CUET UG Biology Sample Paper - 17

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. In a typical angiosperm embryo sac, the cells located at the chalazal end are called:

(A) Synergids

(B) Antipodals

(C) Polar nuclei

(D) Egg cells

Q2. During double fertilization in flowering plants, one male gamete fuses with the egg, and the second male gamete fuses with:

(A) Synergids

(B) Antipodal cells

(C) Secondary nucleus (Polar nuclei)

(D) Nucellus

Q3. The phenomenon where the pollen tube enters the ovule through the integuments is known as:

(A) Porogamy

(B) Mesogamy

(C) Chalazogamy

(D) Apogamy

Q4. Cleistogamous flowers ensure:

(A) Cross-pollination

(B) Geitonogamy

(C) Autogamy

(D) Xenogamy

Q5. The 8-nucleate, 7-celled structure of the female gametophyte is called the:

(A) Pollen grain

(B) Embryo sac

(C) Ovule

(D) Tapetum

Q6. The process of transformation of spermatids into spermatozoa is called:

(A) Spermatogenesis

(B) Spermiation

(C) Spermiogenesis

(D) Oogenesis

Q7. Which hormone is primarily responsible for the "LH Surge" during the menstrual cycle?

(A) Progesterone

(B) Estrogen

(C) FSH

(D) GnRH

Q8. The blastocyst becomes embedded in the endometrium during which process?

(A) Fertilization

(B) Cleavage

(C) Implantation

(D) Gastrulation

Q9. Which layer of the developing follicle ruptures during ovulation?

(A) Corona radiata

(B) Zona pellucida

(C) Graafian follicle

(D) Corpus luteum

Q10. The first milk produced by the mother, containing IgA antibodies, is:

(A) Lactogen

(B) Casein

(C) Colostrum

(D) Prolactin

Q11. Match the following contraceptive methods with their correct category:

List I	Contraceptive methods	List II	Category
(i)	Tubectomy	(a)	IUD
(ii)	Lippes Loop	(b)	Barrier
(iii)	Multiload 375	(c)	Surgical
(iv)	Condoms	(d)	Copper releasing IUD

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

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

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

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

Q12. In which Assisted Reproductive Technology (ART) is the embryo transferred into the Fallopian tube?

(A) IUT

(B) ZIFT

(C) ICSI

(D) AI

Q13. Saheli, a non-steroidal oral contraceptive pill, was developed at:

(A) AIIMS, Delhi

(B) CDRI, Lucknow

(C) IISc, Bangalore

(D) CMC, Vellore

Q14. A cross between a tall pea plant (TT) and a dwarf pea plant (tt) results in an F_2 generation ratio of 1 : 2 : 1 for:

(A) Phenotype

(B) Genotype

(C) Both A and B

(D) Neither A nor B

Q15. Down's syndrome is caused by the presence of an extra copy of chromosome number:

(A) 18

(B) 13

(C) 21

(D) 23

Q16. The frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes was first used by:

(A) Gregor Mendel

(B) T.H. Morgan

(C) Alfred Sturtevant

(D) Henking

Q17. A person with Klinefelter's syndrome has the sex chromosome constitution:

(A) XO

(B) XXY

(C) XYY

(D) XXX

Q18. If a color-blind woman marries a normal vision man, what percentage of their sons will be color-blind?

(A) 0%

(B) 50%

(C) 75%

(D) 100%

Q19. In a dihybrid cross, the phenotypic ratio 9 : 3 : 3 : 1 is a result of

(A) Law of Segregation

(B) Law of Dominance

(C) Law of Independent Assortment

(D) Linkage

Q20. The enzyme DNA-dependent RNA polymerase catalyzes transcription on the:

(A) Coding strand in $5' \rightarrow 3'$ direction

(B) Template strand in $3' \rightarrow 5'$ direction

(C) Template strand in $5' \rightarrow 3'$ direction

(D) Coding strand in $3' \rightarrow 5'$ direction

Q21. In the Lac Operon, the 'i' gene codes for:

(A) Inducer

(B) Repressor

(C) β-galactosidase

(D) Permease

Q22. Satellite DNA is a useful tool in:

(A) Genetic engineering

(B) Organ transplantation

(C) DNA Fingerprinting

(D) Gene therapy

Q23. Which of the following is the start codon for protein synthesis?

(A) UAA

(B) UAG

(C) AUG

(D) UGA

Q24. The unequivocal proof that DNA is the genetic material came from the experiment of:

(A) Griffith

(B) Avery, MacLeod, and McCarty

(C) Hershey and Chase

(D) Meselson and Stahl

Q25. Okazaki fragments are joined together by the enzyme:

(A) DNA Polymerase I

(B) DNA Ligase

(C) Helicase

(D) Primase

Q26. The process of splicing in eukaryotic transcription involves the removal of:

(A) Exons

(B) Introns

(C) Promoters

(D) Terminators

Q27. During translation, the peptide bond formation is catalyzed by:

(A) tRNA

(B) mRNA

(C) Ribozyme (23S rRNA)

(D) DNA polymerase

Q28. In a population at Hardy-Weinberg equilibrium, if the frequency of dominant allele (A) is 0.6, what is the frequency of heterozygotes (Aa)?

(A) 0.36

(B) 0.16

(C) 0.48

(D) 0.24

Q29. The process by which different species in a given geographical area start from a point and literally radiate to other areas of geography is:

(A) Convergent evolution

(B) Adaptive radiation

(C) Parallel evolution

(D) Genetic drift

Q30. Which of the following hominids had a cranial capacity of about 900cc?

(A) Homo habilis

(B) Homo erectus

(C) Neanderthal man

(D) Australopithecus

Q31. Industrial melanism in England is an example of:

(A) Disruptive selection

(B) Stabilizing selection

(C) Directional selection

(D) Mutation

Q32. The sporozoites of Plasmodium are stored in the _____ of the female Anopheles mosquito.

(A) Gut

(B) Stomach

(C) Salivary glands

(D) Hemolymph

Q33. Which type of immunity is responsible for the rejection of a kidney transplant?

(A) Humoral immunity

(B) Cell-mediated immunity (CMI)

(C) Innate immunity

(D) Passive immunity

Q34. HIV attacks which of the following cells first upon entering the body?

(A) B-lymphocytes

(B) Cytotoxic T-cells

(C) Macrophages

(D) Erythrocytes

Q35. The "contact inhibition" property is lost in:

(A) Normal cells

(B) Cancer cells

(C) Bacterial cells

(D) Stem cells

Q36. Which of the following is a biofertilizer?

(A) Bacillus thuringiensis

(B) Anabaena

(C) Trichoderma

(D) Nucleopolyhedrovirus

Q37. In sewage treatment, the "activated sludge" is:

(A) Settled grit

(B) Floating debris

(C) Flocs of bacteria and fungal filaments

(D) Primary effluent

Q38. "Monascus Purpureus" is a yeast used commercially in the production of:

(A) Ethanol

(B) Citric acid

(C) Blood cholesterol lowering statins

(D) Streptokinase

Q39. The naming of the restriction enzyme *EcoRI*, the 'R' stands for:

(A) Genus

(B) Species

(C) Strain

(D) Order of discovery

Q40. In PCR, the step where the temperature is lowered to allow primers to bind to the DNA template is:

(A) Denaturation

(B) Extension

(C) Annealing

(D) Elution

Q41. To separate DNA fragments of different sizes, which technique is used?

(A) Centrifugation

(B) Gel electrophoresis

(C) PCR

(D) Bioreactor

Q42. Which of the following is a "Stirred-tank" bioreactor designed for?

(A) Purification of product

(B) Oxygen availability throughout the process

(C) Addition of preservatives

(D) Downstream processing

Q43. Bt toxin kills insects by:

(A) Blocking the nervous system

(B) Creating pores in the midgut epithelium

(C) Inhibiting DNA replication

(D) Preventing protein synthesis

Q44. RNA interference (RNAi) involves the silencing of a specific mRNA due to a complementary _____ molecule.

(A) ssDNA

(B) dsRNA

(C) tRNA

(D) rRNA

Q45. The "A" and "B" chains of human insulin are linked together by:

(A) Hydrogen bonds

(B) Peptide bonds

(C) Disulphide bridges

(D) Glycosidic bonds

Q46. An age pyramid with a broad base and a narrow top indicates:

(A) Declining population

(B) Stable population

(C) Expanding population

(D) Extinct population

Q47. The interaction where one species is benefited and the other is neither harmed nor benefited is:

(A) Mutualism

(B) Amensalism

(C) Commensalism

(D) Parasitism

Q48. The rate of biomass production is called:

(A) Decomposition

(B) Stratification

(C) Productivity

(D) Humification

Q49. Which of the following is an example of *ex-situ* conservation?

(A) National Park

(B) Wildlife Sanctuary

(C) Seed Bank

(D) Biosphere Reserve

Q50. The "Evil Quartet" is a term associated with:

(A) Population explosion

(B) Causes of biodiversity loss

(C) Greenhouse effect

(D) Steps of PCR

Detailed Solutions

Q1.

Solution

Concept: A mature angiosperm embryo sac (female gametophyte) is typically 7-celled and 8-nucleate. The distribution of cells is specific to the poles of the embryo sac:

- **Micropylar end:** Contains the egg apparatus (one egg cell and two synergids).
- **Center:** Contains the large central cell with two polar nuclei.
- **Chalazal end:** Contains a group of three cells.

Solution: The three cells grouped together at the **chalazal end** of the embryo sac are known as the **antipodals**. Their primary role is to provide nourishment to the developing embryo sac, though they often degenerate shortly after fertilization.
Final Answer: Antipodals

Answer: (B)

Q2.

Solution

Concept: Double fertilization is a unique event in angiosperms involving two types of nuclear fusion:

- **Syngamy:** Fusion of the first male gamete (n) with the egg cell (n) to form a diploid zygote ($2n$).
- **Triple Fusion:** Fusion of the second male gamete (n) with the two polar nuclei ($n + n$) located in the central cell.

Solution: The two polar nuclei usually fuse before fertilization to form a single diploid **secondary nucleus**. The second male gamete fuses with this secondary nucleus (or the two polar nuclei) to form the triploid Primary Endosperm Nucleus (PEN). This process is called triple fusion because it involves the fusion of three haploid nuclei.
Final Answer: Secondary nucleus (Polar nuclei)

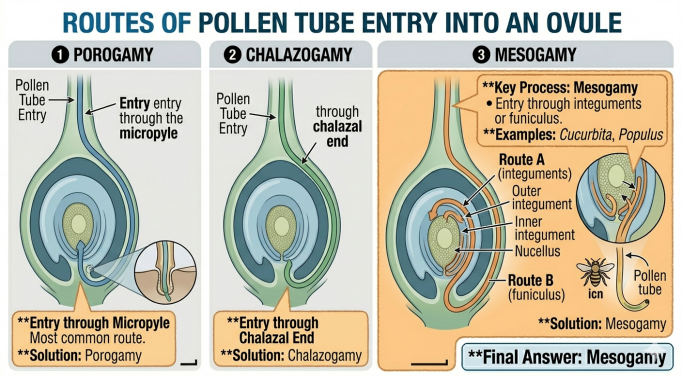
Answer: (C)

Q3.

Solution

Concept: Pollen tubes can enter the ovule via different routes. These routes are classified based on the point of entry into the ovule:

- **Porogamy:** Entry through the micropyle (most common).
- **Chalazogamy:** Entry through the chalazal end.
- **Mesogamy:** Entry through the integuments or the funiculus.



Solution: The entry of the pollen tube through the **integuments** (the protective layers of the ovule) or the funiculus is termed **Mesogamy**. Examples of plants exhibiting mesogamy include *Cucurbita* (pumpkin) and *Populus*.
Final Answer: Mesogamy

Answer: (B)

Q4.

Solution

Concept: Flowers are categorized based on whether they open at maturity.

- **Chasmogamous flowers:** Open flowers with exposed anthers and stigma.
- **Cleistogamous flowers:** Flowers that do not open at all.

Solution: In **cleistogamous flowers**, the anthers and stigma lie very close to each other. Since the flower never opens, pollen grains from the anthers of the same flower inevitably land on the stigma. This ensures **Autogamy** (self-pollination). These plants are assured of seed-set even in the absence of pollinators.
Final Answer: Autogamy

Answer: (C)

Q5.

Solution

Concept: The development of the female gametophyte from a single functional megaspore is known as monosporic development. This process involves three successive mitotic divisions of the nucleus.

Solution: The resulting structure is the **Embryo sac**. In most angiosperms, after three rounds of mitosis, the eight nuclei are distributed into seven cells:

- Three cells at the micropylar end (Egg apparatus).
- Three cells at the chalazal end (Antipodals).
- One large Central cell containing two polar nuclei.

Final Answer: Embryo sac

Answer: (B)

Q6.

Solution

Concept: The production of male gametes involves several distinct stages: the proliferation of germ cells, the reduction of chromosome number through meiosis, and finally, a structural remodeling phase.

Solution: After the completion of meiosis, the resulting haploid cells are called spermatids. These are non-motile, spherical cells. The process by which these spermatids are transformed into mature, motile **spermatozoa** (sperm) is called **spermiogenesis**. Note that "spermiation" refers to the release of mature sperm from the seminiferous tubules, while "spermatogenesis" is the entire process from start to finish.

Final Answer: Spermiogenesis

Answer: (C)

Q7.

Solution

Concept: The menstrual cycle is regulated by complex feedback loops between the ovaries and the pituitary gland. While LH is the hormone that "surges," it does so in response to a specific signal from the developing follicle.

Solution: As the Graafian follicle matures, it secretes increasing amounts of **Estrogen**. Under normal circumstances, estrogen has a negative feedback effect, but when it reaches a high peak level late in the follicular phase, it switches to a positive feedback mechanism. This high concentration of estrogen stimulates the pituitary to release a massive burst of Luteinizing Hormone, known as the **LH surge**, which triggers ovulation.

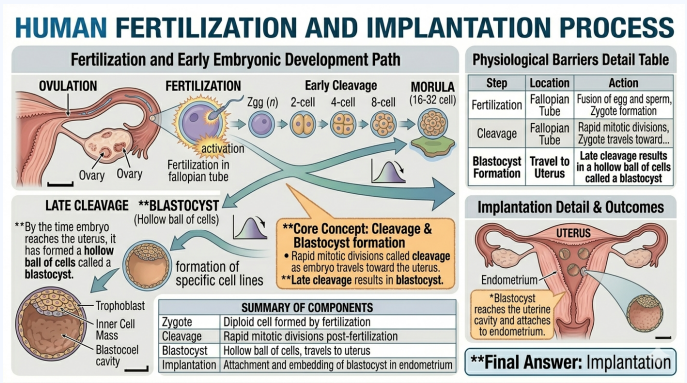
Final Answer: Estrogen

Answer: (B)

Q8.

Solution

Concept: Following fertilization in the fallopian tube, the zygote undergoes rapid mitotic divisions called cleavage as it travels toward the uterus.



Solution: By the time the developing embryo reaches the uterus, it has formed a hollow ball of cells called a blastocyst. The process by which the blastocyst attaches to and becomes **embedded in the endometrium** (the inner lining of the uterus) is called **implantation**. This event marks the beginning of a clinical pregnancy and allows for the formation of the placenta.

Final Answer: Implantation

Answer: (C)

Q9.

Solution

Concept: Oogenesis and follicular development occur in the ovary. The follicle matures through several stages—primary, secondary, and tertiary—before reaching its final mature state.

Solution: The **Graafian follicle** is the mature ovarian follicle. Under the influence of the LH surge, this follicle ruptures at the surface of the ovary to release the secondary oocyte (ovulation). The remaining parts of the ruptured Graafian follicle then transform into the corpus luteum. The *corona radiata* and *zona pellucida* are layers surrounding the oocyte itself, not the structure that ruptures.

Final Answer: Graafian follicle

Answer: (C)

Q10.

Solution

Concept: Lactation is the process of milk production and secretion from the mammary glands. The composition of milk changes during the initial days following parturition.
Solution: The milk produced during the initial few days of lactation is called **colostrum**. it is a yellowish fluid that is essential for the newborn because it contains high concentrations of **IgA antibodies**, which provide passive immunity to protect the infant against various pathogens. *Prolactin* and *Lactogen* are hormones, and *Casein* is a milk protein.
Final Answer: Colostrum

Answer: (C)

Q11.

Solution

Concept: Contraceptive methods are classified based on their mechanism of action, including natural, barrier, IUDs (Intrauterine Devices), oral, injectable, and surgical methods.
Solution: Matching the items:

- (i) **Tubectomy** is a **surgical** method (sterilization) in females. (c)
- (ii) **Lippes Loop** is a non-medicated **IUD**. (a)
- (iii) **Multiload 375** is a **copper-releasing IUD**. (d)
- (iv) **Condoms** are a physical **barrier** method. (b)

This corresponds to the sequence i-c, ii-a, iii-d, iv-b.
Final Answer: i-c, ii-a, iii-d, iv-b

Answer: (A)

Q12.

Solution

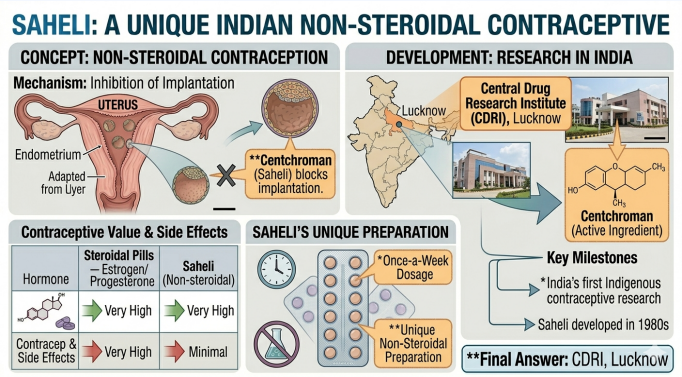
Concept: Assisted Reproductive Technologies (ART) involve various laboratory techniques to help couples achieve pregnancy. The classification depends on the stage of the embryo and the site of transfer.
Solution: In **ZIFT (Zygote Intra-Fallopian Transfer)**, the zygote or early embryo (with up to 8 blastomeres) is transferred into the **Fallopian tube**. In contrast, *IUT (Intra-Uterine Transfer)* involves transferring embryos with more than 8 blastomeres into the uterus. *ICSI* is a procedure to form an embryo in the lab, and *AI (Artificial Insemination)* involves transferring semen into the vagina or uterus.
Final Answer: ZIFT

Answer: (B)

Q13.

Solution

Concept: Chemical contraceptives like oral pills work by inhibiting ovulation and implantation. Research in India led to the development of a unique non-steroidal preparation.



Solution: **Saheli** is a non-steroidal, "once-a-week" oral contraceptive pill. It was developed by scientists at the **Central Drug Research Institute (CDRI) in Lucknow**, India. It contains Centchroman and is known for having very high contraceptive value with minimal side effects.
Final Answer: CDRI, Lucknow

Answer: (B)

Q14.

Solution

Concept: In a monohybrid cross, the F_1 generation is self-pollinated to produce the F_2 generation. This reveals the hidden recessive traits and results in specific mathematical ratios.
Solution: When Tt (from the F_1 generation) is selfed ($Tt \times Tt$), the F_2 generation results in:

- 1 TT (Homozygous Tall)
- 2 Tt (Heterozygous Tall)
- 1 tt (Homozygous Dwarf)

The **genotypic ratio** is therefore **1:2:1**. However, because TT and Tt both appear tall, the phenotypic ratio is 3:1.
Final Answer: Genotype

Answer: (B)

Q15.

Solution

Concept: Aneuploidy is a chromosomal aberration where an individual has an abnormal number of chromosomes. Trisomy refers to the presence of three copies of a particular chromosome instead of the usual two.

Solution: **Down's syndrome** is a genetic disorder caused by the presence of an extra copy of **chromosome number 21**. This results in a total of 47 chromosomes ($2n + 1$). It leads to specific physical and mental characteristics, such as a rounded face, a broad forehead, and varying degrees of intellectual disability.

Final Answer: 21

Answer: (C)

Q16.

Solution

Concept: Linkage and recombination describe the tendency of genes located close together on a chromosome to be inherited together. The "distance" between these genes can be mapped based on how often they cross over.

Solution: While T.H. Morgan pioneered the study of linkage in *Drosophila*, it was his student **Alfred Sturtevant** who first used the frequency of recombination between gene pairs as a measure of the distance between genes. He defined 1% recombination as 1 map unit (now called a centimorgan), providing the foundation for genetic mapping.

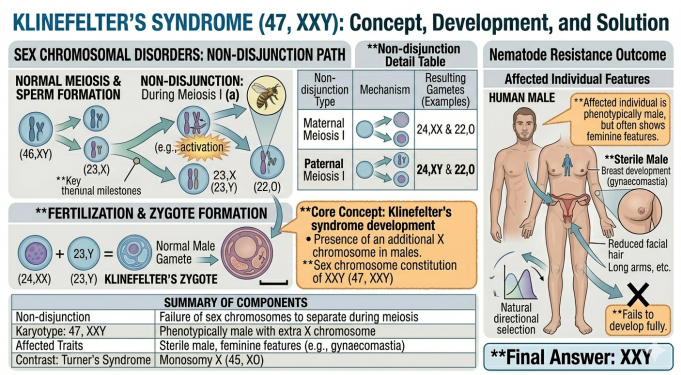
Final Answer: Alfred Sturtevant

Answer: (C)

Q17.

Solution

Concept: Sex chromosomal disorders occur due to the non-disjunction of sex chromosomes during meiosis, leading to individuals with an abnormal complement of X or Y chromosomes.



Solution: **Klinefelter's syndrome** is a condition where a male has an extra X chromosome, resulting in a sex chromosome constitution of **XXY** (47, XXY). These individuals are phenotypically male but often show feminine features such as breast development (gynaecomastia) and are typically sterile. In contrast, XO is Turner's syndrome.

Final Answer: XXY

Answer: (B)

Q18.

Solution

Concept: Red-green color blindness is a sex-linked recessive disorder. The gene for this trait is located on the X chromosome. Because males have only one X chromosome, they express the trait if they inherit a single defective allele.

Solution: A color-blind woman has the genotype X^cX^c. A man with normal vision has the genotype XY. In this cross: 1. The mother produces only X^c gametes. 2. The father produces X and Y gametes. All sons receive the Y chromosome from their father and an X^c from their mother, resulting in the genotype X^cY. Therefore, 100% of the sons will be color-blind. (All daughters will be carriers, X^cX).

Final Answer: 100%

Answer: (D)

Q19.

Solution

Concept: Mendel's experiments with two pairs of contrasting traits (dihybrid cross) led to the formulation of his third law. This law explains the random distribution of alleles into gametes.

Solution: The phenotypic ratio **9:3:3:1** (found in the F_2 generation of a dihybrid cross, e.g., Round Yellow vs. Wrinkled Green) is a direct result of the **Law of Independent Assortment**. This law states that when two pairs of traits are combined in a hybrid, the segregation of one pair of characters is independent of the other pair. If the genes were linked, this ratio would be significantly altered.

Final Answer: Law of Independent Assortment

Answer: (C)

Q20.

Solution

Concept: Transcription is the process of copying genetic information from one strand of DNA into RNA. This requires a specific directionality based on the biochemical constraints of the polymerase enzyme.

Solution: DNA-dependent RNA polymerase catalyzes the polymerization of ribonucleotides in only one direction: $5' \rightarrow 3'$. To achieve this, it must use the DNA strand with $3' \rightarrow 5'$ polarity as a template. Therefore, it catalyzes transcription on the **template strand in the 3' $\rightarrow$ 5' direction**. The coding strand ($5' \rightarrow 3'$) has the same sequence as the resulting RNA (with U instead of T) but is not actually read by the enzyme.

Final Answer: Template strand in 3' $\rightarrow$ 5' direction

Answer: (B)

Q21.

Solution

Concept: The Lac Operon is a regulated system where a regulatory gene controls the expression of structural genes. The regulatory gene functions independently of the presence of lactose.

Solution: The **'i' gene** in the Lac Operon refers to the inhibitor gene. It codes for the **repressor** protein. This repressor is synthesized at all times (constitutively) and binds to the operator region to block transcription when lactose (the inducer) is absent.

Final Answer: Repressor

Answer: (B)

Q22.

Solution

Concept: Repetitive DNA sequences that do not code for proteins but show high degrees of variation between individuals are essential for forensic science.

Solution: **Satellite DNA** consists of highly repetitive sequences that form a large portion of the human genome. These sequences show a high degree of polymorphism (variation). Because these patterns are unique to every individual (except identical twins), they are a fundamental tool in **DNA Fingerprinting** for solving paternity disputes and criminal cases.

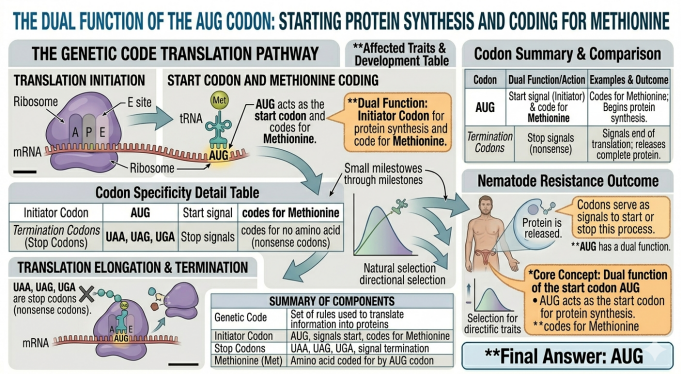
Final Answer: DNA Fingerprinting

Answer: (C)

Q23.

Solution

Concept: The genetic code is a set of rules used by living cells to translate information encoded within genetic material into proteins. Certain codons serve as signals to start or stop this process.



Solution: The codon **AUG** has a dual function: it acts as the **start codon** (initiator codon) for protein synthesis and also codes for the amino acid Methionine. In contrast, UAA, UAG, and UGA are known as stop codons (nonsense codons) because they signal the termination of translation.

Final Answer: AUG

Answer: (C)

Q24.

Solution

Concept: While several scientists contributed to our understanding of heredity, "unequivocal proof" implies the experiment that settled the debate between protein and DNA as the carrier of genetic information.

Solution: The unequivocal proof that DNA is the genetic material came from the experiments of **Alfred Hershey and Martha Chase** (1952). They worked with bacteriophages (viruses that infect bacteria). By labeling the viral DNA with radioactive phosphorus (^{32}P) and the viral protein coat with radioactive sulfur (^{35}S), they proved that only the DNA entered the bacterial cell to direct the synthesis of new viral particles.

Final Answer: Hershey and Chase

Answer: (C)

Q25.

Solution

Concept: DNA replication is semi-discontinuous. On the lagging strand (template with $5' \rightarrow 3'$ polarity), DNA is synthesized in short stretches rather than one continuous piece.

Solution: The short stretches of DNA synthesized discontinuously on the lagging strand are known as **Okazaki fragments**. To complete the replication process and create a continuous strand, these fragments must be covalently bonded. The enzyme **DNA Ligase** catalyzes the formation of the phosphodiester bond between the $3'$-OH of one fragment and the $5'$-phosphate of the next.

Final Answer: DNA Ligase

Answer: (B)

Q26.

Solution

Concept: Eukaryotic genes are "split," meaning they contain both coding and non-coding sequences. The initial transcript (hnRNA) must be processed before it can be translated into a protein.

Solution: The process of **splicing** involves the removal of **introns** (intervening, non-coding sequences) and the joining of exons (expressed, coding sequences) in a defined order. This occurs in the nucleus and is mediated by the spliceosome. Once splicing, capping, and tailing are complete, the transcript is called mature mRNA.

Final Answer: Introns

Answer: (B)

Q27.

Solution

Concept: Translation is the process of synthesizing proteins from mRNA. While ribosomes are made of both protein and RNA, the actual catalytic activity that links amino acids together is performed by an RNA molecule.

Solution: The formation of a peptide bond between amino acids is catalyzed by the enzyme peptidyl transferase. In prokaryotes, this "enzyme" is actually the **23S rRNA** (a component of the large ribosomal subunit), which functions as a **Ribozyme**. This highlights the "RNA World" hypothesis, where RNA acted both as genetic material and a catalyst.

Final Answer: Ribozyme (23S rRNA)

Answer: (C)

Q28.

Solution

Concept: The Hardy-Weinberg principle uses the equation $p^2 + 2pq + q^2 = 1$, where p and q represent the frequencies of the dominant and recessive alleles, respectively.

Solution: Given: Frequency of dominant allele $p(A) = 0.6$. Since $p + q = 1$, the frequency of the recessive allele $q(a) = 1 - 0.6 = 0.4$. The frequency of **heterozygotes (Aa)** is represented by the term **$2pq$**. Calculation: $2 \times 0.6 \times 0.4 = 0.48$. (Note: $p^2 = 0.36$ for AA and $q^2 = 0.16$ for aa).

Final Answer: 0.48

Answer: (C)

Q29.

Solution

Concept: Evolutionary patterns describe how species change over time in relation to their environment and common ancestry.

Solution: The process where different species evolve from a common ancestor and "radiate" to different habitats or ecological niches is called **Adaptive radiation**. This usually occurs when a single ancestral stock encounters diverse environments with little competition. Darwin's finches and Australian marsupials are the most famous examples of this phenomenon.

Final Answer: Adaptive radiation

Answer: (B)

Q30.

Solution

Concept: Evolution of man involved a gradual increase in brain size (cranial capacity) and complexity. These measurements are used by paleoanthropologists to categorize different hominid species.

Solution: Among the given options:

- *Australopithecus* had a capacity of about 450–600cc.
- *Homo habilis* (the "handy man") had a capacity of 650–800cc.
- **Homo erectus** had a larger brain of about **900cc**.
- *Neanderthal man* had a brain size of approximately 1400cc.

Final Answer: Homo erectus

Answer: (B)

Q31.

Solution

Concept: Natural selection can change a population in different ways. Directional selection occurs when an extreme phenotype is favored over other phenotypes, causing the allele frequency to shift over time in the direction of that phenotype.

Solution: Before industrialization in England, light-colored moths were more common because they were camouflaged against lichen-covered trees. After industrialization, trees became dark with soot, and dark (melanic) moths survived better. This shift of the entire population from one extreme (light) to another (dark) is a classic example of **Directional selection**.

Final Answer: Directional selection

Answer: (C)

Q32.

Solution

Concept: The life cycle of *Plasmodium* involves two hosts. Sexual reproduction and certain developmental stages occur within the mosquito, eventually producing the infectious stage for humans.

Solution: After fertilization and development in the mosquito's gut, the zygotes transform into motile forms that eventually produce thousands of infectious **sporozoites**. These sporozoites escape from the gut and migrate to the **salivary glands** of the female *Anopheles* mosquito. They remain there until the mosquito bites a human, at which point they are injected into the human's bloodstream.

Final Answer: Salivary glands

Answer: (C)

Q33.

Solution

Concept: The immune system is capable of distinguishing between "self" and "non-self." In the context of organ transplantation, the body recognizes the donor organ as foreign and initiates an immune response to destroy it.

Solution: Graft rejection is primarily due to the **Cell-mediated immune response (CMI)**. This response is mediated by T-lymphocytes, which recognize foreign antigens on the surface of the transplanted organ. While humoral immunity (antibodies) can play a secondary role in chronic rejection, the acute and primary rejection of a kidney transplant is a T-cell-driven cellular process. This is why patients must take immunosuppressants that target T-cell activity.

Final Answer: Cell-mediated immunity (CMI)

Answer: (B)

Q34.

Solution

Concept: HIV (Human Immunodeficiency Virus) targets specific cells of the immune system that express the CD4 receptor. The path of infection involves initial entry, replication, and eventual depletion of the immune defense.

Solution: After entering the body, HIV first enters **Macrophages**. Inside these cells, the viral RNA genome replicates to form viral DNA using the enzyme reverse transcriptase. The macrophages continue to produce virus particles, effectively acting as an "HIV factory." Simultaneously, HIV enters helper T-lymphocytes (T_H cells) to replicate and eventually decrease their count, leading to immunodeficiency.

Final Answer: Macrophages

Answer: (C)

Q35.

Solution

Concept: Normal cellular growth is highly regulated. One such regulatory mechanism ensures that cells stop dividing once they come into physical contact with neighboring cells, preventing overcrowding.

Solution: **Contact inhibition** is a property of normal cells that prevents uncontrolled proliferation. **Cancer cells** lose this property; as a result, they continue to divide even after coming into contact with other cells. This lack of inhibition leads to the formation of a mass of cells known as a tumor, which can eventually invade surrounding tissues (metastasis).

Final Answer: Cancer cells

Answer: (B)

Q36.

Solution

Concept: Biofertilizers are organisms that enrich the nutrient quality of the soil. The main sources include bacteria, fungi, and cyanobacteria which fix atmospheric nitrogen or solubilize phosphorus.

Solution: **Anabaena** is a free-living and symbiotic cyanobacteria (blue-green algae) that can fix atmospheric nitrogen in specialized cells called heterocysts. It is commonly used as a biofertilizer, particularly in paddy fields. In contrast, *Bacillus thuringiensis* and *Nucleopolyhedrovirus* are used as biopesticides, and *Trichoderma* is a biocontrol agent against plant pathogens.

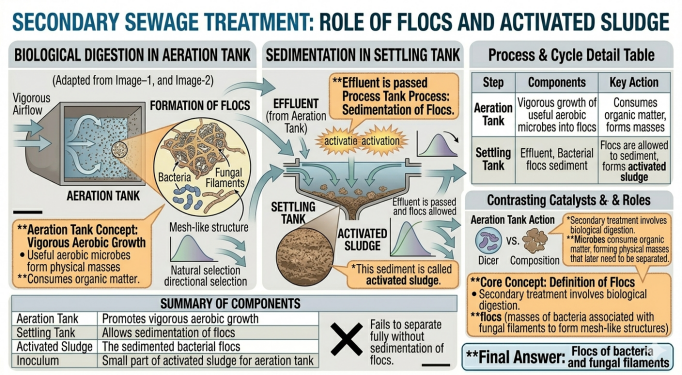
Final Answer: Anabaena

Answer: (B)

Q37.

Solution

Concept: Secondary sewage treatment involves biological digestion. Microbes consume organic matter, forming physical masses that later need to be separated from the treated water.



Solution: In the aeration tank, vigorous growth of useful aerobic microbes into **flocs** (masses of bacteria associated with fungal filaments to form mesh-like structures) consumes the organic matter. When the effluent is passed into a settling tank, these bacterial flocs are allowed to sediment. This sediment is called **activated sludge**. A small part of it is reused as inoculum for the aeration tank.

Final Answer: Flocs of bacteria and fungal filaments

Answer: (C)

Q38.

Solution

Concept: Microbes are used for the industrial production of various bioactive molecules. These molecules are chemicals that are functional in living systems.

Solution: **Monascus purpureus** is a yeast used for the commercial production of **blood cholesterol lowering statins**. Statins work through competitive inhibition of the enzyme HMG-CoA reductase, which is essential for the synthesis of cholesterol in the liver. Note: *Streptokinase* is produced by *Streptococcus*, and *Citric acid* is produced by *Aspergillus niger*.

Final Answer: Blood cholesterol lowering statins

Answer: (C)

Q39.

Solution

Concept: The nomenclature of restriction enzymes follows a specific set of rules based on the source microorganism.

Solution: In the enzyme *EcoRI*:

- **E** comes from the genus *Escherichia*.
- **co** comes from the species *coli*.
- **R** is derived from the **strain** name (*RY 13*).
- **I** (Roman numeral) indicates the order in which the enzyme was isolated from that strain of bacteria.

Final Answer: Strain

Answer: (C)

Q40.

Solution

Concept: PCR (Polymerase Chain Reaction) consists of three main steps that are temperature-dependent to allow for DNA amplification.

Solution: The three steps are: 1. **Denaturation:** High temperature (94°C) to separate DNA strands. 2. **Annealing:** The temperature is **lowered** (usually 50–65°C) to allow two sets of primers to bind (anneal) to the specific sequences on the DNA template. 3. **Extension:** *Taq* polymerase extends the primers at 72°C.

Final Answer: Annealing

Answer: (C)

Q41.

Solution

Concept: DNA fragments are negatively charged molecules. They can be forced to move through a medium toward an anode using an electric field.

Solution: **Gel electrophoresis** is the standard technique used to separate DNA fragments. Since DNA is negatively charged, it moves toward the positive electrode. The agarose gel acts as a sieve; therefore, smaller fragments move faster and further, while larger fragments stay closer to the wells. This effectively separates the fragments based on their **size**.

Final Answer: Gel electrophoresis

Answer: (B)

Q42.

Solution

Concept: Bioreactors are large-scale vessels used to grow microorganisms or cells under controlled conditions. The stirred-tank design is the most common type used in industrial biotechnology.

Solution: A **stirred-tank bioreactor** is equipped with an agitator system (impellers) and an air sparger. Its primary design purpose is to ensure even mixing of the medium and the **availability of oxygen throughout the process**. This ensures that aerobic microbes have constant access to the oxygen required for optimal growth and product formation.

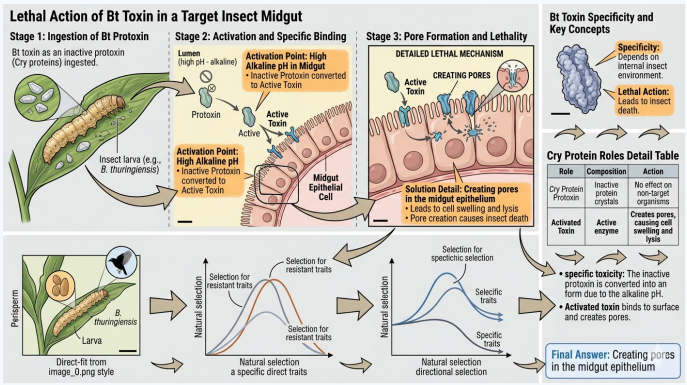
Final Answer: Oxygen availability throughout the process

Answer: (B)

Q43.

Solution

Concept: *Bacillus thuringiensis* produces Cry proteins (Bt toxin) as inactive protoxins. The specificity and lethal action of this toxin depend on the internal environment of the target insect.



Solution: When an insect ingests the Bt toxin, the inactive protoxin is converted into an active form due to the alkaline pH of the insect's gut. The activated toxin binds to the surface of the **midgut epithelial cells** and **creates pores**. This causes cell swelling and lysis, leading to the death of the insect.

Final Answer: Creating pores in the midgut epithelium

Answer: (B)

Q44.

Solution

Concept: RNA interference (RNAi) is a natural cellular defense mechanism in eukaryotes that protects against viral infections and transposons by preventing the translation of specific mRNAs.

Solution: RNAi involves the silencing of a specific mRNA. This is initiated by a **double-stranded RNA (dsRNA)** molecule that is complementary to the target mRNA. The dsRNA is processed into small interfering RNAs (siRNAs) which guide an enzyme complex to bind to and cleave the target mRNA, effectively "silencing" the gene.

Final Answer: dsRNA

Answer: (B)

Q45.

Solution

Concept: Mature human insulin consists of two short polypeptide chains: Chain A and Chain B. Their stability and functional shape depend on specific covalent cross-links between the chains.
Solution: The "A" and "B" chains of human insulin are linked together by **disulphide bridges** (also known as disulfide bonds). Specifically, there are two inter-chain disulfide bridges connecting the A and B chains, and one intra-chain disulfide bridge within the A chain itself. These bonds are formed between the sulfur atoms of cysteine residues.
Final Answer: Disulphide bridges

Answer: (C)

Q46.

Solution

Concept: An age pyramid is a graphic representation of the age distribution within a population. The shape of the pyramid reflects the growth status of that population.
Solution: An age pyramid with a **broad base** indicates a high percentage of individuals in the pre-reproductive age group. As these individuals reach reproductive age, the birth rate will likely remain high or increase, leading to an **expanding population**. A stable population would appear bell-shaped, while a declining population would have a narrow base (urn-shaped).
Final Answer: Expanding population

Answer: (C)

Q47.

Solution

Concept: Population interactions are categorized based on whether the species involved are helped (+), harmed (-), or unaffected (0).
Solution: The interaction where one species is benefited (+) and the other is neither harmed nor benefited (0) is called **Commensalism**.

- **Mutualism:** Both species benefit (+/+).
- **Amensalism:** One is harmed, the other is unaffected (-/0).
- **Parasitism:** One benefits, the other is harmed (+/-).

Final Answer: Commensalism

Answer: (C)

Q48.

Solution

Concept: In ecology, the amount of organic matter or biomass produced by organisms over a specific period is a measure of the energy flow through an ecosystem.

Solution: The rate of biomass production is called **Productivity**. It is expressed in terms of weight ($g\ m^{-2}\ yr^{-1}$) or energy ($kcal\ m^{-2}\ yr^{-1}$). It is further divided into Primary Productivity (by producers) and Secondary Productivity (by consumers). *Decomposition* and *Humification* relate to the breakdown of organic matter, while *Stratification* is the vertical distribution of different species.

Final Answer: Productivity

Answer: (C)

Q49.

Solution

Concept: Ex-situ (off-site) conservation involves the protection of threatened species outside their natural habitats in controlled environments.

Solution: A **Seed Bank** is a prime example of **Ex-situ conservation**, where seeds of various plants are stored in a viable and fertile condition for long periods. Other examples include botanical gardens, zoos, and cryopreservation. In contrast, National Parks, Wildlife Sanctuaries, and Biosphere Reserves are In-situ methods where species are protected within their natural ecosystem.

Final Answer: Seed Bank

Answer: (C)

Q50.

Solution

Concept: The "Evil Quartet" is a framework used to describe the primary anthropogenic (human-caused) activities that lead to the accelerated rates of species extinction.

Solution: The term **"Evil Quartet"** is associated with the **causes of biodiversity loss**. These four "evil" drivers are: 1. Habitat loss and fragmentation. 2. Over-exploitation. 3. Alien species invasions. 4. Co-extinctions.

Final Answer: Causes of biodiversity loss

Answer: (B)

Answer Key

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