CUET UG Biology Sample Paper - 11

Duration: 1 Hour **Maximum Marks: 250**

Instructions

- This paper contains a total of 50 Multiple Choice Questions.
- Each correct answer carries **+5 marks**.
- Each incorrect answer carries **-1 mark**.
- No negative marking for unattempted questions.

Q1. The ploidy of cells in the tetrad, nucellus, and MMC (Megaspore Mother Cell) respectively is:

(A) n, 2n, 2n

(B) 2n, n, 2n

(C) n, n, 2n

(D) 2n, 2n, n

Q2. Match the following regarding pollination types

List I	Pollination Type	List II	Plant
(i)	Anemophily	(a)	Salvia
(ii)	Hydrophily	(b)	Maize
(iii)	Entomophily	(c)	Vallisneria

(A) i-a, ii-b, iii-c

(B) i-b, ii-c, iii-a

(C) i-c, ii-a, iii-b

(D) i-b, ii-a, iii-c

Q3. In a 7-celled embryo sac, the large central cell contains:

(A) One haploid nucleus

(B) Two haploid nuclei

(C) One diploid nucleus

(D) Two polar nuclei

Q4. Which part of the embryo sac guides the entry of the pollen tube?

(A) Antipodals

(B) Central cell

(C) Filiform apparatus

(D) Secondary nucleus

Q5. Endosperm is completely consumed by the developing embryo in:

(A) Castor and Coconut

(B) Pea and Groundnut

(C) Maize and Wheat

(D) Rice and Castor

Q6. The secretory phase in the human menstrual cycle is also called:

(A) Follicular phase

(B) Luteal phase

(C) Proliferative phase

(D) Ovulatory phase

Q7. Which part of the sperm contains the mitochondria to facilitate movement?

(A) Head

(B) Neck

(C) Middle piece

(D) Tail

Q8. The process of release of a mature ovum from the Graafian follicle is called:

(A) Spermiation

(B) Ovulation

(C) Implantation

(D) Insemination

Q9. In humans, the first meiotic division during oogenesis is completed within:

(A) Primary follicle

(B) Secondary follicle

(C) Tertiary follicle

(D) Graafian follicle

Q10. Implantation of the blastocyst usually occurs on which day after fertilization?

(A) 2nd day

(B) 4th day

(C) 7th day

(D) 10th day

Q11. Which of the following is an example of a hormone-releasing IUD?

(A) Multiload 375

(B) Lippes Loop

(C) Progestasert

(D) Cu7

Q12. Transfer of an ovum collected from a donor into the fallopian tube of another female who cannot produce one is:

(A) ZIFT
(B) GIFT
(C) ICSI
(D) IUI

Q13. Emergency contraceptives are effective if used within:

(A) 72 hours of coitus
(B) 24 hours of coitus
(C) 120 hours of coitus
(D) 48 hours of coitus

Q14. A test cross is used to determine:

(A) Genotype of F2 plant
(B) Phenotype of F1 plant
(C) Genotype of an individual exhibiting dominant trait
(D) Number of alleles

Q15. If a color-blind woman marries a normal vision man, what is the probability of their son being color-blind?

(A) 0%
(B) 50%
(C) 75%
(D) 100%

Q16. The tendency of genes on the same chromosome to remain together during inheritance is:

(A) Recombination

(B) Linkage

(C) Epistasis

(D) Dominance

Q17. Which chromosomal disorder is characterized by "Gynaecomastia"?

(A) Down's Syndrome

(B) Turner's Syndrome

(C) Klinefelter's Syndrome

(D) Edward's Syndrome

Q18. Thalassemia is a quantitative problem of synthesizing too few globin molecules, while sickle-cell anemia is a _____ problem of synthesizing an incorrectly functioning globin.

(A) Quantitative

(B) Qualitative

(C) Chromosomal

(D) Dominant

Q19. Phenotypic and Genotypic ratios are both 1:2:1 in which case?

(A) Complete dominance

(B) Incomplete dominance

(C) Segregation

(D) Independent assortment

Q20. The enzyme DNA dependent RNA polymerase catalyzes polymerization in which direction?

(A) 3' → 5'

(B) 5' → 3'

(C) Both directions

(D) Randomly

Q21. In the Lac Operon, which protein is synthesized by the 'i' gene?

(A) Beta-galactosidase

(B) Permease

(C) Repressor protein

(D) Transacetylase

Q22. During DNA replication, the discontinuously synthesized fragments are joined by:

(A) DNA Polymerase I

(B) DNA Ligase

(C) Helicase

(D) Primase

Q23. Which site of the tRNA molecule binds to the mRNA?

(A) Amino acid attachment site

(B) DHU loop

(C) Anticodon loop

(D) T-psi-C loop

Q24. The process of charging of tRNA is also known as:

(A) Transcription

(B) Aminoacylation

(C) Splicing

(D) Capping

Q25. Avery, MacLeod, and McCarty used which enzymes to prove DNA is the transforming principle?

(A) Proteases and RNases

(B) Lipases

(C) DNase

(D) Both A and C

Q26. In Eukaryotes, the primary transcript (hnRNA) contains:

(A) Only exons

(B) Only introns

(C) Both exons and introns

(D) Only promoters

Q27. Satellite DNA is useful in:

(A) Protein synthesis

(B) Organ culture

(C) DNA Fingerprinting

(D) Genetic engineering

Q28. The brain capacity of Neanderthal man was:

(A) 900cc

(B) 1400cc

(C) 650cc

(D) 1600cc

Q29. In a population of 2000 individuals, 800 belong to the genotype AA, 800 to Aa and 400 to aa. The frequency of allele A is:

(A) 0.5
(B) 0.6
(C) 0.7
(D) 0.4

Q30. Appearance of dark-colored moths in England during the industrial revolution is an example of:

(A) Disruptive selection
(B) Stabilizing selection
(C) Directional selection
(D) Genetic drift

Q31. Forelimbs of whale, bat, cheetah, and human are examples of:

(A) Analogy
(B) Homology
(C) Convergent evolution
(D) Saltation

Q32. The chemical substance 'Heroin' is synthesized by:

(A) Nitration of morphine
(B) Acetylation of morphine
(C) Methylation of morphine
(D) Glycosylation of morphine

Q33. When the body encounters a pathogen for the first time, it produces a low-intensity response called:

(A) Anamnestic response

(B) Primary response

(C) Secondary response

(D) Passive response

Q34. Which of the following is used in the treatment of cancer?

(A) Alpha-interferon

(B) Penicillin

(C) Insulin

(D) Statins

Q35. The malignant malaria is caused by:

(A) Plasmodium vivax

(B) Plasmodium malariae

(C) Plasmodium falciparum

(D) Plasmodium ovale

Q36. Which bacterium is used for the production of Butyric acid?

(A) Acetobacter aceti

(B) Clostridium butylicum

(C) Lactobacillus

(D) Aspergillus niger

Q37. The BOD (Biochemical Oxygen Demand) of waste water is a measure of:

(A) Total organic matter

(B) Biodegradable organic matter

(C) Dissolved oxygen

(D) Inorganic waste

Q38. "Flocs" used in sewage treatment are:

(A) Masses of anaerobic bacteria

(B) Masses of aerobic bacteria and fungal filaments

(C) Floating debris

(D) Chemical precipitates

Q39. The enzyme used to isolate DNA from a fungal cell is:

(A) Lysozyme

(B) Cellulase

(C) Chitinase

(D) DNase

Q40. Which of the following is a cloning vector?

(A) pBR322

(B) EcoRI

(C) Taq polymerase

(D) HindIII

Q41. The function of the "Stirred-tank" in a bioreactor is to:

(A) Maintain sterile conditions

(B) Oxygen availability throughout the process

(C) Separate product

(D) Act as a filter

Q42. In Gel Electrophoresis, DNA fragments move towards:

(A) Cathode

(B) Anode

(C) Neutral pole

(D) Top of the gel

Q43. 'Bt' in Bt-cotton stands for:

(A) Barium treated

(B) Biotechnology

(C) Bacillus thuringiensis

(D) Bio-toxin

Q44. The process of silencing of a specific mRNA due to a complementary dsRNA molecule is:

(A) Translation

(B) RNA interference

(C) Transcription

(D) Reverse transcription

Q45. The first clinical gene therapy was given in 1990 to a 4-year-old girl for which deficiency?

(A) Insulin

(B) ADA (Adenosine deaminase)

(C) Growth hormone

(D) Glucagon

Q46. An interaction where one species is harmed and the other is unaffected is:

(A) Commensalism

(B) Amensalism

(C) Parasitism

(D) Predation

Q47. In an age pyramid, if the pre-reproductive population is very large, the population is:

(A) Declining

(B) Stable

(C) Growing

(D) Fluctuating

Q48. The pyramid of energy is always:

(A) Inverted

(B) Spindle-shaped

(C) Upright

(D) Urn-shaped

Q49. Which of the following is considered one of the "Evil Quartet" in biodiversity loss?

(A) Fragmentation

(B) Recombination

(C) Mutualism

(D) Speciation

Q50. India has how many ecologically hot spots?

(A) 2

(B) 3

(C) 4

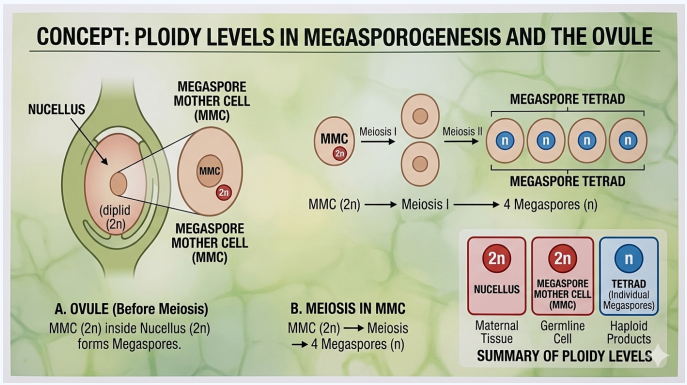
(D) 34

Detailed Solutions

Q1.

Solution

Concept: Ploidy refers to the number of sets of chromosomes in a cell. * **Nucellus:** This is the diploid ($2n$) maternal tissue of the ovule. * **Megaspore Mother Cell (MMC):** A specialized diploid ($2n$) cell within the nucellus that undergoes meiosis. * **Tetrad:** The MMC undergoes meiosis to produce four haploid (n) megaspores, collectively called a tetrad.



Solution: The correct order for Tetrad, Nucellus, and MMC is: * Tetrad: n * Nucellus: $2n$ * MMC: $2n$

Final Answer: n, 2n, 2n

Answer: (A)

Q2.

Solution

Concept: Pollination types are named based on the agent of transfer: * **Anemophily:** Pollination by wind (common in grasses). * **Hydrophily:** Pollination by water (common in aquatic plants). * **Entomophily:** Pollination by insects.

Solution: * **(i) Anemophily (Wind):** **Maize** (b). It has light, non-sticky pollen and well-exposed stamens. * **(ii) Hydrophily (Water):** **Vallisneria** (c). The female flowers reach the surface of the water by long stalks to meet the pollen. * **(iii) Entomophily (Insects):** **Salvia** (a). It uses a "lever mechanism" to deposit pollen on bees.

Final Answer: i-b, ii-c, iii-a

Answer: (B)

Q3.

Solution

Concept: The typical angiosperm embryo sac at maturity is **8-nucleate but 7-celled**. This occurs because the two nuclei in the center share a single large cell.

Solution: The **Central Cell** is the largest cell of the embryo sac. It contains the **two polar nuclei**. After triple fusion (fertilization), these nuclei fuse with a male gamete to form the triploid ($3n$) Primary Endosperm Nucleus (PEN).

Final Answer: Two polar nuclei

Answer: (D)

Q4.

Solution

Concept: The **egg apparatus** consists of two **synergids** and one egg cell located at the micropylar end of the embryo sac. The synergids possess special cellular thickenings at their micropylar tip.

Solution: The **Filiform apparatus** is the structure responsible for guiding the pollen tube. * It is located within the **synergids**. * It functions by secreting chemical attractants (chemotropism) that direct the pollen tube to enter one of the synergids. * Once the pollen tube enters, the synergid typically degenerates, releasing the two male gametes for double fertilization.

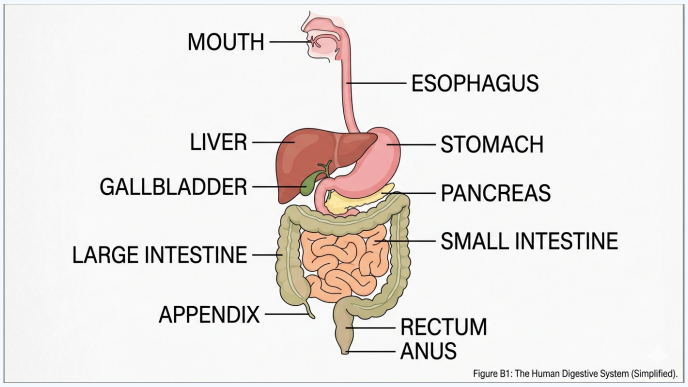
Final Answer: Filiform apparatus

Answer: (C)

Q5.

Solution

Concept: The endosperm is a nutrient-rich tissue formed by triple fusion that provides nourishment to the developing embryo. * **Non-albuminous seeds:** The embryo completely consumes the endosperm during its development. Food is then typically stored in the cotyledons. * **Albuminous seeds:** The endosperm is not completely used up and persists in the mature seed.



Solution: In **Pea and Groundnut** (typically dicots), the endosperm is **completely consumed** by the developing embryo before the seed matures. Therefore, these are non-albuminous seeds. * **Castor and Coconut:** These are albuminous seeds where the endosperm persists. * **Maize, Wheat, and Rice:** These are monocot seeds where the endosperm is the primary storage tissue in the mature seed.

Final Answer: Pea and Groundnut

Answer: (B)

Q6.

Solution

Concept: The phases of the menstrual cycle are often named both after the events occurring in the ovary and the events occurring in the uterus. * **Follicular Phase (Ovary):** Also known as the **Proliferative Phase** (Uterus), where the endometrium regenerates. * **Luteal Phase (Ovary):** Occurs after ovulation when the ruptured follicle transforms into the Corpus Luteum.

Solution: The **secretory phase** is also called the **Luteal phase**. * During this period (typically days 15–28), the **Corpus Luteum** secretes large amounts of **Progesterone**. * Progesterone is essential for maintaining the endometrium and stimulating it to secrete nutrients (hence "secretory") to prepare for the possible implantation of a fertilized ovum.

* **Follicular/Proliferative Phase:** Before ovulation; dominated by Estrogen. * **Ovulatory Phase:** The brief period where the egg is released (LH surge).

Final Answer: Luteal phase

Answer: (B)

Q7.

Solution

Concept: For fertilization to occur, the sperm must travel a significant distance through the female reproductive tract. This requires a constant and substantial supply of energy (ATP) to power the lashing movement of the tail.

Solution: The **Middle piece** of the sperm contains numerous **mitochondria** coiled around the axial filament. * These mitochondria are often referred to as the "powerhouse of the sperm." * They produce ATP through aerobic respiration, providing the energy necessary for the **tail** to move, which in turn facilitates sperm motility essential for reaching the ovum.

* **Head:** Contains the haploid nucleus and the acrosome (filled with enzymes). * **Neck:** Contains the centrioles. * **Tail:** The longest part, responsible for the actual swimming motion.

Final Answer: Middle piece

Answer: (C)

Q8.

Solution

Concept: The menstrual cycle involves the maturation of follicles in the ovary. Once a follicle reaches its final mature stage (Graafian follicle), it ruptures to release the female gamete.

Solution: The process of release of a mature ovum (secondary oocyte) from the Graafian follicle is called **Ovulation**. * This event is typically triggered by a sharp rise in Luteinizing Hormone, known as the **LH surge**, around day 14 of a 28-day cycle. * **Spermiation:** The release of sperms from the seminiferous tubules. * **Implantation:** The attachment of the blastocyst to the uterine wall. * **Insemination:** The transfer of sperms into the female reproductive tract.

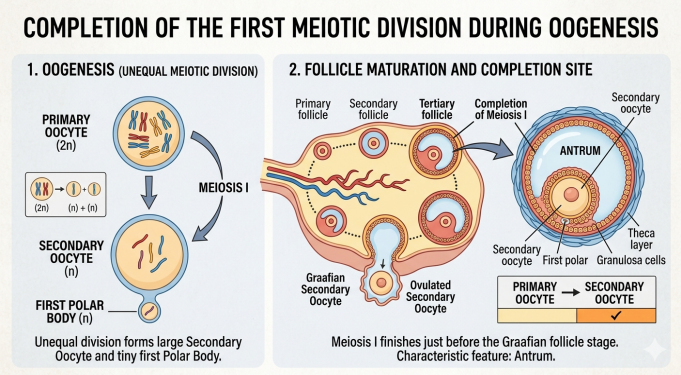
Final Answer: Ovulation

Answer: (B)

Q9.

Solution

Concept: Oogenesis is an unequal division process. The primary oocyte (within a follicle) completes its first meiotic division to form a large haploid secondary oocyte and a tiny first polar body.



Solution: In humans, the first meiotic division is completed within the **Tertiary follicle**. * The primary oocyte grows in size and finishes Meiosis I just prior to the follicle maturing into a Graafian follicle. * A characteristic feature of the Tertiary follicle is the presence of a fluid-filled cavity called the **Antrum**.

Final Answer: Tertiary follicle

Answer: (C)

Q10.

Solution

Concept: Following fertilization in the ampulla of the fallopian tube, the zygote undergoes rapid mitotic divisions (cleavage) as it moves toward the uterus. It transforms from a morula (8–16 cells) into a **blastocyst**.

Solution: The blastocyst reaches the uterine cavity and begins the process of **implantation** roughly **7 days** after fertilization (typically ranging between days 6 and 9). * During this stage, the outer layer of the blastocyst, called the **trophoblast**, attaches to the endometrium. * The endometrial cells then grow rapidly and cover the blastocyst, embedding it securely within the uterine wall.

Final Answer: 7th day

Answer: (C)

Q11.

Solution

Concept: Intrauterine Devices (IUDs) are classified into three types based on their mechanism of action: * **Non-medicated IUDs:** e.g., Lippes Loop. * **Copper-releasing IUDs:** e.g., CuT, Cu7, Multiload 375. * **Hormone-releasing IUDs:** e.g., Progestasert, LNG-20.

Solution: **Progestasert** is a hormone-releasing IUD. These devices make the uterus unsuitable for implantation and the cervix hostile to the sperm by releasing small amounts of hormones (progestogens).

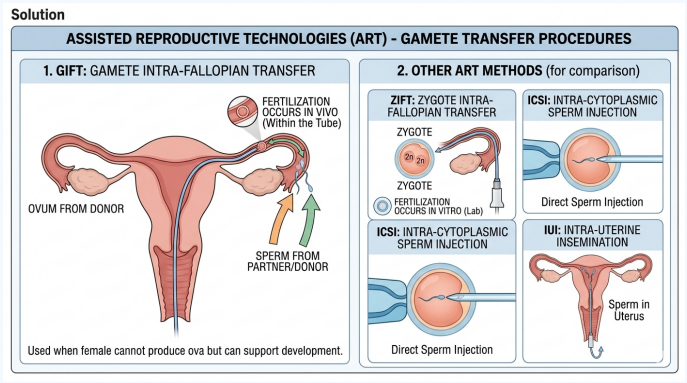
Final Answer: Progestasert

Answer: (C)

Q12.

Solution

Concept: Assisted Reproductive Technology (ART) includes several methods to help couples conceive. The choice of method depends on the specific cause of infertility.



Solution: The transfer of an ovum collected from a donor into the fallopian tube of another female is called **GIFT** (**Gamete Intra-Fallopian Transfer**). * This is used for females who cannot produce ova but can provide a suitable environment for fertilization and further development. * **ZIFT (Zygote Intra-Fallopian Transfer):** Transfer of a zygote or early embryo (up to 8 blastomeres) into the fallopian tube. * **ICSI (Intra-Cytoplasmic Sperm Injection):** A specialized procedure to form an embryo in the laboratory by directly injecting a sperm into an ovum. * **IUI (Intra-Uterine Insemination):** Semen is artificially introduced into the uterus.

Final Answer: GIFT

Answer: (B)

Q13.

Solution

Concept: Emergency contraceptives (such as progestogens or progestogen-estrogen combinations, or IUDs) are used to prevent possible pregnancy due to casual unprotected intercourse, rape, or contraceptive failure.

Solution: These methods are found to be very effective if used within **72 hours of coitus**. They work primarily by delaying ovulation or interfering with implantation.

Final Answer: 72 hours of coitus

Answer: (A)

Q14.

Solution

Concept: In Mendelian genetics, an individual showing a dominant phenotype could be either homozygous (TT) or heterozygous (Tt). A **test cross** is a cross between this individual and a **recessive parent** (tt).

Solution: A test cross is used to determine the **Genotype of an individual exhibiting a dominant trait**. * If the offspring are 100* If the offspring show a 1:1 ratio of dominant to recessive, the parent was heterozygous.

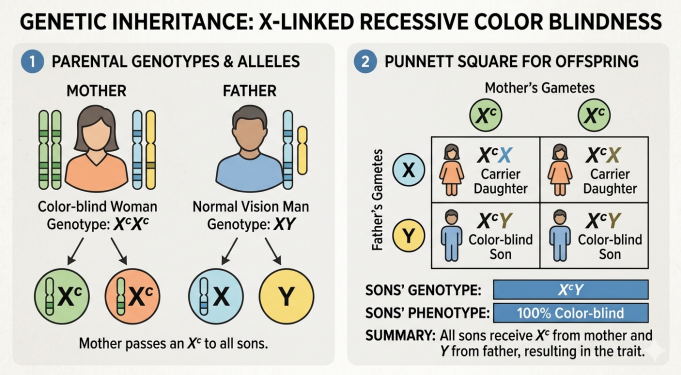
Final Answer: Genotype of an individual exhibiting dominant trait

Answer: (C)

Q15.

Solution

Concept: Color blindness is an **X-linked recessive** disorder. * A color-blind woman has the genotype X^cX^c. * A normal vision man has the genotype XY.



Solution: When they have children: 1. The mother always passes an X^c chromosome to her sons. 2. The father passes his Y chromosome to his sons. Therefore, all sons will have the genotype **X^cY**, making them **100% color-blind**.

Final Answer: 100%

Answer: (D)

Q16.

Solution

Concept: When genes are located physically close to each other on the same chromosome, they do not assort independently. Instead, they tend to be inherited together as a unit.

Solution: The physical association of genes on a chromosome is called **Linkage**. This phenomenon was extensively studied by T.H. Morgan using *Drosophila melanogaster*. Linkage reduces the frequency of **Recombination** (the formation of non-parental gene combinations).

Final Answer: Linkage

Answer: (B)

Q17.

Solution

Concept: Some disorders are caused by an abnormal number of chromosomes (aneuploidy) due to the failure of chromatids to segregate during cell division.

Solution: **Klinefelter's Syndrome** is caused by the presence of an additional copy of the X-chromosome, resulting in a karyotype of **47, XXY**. * These individuals are overall masculine but express feminine characters. * **Gynaecomastia** (development of breast tissue in males) is a hallmark clinical feature of this syndrome. * **Down's Syndrome:** Trisomy of chromosome 21. * **Turner's Syndrome:** Monosomy (45, XO), where females are sterile.

Final Answer: Klinefelter's Syndrome

Answer: (C)

Q18.

Solution

Concept: Both disorders involve the hemoglobin molecule but differ in the nature of the genetic defect.

Solution: Sickle-cell anemia is a **Qualitative** problem. * It is caused by a point mutation in the β-globin gene (substitution of Glutamic acid by Valine at the 6th position). * This leads to a change in the **shape** (quality) of the hemoglobin molecule under low oxygen tension, causing RBCs to become sickle-shaped. * Conversely, Thalassemia is **Quantitative** because it results in a reduced **rate** (amount) of synthesis of globin chains.

[Image comparing normal RBCs and Sickle-shaped RBCs with hemoglobin structure]

Final Answer: Qualitative

Answer: (B)

Q19.

Solution

Concept: In Mendel's classic monohybrid cross (Complete Dominance), the F2 phenotypic ratio is 3 : 1 while the genotypic ratio is 1 : 2 : 1. However, in some cases, the heterozygote shows a phenotype that is intermediate between the two homozygotes.

Solution: Phenotypic and Genotypic ratios are both 1 : 2 : 1 in **Incomplete dominance**. * A classic example is the flower color in the Snapdragon (*Antirrhinum sp.*). * Crossing a Red (RR) flower with a White (rr) flower produces Pink (Rr) hybrids in the F1 generation. * When F1 is selfed, the F2 generation results in 1 Red (RR) : 2 Pink (Rr) : 1 White (rr).

Final Answer: Incomplete dominance

Answer: (B)

Q20.

Solution

Concept: Nucleic acid synthesis (both DNA replication and Transcription) always follows a specific polarity because the polymerizing enzyme can only add new nucleotides to the 3′-OH group of the growing chain.

Solution: DNA dependent RNA polymerase catalyzes polymerization in the **5′ → 3′** direction. * Even though it reads the DNA template strand in the 3′ → 5′ direction, the actual synthesis of the RNA strand occurs by adding ribonucleotides to the 3′ end, resulting in a 5′ → 3′ growth.

Final Answer: 5′ → 3′

Answer: (B)

Q21.

Solution

Concept: The lac operon consists of one regulatory gene (the *i* gene) and three structural genes (*z*, *y*, and *a*). The *i* gene is expressed constitutively (all the time).

Solution: The '*i*' gene synthesizes the **Repressor protein**. * The repressor protein binds to the **operator** region of the operon and prevents RNA polymerase from transcribing the structural genes in the absence of an inducer (Lactose). * ***z* gene:** Codes for Beta-galactosidase. * ***y* gene:** Codes for Permease. * ***a* gene:** Codes for Transacetylase.

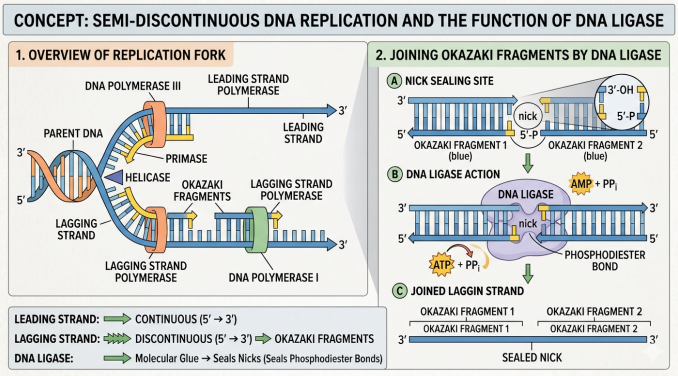
Final Answer: Repressor protein

Answer: (C)

Q22.

Solution

Concept: DNA replication is semi-discontinuous. While the leading strand is synthesized continuously, the lagging strand is synthesized in short stretches called **Okazaki fragments**.



Solution: **DNA Ligase** is the enzyme responsible for joining these fragments. It acts like "molecular glue" by catalyzing the formation of a phosphodiester bond between the 3′-hydroxyl end of one fragment and the 5′-phosphate end of the next.

Final Answer: DNA Ligase

Answer: (B)

Q23.

Solution

Concept: tRNA (Transfer RNA) acts as an adapter molecule that reads the genetic code on mRNA and brings the corresponding amino acid.

Solution: The **Anticodon loop** contains three bases that are complementary to the specific codon on the mRNA strand. This base-pairing ensures that the correct amino acid is incorporated into the growing polypeptide chain.

Final Answer: Anticodon loop

Answer: (C)

Q24.

Solution

Concept: Before translation can occur, amino acids must be activated and linked to their specific tRNA molecules. This is an energy-consuming process.

Solution: This process is called **Aminoacylation**. When an amino acid is chemically bonded to its tRNA in the presence of ATP and the enzyme aminoacyl-tRNA synthetase, the tRNA is said to be "charged."

Final Answer: Aminoacylation

Answer: (B)

Q25.

Solution

Concept: They worked to determine the biochemical nature of the "transforming principle" in Griffith's experiment. They purified proteins, DNA, and RNA from heat-killed S-cells.

Solution: They used **Both A and C**. * They found that **Proteases** (protein-digesting enzymes) and **RNases** (RNA-digesting enzymes) did not affect transformation. * However, digestion with **DNase** did inhibit transformation, proving that DNA was the genetic material responsible.

Final Answer: Both A and C

Answer: (D)

Q26.

Solution

Concept: In eukaryotes, transcription produces **hnRNA** (heterogeneous nuclear RNA), which is the precursor to mRNA. Unlike prokaryotic mRNA, eukaryotic hnRNA is "non-functional" in its initial state.

Solution: hnRNA contains **both exons and introns**. * **Exons** are the coding sequences that will be expressed. * **Introns** are the non-coding intervening sequences. To become functional mRNA, the hnRNA must undergo **splicing**, where introns are removed and exons are joined together.

Final Answer: Both exons and introns

Answer: (C)

Q27.

Solution

Concept: A large portion of the human genome consists of repetitive DNA. When genomic DNA is centrifuged, it forms a major peak and several smaller peaks called **satellite DNA**.

Solution: Satellite DNA is the basis of **DNA Fingerprinting**. * These sequences (like VNTRs) do not code for proteins but show high degrees of **polymorphism** (variation). * Since these variations are inherited, they are used for forensic investigations and paternity testing.

Final Answer: DNA Fingerprinting

Answer: (C)

Q28.

Solution

Concept: Human evolution is marked by a significant increase in cranial capacity over time.

Solution: The Neanderthal man had a brain capacity of **1400cc**. * They lived in near-east and central Asia between 100,000–40,000 years ago. * They were known for burying their dead and using hides to protect their bodies. * For comparison: *Homo habilis* (650–800cc) and *Homo erectus* (900cc).

Final Answer: 1400cc

Answer: (B)

Q29.

Solution

Concept: Allele frequency is the total number of a specific allele divided by the total number of alleles in the population.

Solution: Each individual has 2 alleles. Total alleles = $2000 \times 2 = 4000$. 1. **Alleles from AA:** $800 \times 2 = 1600$ 'A' alleles. 2. **Alleles from Aa:** $800 \times 1 = 800$ 'A' alleles (and 800 'a' alleles). 3. **Total 'A' alleles:** 1600 + 800 = 2400. 4. **Frequency of A (p):** 2400/4000 = 0.6.

Final Answer: 0.6

Answer: (B)

Q30.

Solution

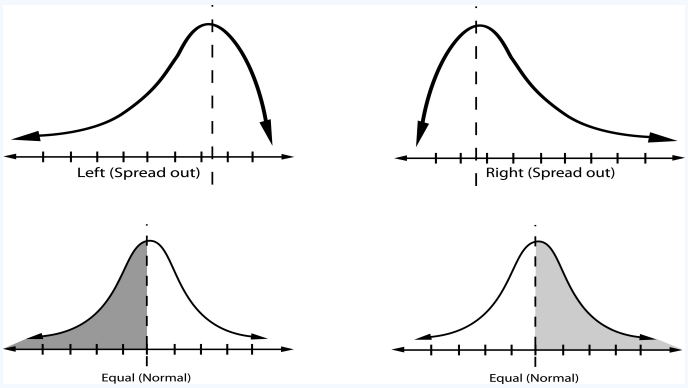
Concept: Natural selection can shift the frequency of a trait in different ways. **Directional selection** occurs when the environment changes, favoring one extreme phenotype over the others.
Solution: This is **Directional selection**. * Before industrialization, white moths were favored. * After industrialization, soot covered the trees, favoring the dark (melanic) moths. The population mean shifted toward the dark phenotype.
Final Answer: Directional selection

Answer: (C)

Q31.

Solution

Concept: **Homology** refers to structures that share the same fundamental anatomical plan but perform different functions. It indicates **divergent evolution** (common ancestry).



Solution: These are examples of **Homology**. * All these mammals share a similar bone structure (humerus, radius, ulna, carpals, metacarpals, and phalanges) because they share a common ancestor. * They have adapted these structures for swimming (whale), flying (bat), running (cheetah), and grasping (human).
Final Answer: Homology

Answer: (B)

Q32.

Solution

Concept: Heroin, chemically known as **diacetylmorphine**, is an opioid drug derived from the latex of the poppy plant (*Papaver somniferum*).

Solution: Heroin is obtained by the **Acetylation of morphine**. * It is a white, odorless, bitter crystalline compound. * It acts as a depressant and slows down body functions by binding to specific opioid receptors in the central nervous system and gastrointestinal tract.

Final Answer: Acetylation of morphine

Answer: (B)

Q33.

Solution

Concept: The acquired immune system is characterized by memory. The intensity of the immune response depends on whether the body has seen the antigen before.

Solution: The first encounter with a pathogen results in a **Primary response**. * This response is of **low intensity** because the immune system takes time to recognize the antigen and produce specific antibodies. * Subsequent encounters with the same pathogen elicit a highly intensified **Secondary (or Anamnestic) response** because the body "remembers" the previous encounter.

Final Answer: Primary response

Answer: (B)

Q34.

Solution

Concept: Cancer treatment often involves biological response modifiers that help the immune system recognize and destroy tumor cells.

Solution: **Alpha-interferon** is used in cancer therapy. * It is a biological response modifier that activates the immune system and helps in destroying the tumor. * **Penicillin** is an antibiotic; **Insulin** treats diabetes; **Statins** are blood-cholesterol lowering agents.

Final Answer: Alpha-interferon

Answer: (A)

Q35.

Solution

Concept: Malaria is caused by various species of the protozoan *Plasmodium*. While all cause illness, the severity varies significantly between species.

Solution: Malignant malaria, the most serious and potentially fatal form of the disease, is caused by **Plasmodium falciparum**. * It can lead to complications like cerebral malaria and organ failure. * *P. vivax*, *P. malariae*, and *P. ovale* generally cause more benign forms of malaria.

Final Answer: Plasmodium falciparum

Answer: (C)

Q36.

Solution

Concept: Microbes are used for the commercial and industrial production of certain organic acids.

Solution: **Clostridium butylicum** is the bacterium used to produce Butyric acid. * **Acetobacter aceti:** A bacterium used to produce Acetic acid (vinegar). * **Lactobacillus:** A bacterium used to produce Lactic acid. * **Aspergillus niger:** A fungus used to produce Citric acid.

Final Answer: Clostridium butylicum

Answer: (B)

Q37.

Solution

Concept: BOD refers to the amount of oxygen that would be consumed if all the organic matter in one liter of water were oxidized by bacteria.

Solution: BOD is a measure of the **Biodegradable organic matter** in water. * A higher BOD value indicates that the water is more polluted because there is more organic matter available for decomposers to break down, which uses up more dissolved oxygen.

Final Answer: Biodegradable organic matter

Answer: (B)

Q38.

Solution

Concept: During secondary (biological) sewage treatment, the primary effluent is passed into large aeration tanks where it is constantly agitated and air is pumped into it.

Solution: This allows vigorous growth of useful **aerobic microbes into flocs**. * Flocs are masses of **bacteria associated with fungal filaments** to form mesh-like structures. * These microbes consume the major part of the organic matter in the effluent, significantly reducing the BOD.

Final Answer: Masses of aerobic bacteria and fungal filaments

Answer: (B)

Q39.

Solution

Concept: To isolate DNA, the cell wall must be broken down to release the genetic material. The enzyme used depends on the composition of the cell wall.

Solution: Fungal cell walls are primarily composed of chitin. Therefore, **Chitinase** is used to dissolve the wall. * **Lysozyme:** Used for bacterial cells. * **Cellulase:** Used for plant cells (cellulose). * **DNase:** This would actually destroy the DNA, so it is never used during isolation!

Final Answer: Chitinase

Answer: (C)

Q40.

Solution

Concept: A cloning vector is a DNA molecule used as a vehicle to artificially carry foreign genetic material into another cell.

Solution: **pBR322** is a widely used plasmid cloning vector in *E. coli*. * **EcoRI and HindIII:** These are restriction endonucleases (molecular scissors). * **Taq polymerase:** A heat-stable DNA polymerase used in PCR.

Final Answer: pBR322

Answer: (A)

Q41.

Solution

Concept: A stirred-tank bioreactor is designed for large-scale production of biological products. It is usually cylindrical with a curved base to facilitate the mixing of the contents.

Solution: The stirrer facilitates even mixing and **oxygen availability throughout the bioreactor**. * It ensures that the nutrients and oxygen are evenly distributed so that the microbes can grow optimally. * The "sparged" type of stirred-tank bioreactor specifically bubbles air through the system to increase the surface area for oxygen transfer.

Final Answer: Oxygen availability throughout the process

Answer: (B)

Q42.

Solution

Concept: DNA molecules are negatively charged because of the phosphate groups in their backbone. In an electric field, charged molecules migrate toward the opposite electrode.

Solution: Since DNA is negatively charged, it moves toward the **Anode** (the positive electrode). * The fragments are separated by size through the "sieving effect" of the agarose gel; smaller fragments move faster and further toward the anode than larger ones.

Final Answer: Anode

Answer: (B)

Q43.

Solution

Concept: Bt-cotton is a genetically modified crop designed to be resistant to specific pests like bollworms.

Solution: 'Bt' stands for **Bacillus thuringiensis**, a soil bacterium. * This bacterium produces a protein crystal (*Cry* protein) that contains a toxic insecticidal protein. * By incorporating these *Cry* genes into the cotton plant, the plant becomes capable of producing the toxin itself, killing susceptible insects that feed on it.

Final Answer: Bacillus thuringiensis

Answer: (C)

Q44.

Solution

Concept: This is a method of cellular defense in all eukaryotic organisms. It involves preventing the translation of a specific mRNA.

Solution: This process is called **RNA interference (RNAi)**. * A double-stranded RNA (dsRNA) molecule is introduced or produced in the cell. It is processed into small pieces that bind to the target mRNA, leading to its degradation or preventing its translation into a protein.

Final Answer: RNA interference

Answer: (B)

Q45.

Solution

Concept: Gene therapy is a collection of methods that allows the correction of a gene defect that has been diagnosed in a child or embryo.

Solution: The first clinical gene therapy was given for **ADA (Adenosine deaminase)** deficiency. * This enzyme is crucial for the immune system to function. * The treatment involved taking lymphocytes from the patient's blood, growing them in culture, inserting a functional ADA cDNA using a retroviral vector, and returning the cells to the patient.

Final Answer: ADA (Adenosine deaminase)

Answer: (B)

Q46.

Solution

Concept: Interspecific interactions can be beneficial (+), detrimental (-), or neutral (0) for the species involved.

Solution: The interaction where one species is harmed (-) and the other is unaffected (0) is **Amensalism**. * A classic example is the mold *Penicillium* producing an antibiotic that kills bacteria, while the mold itself remains unaffected. * **Commensalism:** One benefits (+), the other is unaffected (0). * **Parasitism and Predation:** One benefits (+), the other is harmed (-).

Final Answer: Amensalism

Answer: (B)

Q47.

Solution

Concept: An age pyramid displays the distribution of various age groups (pre-reproductive, reproductive, and post-reproductive) in a population. The shape of the pyramid indicates the growth status.

Solution: If the pre-reproductive individuals are more numerous than any other group, the population is **Growing**. * This results in a triangular/broad-based pyramid. As these young individuals move into the reproductive stage, they will produce even more offspring, causing the population size to increase.

Final Answer: Growing

Answer: (C)

Q48.

Solution

Concept: An energy pyramid represents the amount of energy at each trophic level in a food chain.

Solution: The pyramid of energy is **always Upright**. * This is due to the **10* Energy is lost as heat at every step; therefore, the amount of energy significantly decreases as you move from producers to top carnivores. It can never be inverted.

Final Answer: Upright

Answer: (C)

Q49.

Solution

Concept: The "Evil Quartet" describes the four primary drivers of extinction: 1. **Habitat loss and fragmentation** (the most important cause). 2. **Over-exploitation** (e.g., Passenger pigeon). 3. **Alien species invasions** (e.g., Nile perch). 4. **Co-extinctions** (e.g., plant-pollinator mutualisms).

Solution: **Fragmentation** is part of the first and most significant driver. When large habitats are broken into small fragments due to human activities, mammals and birds requiring large territories and certain animals with migratory habits are badly affected, leading to population declines.

Final Answer: Fragmentation

Answer: (A)

Q50.

Solution

Concept: Biodiversity "Hotspots" are regions with very high levels of species richness and high degree of endemism (species found nowhere else), which are also under constant threat.

Solution: India has **3** ecologically hotspots that cover our country's exceptionally high biodiversity regions. These are: 1. **Western Ghats and Sri Lanka** 2. **Indo-Burma** 3. **Himalaya**

Note: While there are 34-36 hotspots globally, only 3 (sometimes 4 including Sundaland/Nicobar Islands) are specifically associated with the Indian subcontinent.

[Image map of biodiversity hotspots in India]

Final Answer: 3

Answer: (B)

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	A	2	B	3	D	4	C	5	B
6	B	7	C	8	B	9	C	10	C
11	C	12	B	13	A	14	C	15	D
16	B	17	C	18	B	19	B	20	B
21	C	22	B	23	C	24	B	25	D
26	C	27	C	28	B	29	B	30	C
31	B	32	B	33	B	34	A	35	C
36	B	37	B	38	B	39	C	40	A
41	B	42	B	43	C	44	B	45	B
46	B	47	C	48	C	49	A	50	B