C)-(III), (D)-(IV)
(c) (A)-(I), (B)-(II), (C)-(IV), (D)-(III)
(d) (A)-(IV), (B)-(II), (C)-(I), (D)-(III)

**Q39.** Which of the following is/ are not the factor(s) causing the poor health of a person?
(A) Genetic disorders
(B) Infections
(C) Intake of unbalanced diet and un-clean water
(D) Having good eating habits

Choose the **correct** answer from the options given below:
(a) (A) and (C) only
(b) (D) only
(c) (B) only
(d) (C) and (D) only

**Q40.** Which of the following statement about cry genes is NOT correct?
(a) *cryIAc* control the cotton bollworms
(b) *cryIIAb* control the cotton bollworms
(c) *cryIAb* control the cotton bollworms
(d) *cryIAb* control the corn borer

Direction for the question 41 to 45: **Read the given passage and answer the question given below.**
The 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 the disease may transmit it to sons. The possibility of a female becoming a sufferer of disease is extremely rare because mother of such a female has to be at least carrier and the father should be sufferer.
The family pedigree of Queen Victoria shows a number of suffering descendants as she was a carrier of the disease.

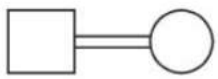
**Q41.** Identify the name of disease seen in the descendents of Queen Victoria:
(a) Sickle cell anaemia
(b) Thalassaemia
(c) Haemophilia
(d) Phenylketonuria

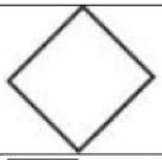
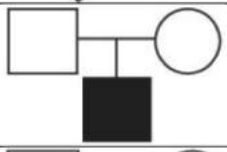
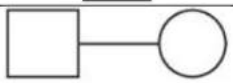
**Q42.** Identify the type of genetic disorder explained in this paragraph:
(a) Pedigree Analysis
(b) Mendelian Disorder
(c) Chromosomal Disorder
(d) Incomplete dominance

**Q43.** Identify the genotype of queen Victoria. (• - gene for disorder)
(a) X•X•
(b) X•X
(c) X•Y
(d) XX

**Q44.** Man who is sufferer of the disease marries a woman who is a carrier of this disease. What percentage of children born as carrier of this disease?
(a) 100
(b) 50
(c) 25
(d) zero

**Q45.** Match **List-I** with **List-II**:

| **List-I Symbols used in Pedigree analysis** | | **List-II Description** | |
|---|---|---|---|
| (A) |  | (I) | Parents with male child affected with disease |

| | | | |
|---|---|---|---|
| (B) |  | (II) | Consanguineous mating |
| (C) |  | (III) | Mating |
| (D) |  | (IV) | Unspecified sex |

Choose the **correct** answer from the options given below:
(a) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
(b) (A)-(I), (B)-(IV), (C)-(III), (D)-(II)
(c) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)
(d) (A)-(II), (B)-(IV), (C)-(I), (D)-(III)

Direction for the question 46 to 50: **The codons for the various amino acids are given below. Answer the question.**

| Firts Position | Second Position U | Second Position C | Second Position A | Second Position G | Third Position |
|---|---|---|---|---|---|
| U | UUU Phe | UCU Ser | UAU Tyr | UGU Cys | U |
| | UUC Phe | UCC Ser | UAC Tyr | UGC Cys | C |
| | UUA Leu | UCA Ser | UAA Stop | UGA Stop | A |
| | UUG Leu | UCG Ser | UAG Stop | UGG Trp | G |
| C | CUU Leu | CCU Pro | CAU His | CGU Arg | U |
| | CUC Leu | CCC Pro | CAC His | CGC Arg | C |
| | CUA Leu | CCA Pro | CAA Gin | CGA Arg | A |
| | CUG Leu | CCG Pro | CAG Gin | CGG Arg | G |
| A | AUU Ile | ACU Thr | AAU Asn | AGU Ser | U |
| | AUC Ile | ACC Thr | AAC Asn | AGC Ser | C |
| | AUA Ile | ACA Thr | AAA Lys | AGA Arg | A |
| | AUG Met | ACG Thr | AAG Lys | AGG Arg | G |
| G | GUU Val | GCU AIa | GAU Asp | GGU Gly | U |
| | GUC Val | GCC AIa | GAC Asp | GGC Gly | C |
| | GUA Val | GCA AIa | GAA Glu | GGA Gly | A |
| | GUG Val | GCG AIa | GAG Glu | GGG Gly | G |

**Q46.** Identify the sequence of amino acids in an mRNA AUG UUU UUA CCU UCG A _____.
(a) Met Phe Leu Ser Pro
(b) Met Phe Leu Pro Ser
(c) Met Leu Phe Pro Ser
(d) Phe Pro Leu Met Ser

**Q47.** Identify the degenerate codon from the following:
(a) CCU, CAU, CGU
(b) UUG, UCG, UAG.
(c) AUU, ACU, AAU
(d) GUU, GUG, GUA

**Q48.** Identify the start codon from the following:
(a) AUG
(b) AUC
(c) UAG
(d) UGC

**Q49.** What will be the number of amino acids in a polypeptide chain formed from the RNA with the given codons?
AUG GUU GCA CGU UAA AAU AAG
(a) 6
(b) 7
(c) 4
(d) 5

**Q50.** In the given RNA the nitrogenous base at position 2 of the fourth codon is replaced by G. What will be the effect on protein synthesis?
AUG GUU AGU UAA
(a) Different proton is synthesised
(b) Change in amino acid at position four
(c) No effect on protein synthesis
(d) Transcription will not be initiated

## SOLUTIONS

**S1. Ans. (d)**

**Sol.** Scientists have isolated single cells from plants and after digesting their cell walls have been able to isolate naked protoplasts (surrounded by plasma membranes). Isolated protoplasts from two different varieties of plants – each having a desirable character – can be fused to get hybrid protoplasts, which can be further grown to form a new plant. These hybrids are called somatic hybrids while the process is called somatic hybridisation. A protoplast of tomato is fused with that of potato, and then they are grown – to form new hybrid plants combining tomato and potato characteristics called as pomato.

**S2. Ans. (d)**

**Sol.** The B-lymphocytes produce an army of proteins in response to pathogens into our blood to fight with them. These proteins are called antibodies. Because these antibodies are found in the blood, the response is also called as humoral immune response. Rheumatoid arthritis which affects many people in our society is an auto-immune disease. The primary lymphoid organs are bone marrow and thymus. AIDS is Acquired Immuno Deficiency Syndrome.

**S3. Ans. (b)**

**Sol.** An ideal contraceptive should be user-friendly, easily available, effective and reversible with no or least side-effects. It also should in no way interfere with the sexual drive, desire and/or the sexual act of the user.

**S4. Ans. (b)**

**Sol.** The spermatids are transformed into spermatozoa (sperms) by the process called spermiogenesis.

**S5. Ans. (a)**

**Sol.** The cutting of DNA by restriction endonucleases results in the fragments of DNA. These fragments can be separated by a technique known as gel electrophoresis. The separated DNA fragments can be visualised only after staining the DNA with a compound known as ethidium bromide followed by exposure to UV radiation. The bright orange coloured bands of DNA in a ethidium bromide stained gel can be seen when exposed to UV light.

**S6. Ans. (c)**

**Sol.** Secondary succession begins in areas where natural biotic communities have been destroyed such as in abandoned farm lands, burned or cut forests, lands that have been flooded.

**S7. Ans. (b)**

**Sol.** In most aquatic organisms, such as a majority of algae and fishes as well as amphibians, syngamy occurs in the external medium (water).

**S8. Ans. (b)**

**Sol.** The steps of plant breeding are as follows: Collection of variability, evaluation and selection of parents, cross hybridisation among the selected parents and selection and testing of superior recombinants and testing, release and commercialisation of new cultivars.

**S9. Ans. (b)**

**Sol.** According to the 10 percent law, only 10% of the energy is transferred to each trophic level from its lower trophic level.

**S10. Ans. (a)**

**Sol.** During microsporogenesis, meiosis occurs in microspore mother cells.

**S11. Ans. (c)**

**Sol.** During secondary or biological treatment the primary effluent is passed into large aeration tanks where it is constantly agitated mechanically and air is pumped into it.

**S12. Ans. (b)**

**Sol.** Water hyacinth (Eichhornia crassipes) is called the 'Terror of Bengal'. It is one of the most invasive weeds found growing wherever there is standing water. It drains oxygen from the water, which leads to death of fishes.

**S13. Ans. (c)**

**Sol.** Adenine pairs with thymine and cytosine pairs with guanine throughout the entire length of DNA. So, complementary sequence of 5' ---- GAATTC ---- 3' will be 3' ---- CTTAAG ---- 5'

**S14. Ans. (b)**

**Sol.** The spleen is a large bean-shaped organ. It mainly contains lymphocytes and phagocytes. It acts as a filter of the blood by trapping blood-borne micro-organisms. Spleen also has a large reservoir of erythrocytes.

**S15. Ans. (b)**

**Sol.** Hugo deVries based on his work on evening primrose brought forth the idea of mutations – large difference arising suddenly in a population. He believed that it is mutation which causes evolution and not the minor variations (heritable) that Darwin talked about. Work of Thomas Malthus on populations influenced Darwin. A French naturalist Lamarck had said that evolution of life forms had occurred but driven by use and disuse organs. The essence of Darwinian theory about evolution is natural selection.

**S16. Ans. (c)**

**Sol.** The two chains are coiled in a right-handed fashion in a DNA double helix. Adenine forms two hydrogen bonds with Thymine from opposite strand and vice-versa. Similarly, Guanine is bonded with Cytosine with three H-bonds.

**S17. Ans. (c)**

**Sol.** Restriction endonucleases are enzymes that cleave DNA at specific sequences.

**S18. Ans. (a)**

**Sol.** Sickle-cell anaemia is an autosome linked recessive trait that can be transmitted from parents to the offspring when both the partners are carrier for the gene (or heterozygous).

**S19. Ans. (a)**

**Sol.** 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. Leydig cells synthesise and secrete testicular hormones called androgens. Spermatogenesis starts at the age of puberty due to significant increase in the secretion of gonadotropin releasing hormone (GnRH), it is a hypothalamic hormone. The corpus luteum secretes large amounts of progesterone which is essential for maintenance of the endometrium.

**S20. Ans. (c)**

**Sol.** GM plants have been useful in many ways. It has: (i) made crops more tolerant to abiotic stresses (cold, drought, salt, heat). (ii) reduced reliance on chemical pesticides (pest-resistant crops). (iii) helped to reduce post harvest losses. (iv) increased efficiency of mineral usage by plants (this prevents early exhaustion of fertility of soil). (v) enhanced nutritional value of food, e.g., golden rice, i.e., Vitamin 'A' enriched rice.

**S21. Ans. (d)**

**Sol.** S.L. Miller supported Oprain and Haldan's proposal. He created Earth's reducing atmosphere during early days of development. He created electric discharge in a closed flask containing methane, hydrogen, ammonia and water vapour at $800^{o}$ C. This resulted is the formation of amino acids. His experiment supported that the chemical evolution of organic molecules occurred from the inorganic substances.

**S22. Ans. (b)**

**Sol.** Turner's Syndrome is caused due to the absence of one of the X chromosomes

**S23. Ans. (c)**

**Sol.** The traits that are controlled by three or more genes are called as polygenic traits. Human skin colour is another classic example for this. In such a trait the phenotype reflects the contribution of each allele, i.e., the effect of each allele is additive.

**S24. Ans. (d)**

**Sol.** Lipases are used in detergent formulations and are helpful in removing oily stains from the laundry. Streptokinase produced by the bacterium Streptococcus and modified by genetic engineering is used as a 'clot buster' for removing clots from the blood vessels of patients who have undergone myocardial infarction leading to heart attack. Another bioactive molecule, cyclosporin A, that is used as an immunosuppressive agent in organ-transplant patients, is produced by the fungus Trichoderma polysporum. Statins produced by the yeast Monascus purpureus have been commercialised as blood-cholesterol lowering agents.

**S25. Ans. (b)**

**Sol.** A population growing in a habitat with limited resources show initially a lag phase, followed by phases of acceleration and deceleration and finally an asymptote, when the population density reaches the carrying capacity. A plot of N in relation to time (t) results in a sigmoid curve. This type of population growth is called Verhulst-Pearl Logistic Growth and is described by the following equation: $dN/dt = rN (K – N \div K)$

**S26. Ans. (d)**

**Sol.** Amorphophallus is the tallest flower, cleistogamous flowers are flowers which do not open at all, papaya is one of the best examples of the dioecious plant and some examples of water pollinated plants are Vallisneria and Hydrilla which grow in fresh water and several marine sea-grasses such as Zostera.

**S27. Ans. (c)**

**Sol.** Eichhomia or water hyacinth was introduced in India for its beautiful flowers and shape of leaves but since it vegetatively propagates rapidly, it becme notorious weed later on.

**S28. Ans. (c)**

**Sol.** Using Agrobacterium vectors, nematode-specific genes were introduced into the host plant. The introduction of DNA was such that it produced both sense and anti-sense RNA in the host cells. These two RNA's being complementary to each other formed a double stranded (dsRNA) that initiated RNAi and thus, silenced the specific mRNA of the nematode.

**S29. Ans. (b)**

**Sol.** The technique of DNA Fingerprinting was initially developed by Alec Jeffreys. He used a satellite DNA as probe that shows very high degree of polymorphism. It was called as Variable Number of Tandem Repeats (VNTR). The technique, as used earlier, involved Southern blot hybridisation using radiolabelled VNTR as a probe. It included (i) isolation of DNA, (ii) digestion of DNA by restriction endonucleases, (iii) separation of DNA fragments by electrophoresis, (iv) transferring (blotting) of separated DNA fragments to synthetic membranes, such as nitrocellulose or nylon, (v) hybridisation using labelled VNTR probe, and (vi) detection of hybridised DNA fragments by autoradiography.

**S30. Ans. (b)**

**Sol.** Many species extinctions in the last 500 years (Steller's Sea cow, passenger pigeon) were due to overexploitation by humans.

**S31. Ans. (b)**

**Sol.** A few toxic substances, often present in industrial waste waters, can undergo biological magnification (Biomagnification) in the aquatic food chain. Biomagnification refers to increase in concentration of the toxicant at successive trophic levels.

**S32. Ans. (c)**

**Sol.** Adding Azotobacter to a wheat crop can have several potential benefits. Azotobacter is a type of nitrogen-fixing bacteria that has the ability to convert atmospheric nitrogen into forms that are usable by plants. Addition of Azotobacter will 1. Increase nitrogen availability: Azotobacter can fix atmospheric nitrogen and convert it into ammonium, which can be absorbed by wheat plants. This can increase the availability of nitrogen in the soil, reducing the need for synthetic nitrogen fertilizers.

2. Enhanced plant growth: By providing a supplementary source of nitrogen, Azotobacter can support healthy plant growth. Nitrogen is an essential nutrient for plants, and its availability can influence factors such as leaf development, stem elongation, and overall biomass production.

3. Improved nutrient uptake: Azotobacter can also enhance the uptake of other essential nutrients by wheat plants. Its presence in the soil can improve the solubility and availability of minerals, facilitating their absorption by plant roots.

**S33. Ans. (a)**

**Sol.** Oral administration of small doses of either progestogens or progestogen–estrogen combinations is another contraceptive method used by the females. They are used in the form of tablets and hence are popularly called the pills.

**S34. Ans. (d)**

**Sol.** Microbial biocontrol agents that can be introduced in order to control butterfly caterpillars is the bacteria Bacillus thuringiensis. These are available in sachets as dried spores which are mixed with water and sprayed onto vulnerable plants such as brassicas and fruit trees, where these are eaten by the insect larvae. In the gut of the larvae, the toxin is released and the larvae get killed. The bacterial disease will kill the caterpillars, but leave other insects unharmed. Aspergillus niger (a fungus) is used in commercial production of citric acid. Another bioactive molecule, cyclosporin A, that is used as an immunosuppressive agent in organ-transplant patients, is produced by the fungus Trichoderma polysporum. Yeast (Saccharomyces cerevisiae) is used for commercial production of ethanol.

**S35. Ans. (b)**

**Sol.** The Neanderthal man with a brain size of 1400cc lived in near east and central Asia between 1,00,000-40,000 years back. They used hides to protect their body and buried their dead.

**S36. Ans. (d)**

**Sol.** The accelerated rates of species extinctions that the world is facing now are largely due to human activities like Habitat loss and fragmentation, Over-exploitation, alien species invasion and co-extinctions.

**S37. Ans. (a)**

**Sol.** Another example of commensalism is the interaction between sea anemone that has stinging tentacles and the clown fish that lives among them. The fish gets protection from predators which stay away from the stinging tentacles. The anemone does not appear to derive any benefit by hosting the clown fish.

**S38. Ans. (d)**

**Sol.** In bacteria, there are three major types of RNAs: mRNA (messenger RNA), tRNA (transfer RNA), and rRNA (ribosomal RNA). All three RNAs are needed to synthesise a protein in a cell. The mRNA provides the template, tRNA brings aminoacids and reads the genetic code, and rRNAs play structural and catalytic role during translation.

**S39. Ans. (b)**

**Sol.** Balanced diet, personal hygiene and regular exercise are very important to maintain good health. Yoga has been practised since time immemorial to achieve physical and mental health.

**S40. Ans. (c)**

**Sol.** the proteins encoded by the genes cryIAc and cryIIAb control the cotton bollworms, that of cryIAb controls corn borer.

**S41. Ans. (c)**

**Sol.** The family pedigree of Queen Victoria shows a number of haemophilic descendents as she was a carrier of the disease.

**S42. Ans. (b)**

**Sol.** Most common and prevalent Mendelian disorders are Haemophilia, Cystic fibrosis, Sicklecell anaemia, Colour blindness, Phenylketonuria, Thalassemia, etc.

**S43. Ans. (b)**

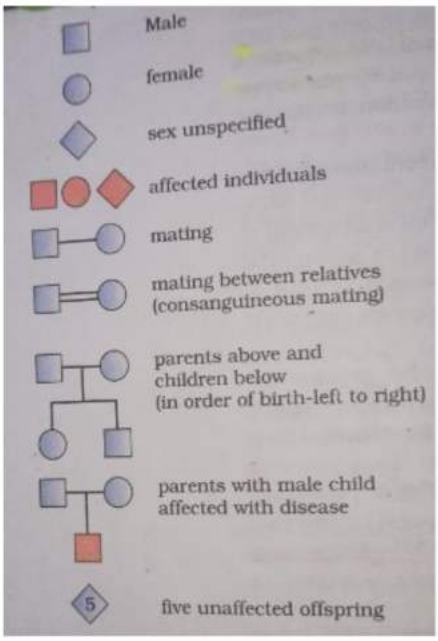
**Sol.** Hemophilia is a sex-linked trait, which means it is carried on the X chromosome. Since males have only one X chromosome (XY), they will express the trait if they inherit the hemophilia allele. Females have two X chromosomes (XX), so they can be carriers if they have one hemophilia allele and one normal allele, or they can be affected if they have two hemophilia alleles.

**S44. Ans. (c)**

**Sol.** The X chromosome is a sex chromosome that is present in both males and females. However, females have two copies of this (XX) chromosome, while males have one copy of the X chromosome and one copy of the Y (XY) chromosome to define their sex. Since this is a recessive genetic disease, it will be necessary for a woman to inherit **both sex chromosomes** with the mutation caused by hemophilia from her parents in order to have the disease. If she receives only one X chromosome with the mutation, the woman will be a carrier with no symptoms. Instead, it is enough for men to inherit **an X chromosome** with the mutation to be hemophiliacs.

**S45. Ans. (d)**

**Sol.** Symbols used in the human pedigree analysis are as follows:




**S46. Ans. (b)**

**Sol.** George Gamow, a physicist argued that since there are only 4 bases and if they have to code for 20 amino acids, the code should constitute a combination of bases. He suggested that in order to code for all the 20 amino acids, the code should be made up of three nucleotides. This was a very bold proposition, because a permutation combination of 43 (4 × 4 × 4) would generate 64 codons; generating many more codons than required.

**S47. Ans. (d)**

**Sol.** Some amino acids are coded by more than one codon, hence the code is degenerate. GUU, GUG and GUA all code for one amino acid that is valine.

**S48. Ans. (a)**

**Sol.** AUG has dual functions. It codes for Methionine (met) , and it also act as initiator codon

**S49. Ans. (c)**

**Sol.** There are in total 64 codons . Out of these, 61 codons code for amino acids whereas 3 codons donot code for any amino acid. These three codons UAA, UAG and UGA are termed as stop codons as when these are read by the ribosomes no amino acid is incorporated. Rather the protein synthesis terminates. Protein synthesis begins with codon termed as initiator codon generally AUG. In eukaryotes this codon codes for methionine whereas in prokaryotes this codes for N-formylmethione. Protein synthesis initiates with initiator codon in the mRNA and terminates with the stop codon. In the given sequence there are 7 codons. But since the 5th codon is UAA which is a stop codon the translation process will terminate there and a protein of 4 amino acids will be synthesized.

**S50. Ans. (c)**

**Sol.** UAA, UAG and UGA are stop codons if the nitrogenous base at position 2 of the fourth codon is replaced by G, the codon becomes UGA that is also a stop codon, so protein synthesis will not be affected.