BIOLOGY

NTA CUET PAPER
(3RD JUNE 2025, SHIFT-II)

Instructions

All questions are compulsory. Each questions carries 5 marks. One mark will be deducted for a wrong answer.

Full Marks: 250 ***(Time: 60 Minutes)***

1. Which one of the followings is an indirect measure of the organic matter present in water?

(*a*) pH level (*b*) Nitrogen content
(*c*) Turbidity (*d*) BOD

2. Which one of the following plants is the source of cannabinoids commonly used in drug abuse?

(*a*) *Papaver somniferum* (*b*) *Cannabis sativa*
(*c*) *Erythroxylum coca* (*d*) *Atropa belladona*

3. Arrange the following steps of genetically engineered insulin production.

A. Isolation and purification of the insulin gene from beta cells of the pancreatic islets
B. Expression of gene in host cell
C. Joining the two polypeptides by disulfide bonds
D. Cloning of insulin gene in *Escherichia coli* cloning host cell

Choose the **correct** answer from the options given below:

(*a*) A, B, C, D (*b*) A, D, B, C
(*c*) A, B, D, C (*d*) A, C, D, B

4. Which of the following statements about ecological pyramids is incorrect?

(*a*) Pyramids of energy are always upright.
(*b*) Saprophytes are given the top position in ecological pyramids.
(*c*) In terrestrial ecosystems, the pyramid of number can be inverted.
(*d*) In this, the single species related to two or more trophic levels is not considered.

5. Recombinant DNA technology involves the following steps in a specific sequence.

A. Culture of the host cell
B. Extraction of desired product
C. Isolation of desired DNA fragments
D. Transformation of the recombinant DNA into the host cell

Arrange these sequences correctly and choose the **correct** answer from the options given below:

(*a*) A, B, C, D (*b*) C, D, A, B
(*c*) B, A, D, C (*d*) C, B, D, A

6. Match List-I with List-II.

List-I (Terms)		List-II (Features)	
A.	Selectable marker	I.	Site that commonly used for cutting the DNA by restriction enzyme
B.	Origin of replication	II.	Removes nucleotides from the ends of the DNA
C.	Exonuclease	III.	Helps in identification and elimination of non-transformants
D.	Recognition site	IV.	The sequence responsible for controlling the copy number of linked DNA

Choose the **correct** answer from the options given below:

(*a*) A-III, B-IV, C-II, D-I
(*b*) A-I, B-II, C-III, D-IV
(*c*) A-I, B-II, C-IV, D-III
(*d*) A-III, B-IV, C-I, D-II

7. Match List-I with List-II.

List-I (Birth control methods)		List-II (Features)	
A.	Diaphragms	I.	Removal of vas deferens
B.	Lactational amenorrhea	II.	Increase phagocytosis of sperms
C.	Vasectomy	III.	Absence of menstrual cycle and ovulation following parturition
D.	IUDs	IV.	Cover the cervix and blocks the entry of sperm

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

8. Which one of the following plays an important role in guiding the entry of pollen tube into the synergid?
(*a*) Filiform apparatus (*b*) Antipodals
(*c*) Polar nuclei (*d*) Egg cell

9. Which one of the following pyramids of biomass is generally inverted in the ecosystems?
(*a*) Forest (*b*) Grassland
(*c*) Sea (*d*) Desert

10. How many base pairs are present in one complete turn of DNA?
(*a*) 10 (*b*) 5
(*c*) 7 (*d*) 12

11. The arrangement of the nuclei in a normal embryo sac from the chalazal to micropylar end in dicots is:
(*a*) 3 + 3 + 2 (*b*) 2 + 3 + 3
(*c*) 3 + 2 + 3 (*d*) 4 + 1 + 3

12. Match List-I with List-II.

List-I (Scientists)		List-II (Discoveries)	
A.	Frederick Griffith	I.	Genetic Code
B	Francois Jacob and Jacque Monad	II.	Semi-conservative mode of DNA replication
C.	Har Gobind Khorana	III.	Transformation
D.	Meselson and Stahl	IV.	*Lac* operon

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

13. Sex determination in grasshopper is of:
(*a*) XX-XY type (*b*) XX-XO type
(*c*) ZZ-ZO type (*d*) ZZ-ZW type

14. Three cells grouped together at the micropylar end and constitute_____in the embryo sac.
(*a*) Central cell (*b*) Polar cells
(*c*) Egg apparatus (*d*) Antipodals

15. Which one of the following disorders is a sex linked recessive disease?
(*a*) Sickle-cell anaemia (*b*) Haemophilia
(*c*) Phenylketonuria (*d*) Thalassemia

16. Which one of the followings cells are attacked by HIV?
(*a*) Cytotoxic cells (*b*) B-cells
(*c*) T-helper cells (*d*) T-memory cells

17. Arrange the following steps of curd formation from milk.
A. Coagulation and partial digestion of milk protein
B. Growth of starter culture
C. Growth of lactic acid bacteria (LAB) in milk
D. A small amount of curd is added as an inoculum to fresh milk
Choose the **correct** answer from the options given below:
(*a*) B, D, C, A (*b*) D, B, C, A
(*c*) B, D, A, C (*d*) C, D, B, A

18. Which of the following techniques are commonly used for early detection of cancer?
A. Biopsy and histopathological studies
B. Radiography (x-rays)
C. MRI (Magnetic Resonance Imaging)
D. Electrocardiogram (ECG)
Choose the **correct** answer from the options given below:
(*a*) A, B, C and D only (*b*) A, B and D only
(*c*) A, B and C only (*d*) A, B, C and D only

19. Which one of the following diagnostic techniques is based on the principle of antigen-antibody interaction?
(*a*) Recombinant DNA technology
(*b*) Polymerase Chain Reaction
(*c*) Enzyme-linked immuno sorbent assay
(*d*) Gel electrophoresis

20. Match List-I with List-II.

List-I (Microorganisms)		List-II (Commercial Uses)	
A.	*Lactobacillus*	I.	Use for the production of butyric acid
B.	*Saccharomyces cerevisiae*	II.	Use for production of swiss cheese
C.	*Propionibocterium sharmanii*	III.	Use for making bread
D.	*Clostridium butylicum*	IV.	Improves nutritional quality of milk by increasing vitamin B_{12}

Choose the **correct** answer from the options given below:

(*a*) A-IV, B-III, C-II, D-I

(*b*) A-IV, B-II, C-III, D-I

(*c*) A-IV, B-II, C-I, D-III

(*d*) A-II, B-III, C-I, D-IV

21. During allergic reactions, which of the following are secreted?

A. Histamines B. Interferons

C. Serotonin D. Pyrogens

Choose the **correct** answer from the options given below:

(*a*) A, B and D only (*b*) B and C only

(*c*) A, B, C and D (*d*) A and C only

22. *Bacillus thuringiensis* produces proteins (Bt toxin) that kill certain insects. Identify the **correct** statements.

A. Bt toxin protein exists as an inactive form (protoxin) in *Bacillus thuringiensis*.

B. Bt toxin protein exists as an active form toxin in the insect gut.

C. The alkaline pH of the gut of an insect solubilize the toxin and converts in an inactive form.

D. The toxin is coded by a gene *crylAc* named **cry**.

Choose the **correct** answer from the options given below:

(*a*) A, B and C only (*b*) A, B, C and D

(*c*) A, B and D only (*d*) A and B only

23. Which one of the following hormones is **not** secreted by the placenta?

(*a*) hCG (*b*) hPL

(*c*) Progestogens (*d*) Relaxin

24. What is the primary function of the aeration tanks in the secondary treatment of sewage?

(*a*) To remove solid waste through filtration

(*b*) To allow the growrh of aerobic microbes that consume organic matter

(*c*) To reduce the BOD of the effluent using chemicals

(*d*) To settle the activated sludge

25. Human protein, α-1-antitrypsin is used for the treatment of:

(*a*) Cystic fibrosis (*b*) Phenylketonuria

(*c*) Emphysema (*d*) Alzheimer's disease

26. Which one of the following hormones is essential for maintenance of endometrium?

(*a*) TSH (*b*) Estrogens

(*c*) Progesterone (*d*) Relaxin

27. A specific recognition sequence identified by endonuclease to cut at specific locations in DNA

(*a*) Poly(A) sequence

(*b*) Palindromic nucleotide sequence

(*c*) Okazaki sequence

(*d*) Degenerate sequence

28. Match List-I with List-II.

List-I (Pathogens)		List-II (Diseases)	
A.	*Wuchereria bancrofti*	I.	Ringworms
B.	Rhino Virus	II.	Elephantiasis
C.	*Haemophilus influenzae*	III.	Common Cold
D.	*Epidermophyton*	IV.	Pneumonia

Choose the **correct** answer from the options given below:

(*a*) A-II, B-III, C-IV, D-I

(*b*) A-I, B-II, C-III, D-IV

(*c*) A-I, B-II, C-IV, D-III

(*d*) A-III, B-IV, C-I, D-II

29. Which one of the following represents a palindromic sequence?

(*a*) 5′-GAATTC-3′
3′-CTTAAG-5′ (*b*) 5′-CCAATG-3′
3′-GAATCC-5′

(*c*) 5′-CATTAG-3′
3′-GATAAC-5′ (*d*) 5′-GATACC-3′
3′-CCTAAG-5′

30. *Agrobacterium tumifaciens*, is able to deliver a piece of DNA known as _____ to transform normal plant cell into a tumor cell.

(*a*) T-DNA (*b*) Z-DNA

(*c*) B-DNA (*d*) C-DNA

31. The biodiversity is _____ at lower altitudes and _____ with increasing higher latitudes.

(*a*) Highest, Decreases (*b*) Lowest, Increases

(*c*) Highest, Increases (*d*) Lowest, Decreases

32. The degradation of humus by microbes to release inorganic nutrients is known as:

(*a*) Humification (*b*) Mineralisation

(*c*) Fragmentation (*d*) Catabolism

33. Select the **correct** sequence for transport of sperm in the male reproductive system.

A. Urethra B. Urethra meatus

C. Ejaculatory duct D. Vas deferens

Choose the **correct** answer from the options given below:

(*a*) A, B, C, D (*b*) D, C, A, B

(*c*) D, C, B, A (*d*) C, B, D, A

34. Which one of the following diseases is non-infectious?

(*a*) Cholera (*b*) Pneumonia

(*c*) Tuberculosis (*d*) Elephantiasis

35. Which one of the followings is **not** a common mechanical barrier method for birth control?

(*a*) Diaphragms (*b*) Vaults

(*c*) Implants (*d*) Cervical caps

36. Which one of the given Assisted Reproductive Technologies (ART) involves transfer of fertilized egg into the fallopian tube?

(*a*) IUI (*b*) ZIFT

(*c*) GIFT (*d*) ICSI

37. Identify the **correct** statements for Adenosine Deaminase (ADA) deficiency.

A. It is caused by the failure of synthesis of an enzyme, adenosine deaminase.

B. It leads to inherited immunodeficiency disorder, Severe Combined immunodeficiency (SCID).

C. It is attributed to a mutant ADA gene.

D. Its treatment can be done by introducing ADA cDNA into the hepatocytes.

Choose the **correct** answer from the options given below:

(*a*) A, B and D only (*b*) A, B and C only

(*c*) A, B, C and D (*d*) B, C and D only

38. Arrange the following structures involved in embryogenesis in the **correct** sequence.

A. Zygote B. Blastocyst

C. Blastomeres D. Morula

Choose the **correct** answer from the options given below:

(*a*) A, C, D, B (*b*) A, C, B, D

(*c*) B, A, D, C (*d*) C, B, D, A

39. Identify the **correct** combination of statements for sacred groves.

A. These are *in-situ* conservation strategies.

B. These are *ex-situ* conservation strategies.

C. These are found in the Khasi and Jaintia hills in Meghalaya.

D. These hold religious values.

Choose the **correct** answer from the options given below:

(*a*) A, C and D only (*b*) A and D only

(*c*) A and C only (*d*) B, C and D only

40. When Tt × Tt are crossed, how many percent of the offsprings show a recessive phenotype?

(*a*) 25% (*b*) 50%

(*c*) 75% (*d*) 100%

Read the following passage carefully and answer the given questions (Q. 41-45).

Theory of Evolution

The evolution of life is a gradual process through which simple organisms are transformed into complex life forms over billions of years. It involves genetic changes, adaptation to the environment, and the emergence of diversity in species. Fossil records provide evidence of extinct life forms and transitional stages. Evolution is influenced by factors such as mutation, genetic recombination, and environmental pressure, shaping the biodiversity we see today. Charles Darwin and Alfred Russel Wallace were pioneering naturalists who developed the theory of evolution by natural selection.

41. According to Darwin, the term 'Fitness' in the context of natural selection refers to:

(*a*) Physical strength of an organism

(*b*) The ability of an organism to adapt to any environment

(*c*) The reproductive success of an individual or population

(*d*) Survival without reproduction

42. The study of fossils in different sedimentary layers indicates _____.

(*a*) Geographical periods in which they were existed

(*b*) Geological periods in which they were migrated

(*c*) Geological periods in which they were existed

(*d*) Geographical periods in which they were migrated

43. The voyage of the H.M.S. Beagle was significant in the development of Darwin's theory of evolution as

(*a*) It allowed Darwin to study fossilized remains of ancient organisms in museums.

(*b*) It provided direct observations of artificial selection in controlled environment.

(*c*) It helped Darwin to identify patterns of adaptative radiation of species.

(*d*) It gave Darwin access to laboratory experiments that confirmed genetic mutation.

44. Alfred Russel Wallace, a naturalist, arrived at conclusions similar to Darwin while working in:

(*a*) Galapagos island (*b*) Malay archipelago

(*c*) Amazon rainforest (*d*) Australian outback

45. Which one of the following statements is **not** the meaning of the theory of special creation?

(*a*) All living beings were created as they are today.

(*b*) The diversity of life has remained constant since creation.

(*c*) The earth is about 4000 years old.

(*d*) Life forms evolved slowly over millions of years.

Read the following passage carefully and answer the given questions (Q. 46-50).

Productivity in the Ecosystem

The flow of energy through a terrestrial ecosystem starts with the harnessing of sunlight by autotrophs. The radiant energy is converted by photosynthesis to organic compounds is known as productivity. The productivity is expressed in units of energy per unit of area per unit time. The amount of organic

matter present at any given time is biomass. The productivity of any ecosystem is affected by many parameters like weather conditions, nutrient availability etc. The productivity of any ecosystem does vary seasonally and yearly.

46. Identify the correct statement in relation to productivity in an aquatic ecosystem.

(*a*) The GPP is always less than NPP
(*b*) The GPP is always more than NPP
(*c*) The GPP is always equal to NPP
(*d*) No relation between GPP and NPP

47. The biomass available for consumption by herbivores and decomposers is known as:

(*a*) Gross Primary Productivity
(*b*) Net Primary Productivity
(*c*) Secondary Productivity
(*d*) Standing Biomass

48. The unit for expressing productivity is:

(*a*) (Kcal m^{-2}) yr^{-1} (*b*) (Kcal m^{-2}) yr^{-2}
(*c*) (Kcal m^{-1}) yr^{-1} (*d*) (Kcal m^{2}) yr^{-1}

49. The Net Primary Productivity of an ecosystem are represented by:

(*a*) NPP = GPP + Respiration
(*b*) NPP = GPP – Respiration
(*c*) NPP = Radiant Energy – GPP
(*d*) NPP = Radiant Energy + GPP

50. The amount of organic matter accumulated in an ecosystem at a given time is known as:

(*a*) Standing state
(*b*) Standing crop
(*c*) Standing biomass
(*d*) Standing productivity

Answer Key

1. (*d*)	**2.** (*b*)	**3.** (*b*)	**4.** (*b*)	**5.** (*b*)	**6.** (*a*)	**7.** (*b*)	**8.** (*a*)	**9.** (*c*)	**10.** (*a*)
11. (*c*)	**12.** (*d*)	**13.** (*b*)	**14.** (*c*)	**15.** (*b*)	**16.** (*c*)	**17.** (*b*)	**18.** (*c*)	**19.** (*c*)	**20.** (*a*)
21. (*d*)	**22.** (*c*)	**23.** (*d*)	**24.** (*b*)	**25.** (*c*)	**26.** (*c*)	**27.** (*b*)	**28.** (*a*)	**29.** (*a*)	**30.** (*a*)
31. (*a*)	**32.** (*b*)	**33.** (*b*)	**34.** (*d*)	**35.** (*c*)	**36.** (*b*)	**37.** (*b*)	**38.** (*a*)	**39.** (*a*)	**40.** (*a*)
41. (*c*)	**42.** (*c*)	**43.** (*c*)	**44.** (*b*)	**45.** (*d*)	**46.** (*b*)	**47.** (*b*)	**48.** (*a*)	**49.** (*b*)	**50.** (*b*)

Explanations

1. (*d*) BOD (Biochemical Oxygen Demand) measures the amount of oxygen required by microorganisms to decompose organic matter in water.

A high BOD indicates high organic matter pollution.

2. (*b*) Cannabinoids (e.g., marijuana, hashish, ganja, charas) are obtained from *Cannabis sativa*.

Papaver somniferum → Source of opium (morphine, heroin).

Erythroxylum coca → Source of cocaine.

Atropa belladonna → Source of alkaloids

3. (*b*) The correct sequence of insulin production using rDNA technology is:

(A) Isolation and purification of the insulin gene from pancreatic beta cells.

(D) Cloning of insulin gene into *E. coli* host cells for multiplication.

(B) Expression of gene in host cells to produce polypeptides A and B of insulin.

(C) Joining of the two polypeptides (A and B chains) by disulfide bonds to form functional insulin.

4. (*b*) Saprophytes are not included in ecological pyramids even though they play an important role in the ecosystem.

5. (*b*) The correct sequence of steps in Recombinant DNA Technology:

1. Isolation of desired DNA fragments → *(Step C)*
2. Transformation of recombinant DNA into host cell → *(Step D)*
3. Culture of the host cell → *(Step A)*
4. Extraction of desired product → *(Step B)*

6. (*a*) A. Selectable marker → (III) Helps in identification and elimination of non-transformants

B. Origin of replication → (IV) The sequence responsible for controlling the copy number of linked DNA

C. Exonuclease → (II) Removes nucleotides from the ends of the DNA

D. Recognition site → (I) Site that commonly used for cutting the DNA by restriction enzyme

7. (*b*) (A) Diaphragms → (IV) Cover the cervix and block the entry of sperm (barrier method)

(B) Lactational amenorrhea → (III) Absence of menstrual cycle and ovulation following parturition

(C) Vasectomy → (I) Removal (or cutting) of vas deferens in males

(D) IUDs (Intrauterine Devices) → (II) Increase phagocytosis of sperms

8. (*a*) The filiform apparatus is present at the micropylar end of the synergids. It guides the pollen tube into the synergid for the release of male gametes.

9. (*c*) In a sea (aquatic ecosystem), the pyramid of biomass is inverted. This happens because the biomass of producers (phytoplankton) is less than the biomass of primary consumers (zooplankton).

Pyramids of biomass are generally upright in forest, grassland and desert ecosystems.

10. (*a*) DNA is a double helix structure as proposed by Watson and Crick. One complete turn of the DNA helix contains 10 base pairs (bp). The distance between a bp in a helix is approximately 0.34 nm.

11. (*c*) A normal embryo sac (also called mature female gametophyte) in dicots is 7-celled and 8-nucleated, arranged as:

- Chalazal end: 3 antipodal cells - (3 nuclei)
- Central cell: 2 polar nuclei in the center - (2 nuclei)
- Micropylar end: Egg apparatus = 1 egg cell + 2 synergids - (3 nuclei)

12. (*d*) (A-III) Frederick Griffith discovered the phenomenon of transformation in bacteria *(Streptococcus pneumoniae)*.

(B-IV) Francois Jacob and Jacque Monod proposed the *Lac* operon model for gene regulation in bacteria.

(C-I) Har Gobind Khorana helped decipher the genetic code (which codons code for which amino acids).

(D-II) Meselson and Stahl proved that DNA replication is semi-conservative using *E. coli* and N_{15} isotope.

13. (*b*) Grasshoppers show XX-XO type of sex determination. Females have XX sex chromosomes. Males have only one X chromosome (XO). The presence or absence of the second X chromosome determines sex.

14. (*c*) In a mature embryo sac (female gametophyte), the micropylar end contains three cells: 1 egg cell and 2 synergids. Together, they form the egg apparatus.

15. (*b*) Haemophilia is a sex-linked recessive disorder carried on the X chromosome, and is more common in males (XY) since they have only one X chromosome. Females (XX) are usually carriers and show symptoms only if both X chromosomes carry the defective gene.

Sickle-cell anaemia, phenylketonuria, and thalassemia are all autosomal recessive disorders.

16. (*c*) HIV primarily attacks the T-helper cells, which are crucial for activating other immune cells. By destroying these cells, HIV weakens the immune system, making the body vulnerable to infections and diseases.

17. (*b*) The correct order of steps of curd formation from milk are as follows:

(D) A small amount of curd is added as an inoculum to fresh milk.

(B) This inoculum contains starter culture, which starts growing.

(C) Lactic acid bacteria (LAB) multiply and grow in milk.

(A) LAB causes coagulation and partial digestion of milk proteins, forming curd.

18. (*c*) Cancer detection is commonly done through biopsy and histopathological studies, where the suspected tissue is examined microscopically.

Radiography (X-rays) and MRI (Magnetic Resonance Imaging) are useful for detecting cancers of internal organs

ECG is used for heart examination, not for cancer detection.

19. (*c*) ELISA works on the antigen–antibody interaction principle to detect the presence of pathogens or specific proteins.

Recombinant DNA Technology involves joining DNA fragments from different sources to form recombinant DNA.

Polymerase Chain Reaction (PCR) is a molecular technique used to amplify a specific DNA segment *in vitro*.

Gel electrophoresis separates DNA fragments based on size/charge.

20. (*a*) (A) *Lactobacillus* - Improves milk's nutritional quality by increasing vitamin B_{12}(IV)

(B) *Saccharomyces cerevisiae* - Commonly known as baker's yeast, used for bread making (III)

(C) *Propionibacterium sharmanii* - Used in the production of Swiss cheese (II)

(D) *Clostridium butylicum* - Used for production of butyric acid (I)

21. (*d*) During allergic reactions, mast cells release histamine and serotonin, which cause symptoms like inflammation, sneezing, and itching.

Interferons are proteins produced in response to viral infections.

Pyrogens are substances that raise body temperature during infections.

22. (*c*) (A) is correct: Bt toxin exists as an inactive protoxin in *Bacillus thuringiensis*.

(B) is correct: The protoxin becomes active in the insect gut.

(C) is incorrect: The alkaline pH of the insect gut solubilizes the toxin and activates it, not inactivates it

(D) The Bt toxin is coded by the cry gene, such as cry*IAc*

23. (*d*) The placenta secretes hCG (Human Chorionic Gonadotropin), hPL (Human Placental Lactogen), progestogens during pregnancy.

Relaxin is primarily secreted by the ovary.

24. (*b*) In secondary treatment, sewage is pumped into aeration tanks where air (oxygen) is pumped in. This promotes the growth of aerobic microbes. These microbes consume organic matter helping to clean the water.

This process also helps in reducing BOD (Biochemical Oxygen Demand), but not using chemicals.

Solid wastes are removed through filtration during primary treatment.

Activated sludge is settled down in the settling tank.

25. (*c*) Human α-1-antitrypsin is produced using transgenic animals and is used in the treatment of emphysema, a chronic lung disease where alveolar walls are damaged resulting in decreased respiratory surface.

26. (*c*) Progesterone is the hormone that helps in maintaining the endometrium, the inner lining of the uterus. It ensures that the endometrium remains thick and ready for implantation of the fertilized egg.

Without enough progesterone, the endometrial lining sheds, leading to menstruation.

27. (*b*) Restriction endonucleases (also known as restriction enzymes) cut DNA at specific sites. These specific sites are known as recognition sequences. These recognition sequences are typically palindromic, meaning the sequence of base pairs reads the same forward and backward on the two DNA strands.

28. (*a*) (A) *Wuchereria bancrofti* → (II) Elephantiasis

(B) Rhino Virus → (III) Common Cold

(C) *Haemophilus influenzae* → (IV) Pneumonia

(D) *Epidermophyton* → (I) Ringworms

29. (*a*) A palindromic sequence reads the same on both DNA strands in 5′ to 3′ direction.

In option 1:

5′-GAATTC-3′ 3′-CTTAAG-5′

If the second sequence is read in 5′ to 3′, it becomes GAATTC same as the first sequence, making it a palindromic sequence.

30. (*a*) *Agrobacterium tumefaciens* is a bacterium used in plant genetic engineering. It carries a Ti plasmid (tumor-inducing plasmid). A portion of this plasmid called T-DNA (Transfer DNA) gets inserted into the plant genome. This T-DNA transforms the normal plant cell into a tumor cell, causing crown gall disease.

31. (*a*) Biodiversity is highest at lower altitudes (like tropical rainforests) due to favorable climate and stable conditions.

As latitude increases, temperature drops, and conditions become harsher, so biodiversity decreases.

32. (*b*) Mineralisation is the process where microbes break down humus, releasing inorganic nutrients into the soil.

Humification involves formation of humus.

Fragmentation is breakdown of detritus into smaller particles by detritivores.

Catabolism is degradation of detritus into simpler inorganic substances by bacterial and fungal enzymes.

33. (*b*) The correct path of sperm transport is:

Vas deferens (D): Carries sperm from the epididymis to the ejaculatory duct.

Ejaculatory duct (C): Forms by the union of ducts from vas deferens and seminal vesicle and transport semen from these structures to the urethra.

Urethra (A) is passage for sperm through the penis

Urethral meatus (B) is external opening of urethra

34. (*d*) Infectious diseases are one in which a causative organism is carried from one person to another.

Cholera, caused by *Vibrio cholerae* (bacteria) spreads through contaminated food and water, when consumed by someone.

Pneumonia caused by *Streptococcus pneumoniae* or *Haemophilus influenzae* and Tuberculosis caused by *Mycobacterium tuberculosis* can spread from person to person *via* air droplets.

Elephantiasis, however, while caused by a parasitic worm *Wuchereria bancrofti* spread by mosquitoes, is not spread directly from person to person, making it non-infectious.

35. (*c*) Diaphragms, vaults, and cervical caps are mechanical barriers inserted into the female reproductive tract to cover the cervix during coitus, preventing sperm from reaching the egg.

Implants are hormonal contraceptives placed under the skin that release hormones to prevent pregnancy.

36. (*b*) ZIFT involves collecting eggs from the female, fertilizing them outside the body, and then transferring the zygote (fertilized egg,with upto 8 blastomeres) into the fallopian tube.

IUI (Intra Uterine Transfer): Transfer of embryos with more than 8 blastomeres into the uterus.

GIFT: Transfer of an ovum collected from a donor and sperm are placed in the fallopian tube.

ICSI: A sperm is injected into the cytoplasm of egg, but embryo transfer is usually into the uterus.

37. (*b*) Statement D is incorrect: Treatment of Adenosine Deaminase(ADA) deficiency can be done by introduction of ADA cDNA into lymphocytes, not hepatocytes (liver cells).

38. (*a*) The correct sequence of embryogenesis after fertilization is: Zygote → Blastomeres → Morula → Blastocyst

1. Zygote(A) – Formed by the fusion of male and female gametes.
2. Blastomeres(C) – The zygote divides by mitosis to form 2, 4, 8, 16 daughter cells called blastomeres.
3. Morula(D) – A solid ball of 8–16 blastomeres.
4. Blastocyst(B) – A structure formed after the morula stage.

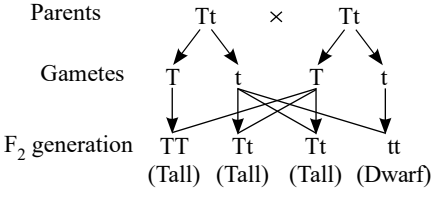
39. (*a*) Sacred groves are natural forest areas protected by communities due to religious beliefs. These are examples of *in-situ* conservation, where biodiversity is conserved in its natural habitat.

Statement B is incorrect: *Ex-situ* means conservation outside natural habitats (like zoos or botanical gardens)

40. (*a*) When Tt × Tt (heterozygous tall plants) are crossed:

Recessive Phenotype (Dwarf) appears only in tt → 1 out of 4 = 1/4 * 100 = 25%

It can be shown as follows:



41. (*c*) According to Charles Darwin, "fitness" in the context of natural selection refers to an organism's ability to survive and reproduce, passing on its genes to the next generation.

42. (*c*) Fossils found in different sedimentary layers of the Earth provide information about which organisms existed during specific geological time periods.

This helps scientists trace the evolutionary history and age of fossils.

43. (*c*) During the voyage of H.M.S. Beagle, Charles Darwin visited places like the Galápagos Islands.

He observed that closely related species of finches had developed different beak shapes to adapt to different food sources.

This led him to propose the idea of adaptive radiation, where one species evolves into many to occupy different ecological niches.

44. (*b*) Alfred Russel Wallace, a naturalist who worked in the Malay Archipelago, came to conclusions on natural selection similar to those of Charles Darwin while studying the flora and fauna there.

45. (*d*) The Theory of Special Creation states that:

- All living beings were created as they are today.
- The diversity of life has remained the same since creation.
- The Earth is approximately 4000 years old
- Diversity of life forms on earth has been changing over millions of years as per Darwinian ideas of organic evolution by natural selection.

46. (*b*) Gross primary productivity(GPP) of an ecosystem is the rate of production of organic matter during photosynthesis.
NPP (Net Primary Productivity)The energy left after respiration (R) by producers.

NPP is less than GPP because some energy is used in respiration.

Therefore, GPP is always more than NPP.

47. (*b*)

- Net primary productivity(NPP) is the available biomass for the consumption to heterotrophs (herbivores and decomposers).
- Gross primary productivity(GPP) of an ecosystem is the rate of production of organic matter during photosynthesis.
- Secondary productivity is defined as the rate of formation of new organic matter by consumers.
- Standing Biomass – Refers to total biomass present, not necessarily available for consumption

48. (*a*) Productivity is defined as the rate of biomass production. It is expressed in terms of $gm^{-2}\ yr^{-1}$ or $(kcal\ m^{-2})yr^{-1}$ to compare the productivity of different ecosystems.

49. (*b*)

- Some of GPP is used by plants in respiration (R). The rest, called NPP, is the biomass available to herbivores and decomposers.
- So, Gross primary productivity minus respiration losses (R), is the net primary productivity (NPP)

So, NPP = GPP – R.

50. (*b*) The standing crop refers to the mass of living material (biomass) or the number of organisms at a specific time in each trophic level of an ecosystem. It is typically measured as the mass of living organisms (biomass) or the number in a unit area.