

CUET UG Biology Sample Paper - 10

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, which cells are located at the chalazal end?

- (A) Synergids
- (B) Antipodals
- (C) Egg cell
- (D) Central cell

Q2. If the endosperm of an angiosperm has 36 chromosomes, the number of chromosomes in its nucellus would be:

- (A) 12
- (B) 24
- (C) 36
- (D) 48

Q3. The "Filiform apparatus" is a characteristic feature of:

- (A) Generative cell
- (B) Nucellar embryo
- (C) Synergids



(D) Aleurone layer

Q4. Which of the following ensures that only cross-pollination (Xenogamy) occurs in a plant species?

(A) Cleistogamy

(B) Dioecy

(C) Bud pollination

(D) Geitonogamy

Q5. Double fertilization involves:

(A) Syngamy and Triple fusion

(B) Two syngamy events

(C) Fusion of two polar nuclei

(D) Fusion of two male gametes with one egg

Q6. The correct sequence of cell stages during spermatogenesis is:

(A) Spermatogonia → Spermatids → Secondary spermatocytes → Spermatozoa

(B) Spermatogonia → Primary spermatocytes → Secondary spermatocytes → Spermatids → Spermatozoa

(C) Primary spermatocytes → Spermatogonia → Spermatids → Spermatozoa

(D) Spermatogonia → Secondary spermatocytes → Spermatids → Spermatozoa

Q7. Which hormone surge acts as a direct trigger for ovulation in humans?

(A) FSH

(B) Progesterone

(C) LH

(D) Estrogen



Q8. In the human female, the second meiotic division is completed:

- (A) At the time of ovulation
- (B) At the time of fertilization
- (C) Prior to menstruation
- (D) During implantation

Q9. The trophoblast layer of the blastocyst attaches to which part of the uterus?

- (A) Myometrium
- (B) Perimetrium
- (C) Endometrium
- (D) Cervical canal

Q10. Colostrum, the first milk produced by mothers, is rich in which antibody providing passive immunity to the infant?

- (A) IgG
- (B) IgE
- (C) IgA
- (D) IgM

Q11. Match the following contraceptive methods:

List I	Tests	List II	Contraceptive method
(i)	IUD	(a)	Vasectomy
(ii)	Barrier	(b)	Multiload 375
(iii)	Surgical	(c)	Condoms

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



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

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

Q12. In which Assisted Reproductive Technology (ART) are eggs and sperms collected and the zygote is transferred into the fallopian tube?

(A) IUT

(B) ZIFT

(C) GIFT

(D) ICSI

Q13. "Saheli" is a non-steroidal oral contraceptive pill that inhibits:

(A) Spermatogenesis

(B) Ovulation

(C) Implantation

(D) Fertilization

Q14. A cross between a tall pea plant (Tt) and a dwarf pea plant (tt) will result in a phenotypic ratio of:

(A) 3:1

(B) 1:1

(C) 9:3:3:1

(D) 1:2:1

Q15. Down's syndrome is caused by the trisomy of which chromosome?

(A) 18

(B) 21

(C) 13



(D) X

Q16. A person with Klinefelter's syndrome has the sex chromosome complement:

(A) XO

(B) XYY

(C) XXY

(D) XXX

Q17. If the recombination frequency between two genes is 50%, it indicates that:

(A) The genes are tightly linked

(B) The genes show independent assortment

(C) The genes are on different chromosomes only

(D) Both B and C are possible

Q18. Thalassaemia is a/an _____ linked recessive blood disorder.

(A) Autosome

(B) X-chromosome

(C) Y-chromosome

(D) Dominant

Q19. Which of the following Mendelian laws cannot be explained by a monohybrid cross?

(A) Law of Dominance

(B) Law of Segregation

(C) Law of Independent Assortment

(D) None of these



- Q20.** During DNA replication, the enzyme that unwinds the DNA helix is:
- (A) DNA Ligase
 - (B) DNA Polymerase
 - (C) Helicase
 - (D) Primase
- Q21.** The "Lac Operon" is turned 'on' when:
- (A) Repressor binds to the operator
 - (B) Inducer binds to the repressor
 - (C) RNA polymerase binds to the structural genes
 - (D) Lactose is absent
- Q22.** In the process of transcription in Eukaryotes, RNA Polymerase III is responsible for the synthesis of:
- (A) mRNA
 - (B) rRNA (28S, 18S, 5.8S)
 - (C) tRNA and 5S rRNA
 - (D) hnRNA
- Q23.** The "Central Dogma" of molecular biology was proposed by:
- (A) Watson
 - (B) Crick
 - (C) Meselson
 - (D) Khorana
- Q24.** If a DNA strand has the sequence 5'-ATGCATGC-3', the sequence of the transcribed mRNA will be:



- (A) 5'-UACGUACG-3'
- (B) 3'-UACGUACG-5'
- (C) 5'-AUHCAUGC-3'
- (D) 5'-AUGCAUGC-3'

Q25. VNTRs (Variable Number of Tandem Repeats) are used in:

- (A) DNA Replication
- (B) DNA Fingerprinting
- (C) Translation
- (D) PCR

Q26. The initiator codon AUG codes for which amino acid?

- (A) Valine
- (B) Methionine
- (C) Lysine
- (D) Glycine

Q27. The process of splicing in Eukaryotes involves the removal of:

- (A) Exons
- (B) Introns
- (C) Promoters
- (D) Terminators

Q28. In a population of 1000 individuals, if the frequency of a recessive allele is 0.4, find the number of heterozygous individuals (Hardy-Weinberg equilibrium).

- (A) 160
- (B) 360



(C) 480

(D) 240

Q29. The process by which organisms with different evolutionary history evolve similar phenotypic adaptations in response to a common environmental challenge is:

(A) Adaptive Radiation

(B) Convergent Evolution

(C) Non-random evolution

(D) Divergent Evolution

Q30. Which of the following is considered the "direct ancestor" of modern Homo sapiens?

(A) Homo habilis

(B) Homo erectus

(C) Australopithecus

(D) Ramapithecus

Q31. The wings of a bird and the wings of an insect are:

(A) Homologous structures

(B) Analogous structures

(C) Vestigial structures

(D) Phylogenetic structures

Q32. The "Infective stage" of Plasmodium for humans is:

(A) Trophozoite

(B) Sporozoite

(C) Gametocyte



(D) Merozoite

Q33. Humoral immunity is mediated by:

(A) T-lymphocytes

(B) B-lymphocytes

(C) Macrophages

(D) Neutrophils

Q34. Which of the following is an "autoimmune" disease?

(A) AIDS

(B) Cancer

(C) Rheumatoid Arthritis

(D) Malaria

Q35. The genes that cause cancer when activated are called:

(A) Proto-oncogenes

(B) Regulatory genes

(C) Structural genes

(D) Jumping genes

Q36. Which microbe is used for the commercial production of Ethanol?

(A) *Clostridium butylicum*

(B) *Saccharomyces cerevisiae*

(C) *Aspergillus niger*

(D) *Lactobacillus*

Q37. In the primary treatment of sewage, which process is used?



- (A) Aeration
- (B) Filtration and Sedimentation
- (C) Microbial digestion
- (D) Chlorination

Q38. Mycorrhiza, a symbiotic association between fungi and roots of higher plants, helps in the absorption of:

- (A) Nitrogen
- (B) Phosphorus
- (C) Potassium
- (D) Calcium

Q39. The restriction enzyme EcoRI cuts the DNA at which specific palindromic sequence?

- (A) GGATCC
- (B) GAATTC
- (C) AGCT
- (D) GATC

Q40. In PCR, the step where primers are attached to the DNA template is:

- (A) Denaturation
- (B) Annealing
- (C) Extension
- (D) Elution

Q41. To visualize DNA fragments in a gel, they are stained with:

- (A) Methylene blue



- (B) Ethidium bromide
- (C) Acetocarmine
- (D) Bromophenol blue

Q42. Which part of the bioreactor is responsible for maintaining the temperature?

- (A) Agitator system
- (B) Foam control system
- (C) Cooling jacket
- (D) Sparger

Q43. Bt cotton is resistant to pests due to the presence of:

- (A) Protoxin activated by alkaline pH of insect gut
- (B) Protoxin activated by acidic pH of insect gut
- (C) Pre-formed toxin
- (D) Antibiotics

Q44. RNA interference (RNAi) is a mechanism used to silence specific genes in:

- (A) *Meloidogyne incognita*
- (B) *Bacillus thuringiensis*
- (C) *Agrobacterium*
- (D) *E. coli*

Q45. Humulin, the human insulin, consists of two short polypeptide chains linked by:

- (A) Hydrogen bonds
- (B) Phosphodiester bonds
- (C) Disulfide bridges
- (D) Peptide bonds



- Q46.** Which of the following represents an "Expanded" age pyramid?
- (A) Bell-shaped
 - (B) Triangular
 - (C) Urn-shaped
 - (D) Rectangular
- Q47.** The interaction between an Orchid growing on a Mango tree is an example of:
- (A) Mutualism
 - (B) Parasitism
 - (C) Commensalism
 - (D) Amensalism
- Q48.** The rate of biomass production is called Productivity. Net Primary Productivity (NPP) is:
- (A) $GPP + R$
 - (B) $GPP - R$
 - (C) Secondary productivity
 - (D) Gross productivity
- Q49.** Which of the following is an "In-situ" conservation method?
- (A) Botanical Garden
 - (B) Cryopreservation
 - (C) Biosphere Reserve
 - (D) Wildlife Safari Park



Q50. The "Evil Quartet" refers to the four major causes of:

- (A) Pollution
- (B) Population explosion
- (C) Biodiversity loss
- (D) Global warming



Detailed Solutions

Q1.

Solution

Concept: A mature angiosperm embryo sac (the female gametophyte) is typically a 7-celled, 8-nucleate structure. It has a distinct polarity with two ends: the **micropylar end** and the **chalazal end**.

Solution: The distribution of cells within the embryo sac is as follows: **Micropylar end:** Contains the **egg apparatus**, which consists of two **synergids** and one **egg cell**. **Chalazal end:** Contains three cells known as the **antipodals**. **Center:** Contains the large **central cell** with two polar nuclei.

Since the question asks specifically for the cells at the chalazal end, the answer is the antipodals.

Final Answer: Antipodals

Answer: (B)

Q2.

Solution

Concept: Ploidy level refers to the number of sets of chromosomes in a cell. In angiosperms: **Endosperm** is formed by triple fusion (one male gamete + two polar nuclei), making it **triploid (3n)**. **Nucellus** is part of the ovule tissue (sporophytic), making it **diploid (2n)**.

Solution: Given that the endosperm (3n) = 36 chromosomes:

$$3n = 36$$

$$n = 36/3 = 12$$

The nucellus is diploid (2n). Therefore:

$$2n = 2 \times 12 = 24$$

Final Answer: 24

Answer: (B)



Q3.

Solution

Concept: The filiform apparatus is a specialized cellular structure located at the micropylar tip of the embryo sac.

Solution: The **filiform apparatus** is a finger-like projection of the wall found specifically in the **synergids**. Its primary function is to guide the pollen tube into the synergid by secreting chemical attractants.

Final Answer: Synergids

Answer: (C)

Q4.

Solution

Concept: Plants have evolved various mechanisms (outbreeding devices) to prevent self-pollination and encourage genetic diversity through cross-pollination.

Solution: **Dioecy** is a condition where male and female flowers are borne on separate plants (e.g., Papaya). This physically ensures that only **Xenogamy** (cross-pollination between different plants) can occur. **Cleistogamy** and **Bud pollination** lead to mandatory self-pollination. **Geitonogamy** is functionally cross-pollination but genetically similar to self-pollination as it occurs between flowers of the same plant.

Final Answer: Dioecy

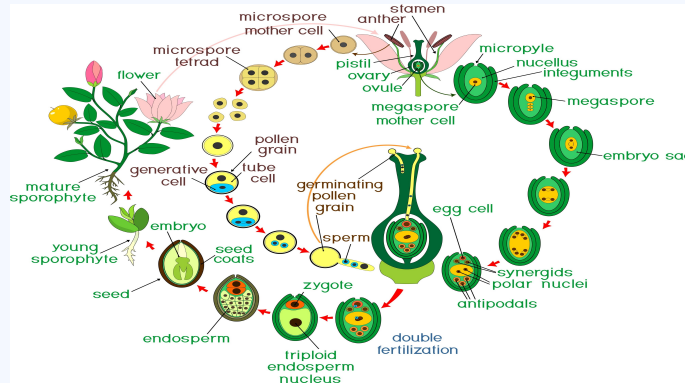
Answer: (B)



Q5.

Solution

Concept: Double fertilization is a unique event in angiosperms where two distinct types of fusion occur within the same embryo sac.



Solution: The process involves two male gametes: 1. One male gamete fuses with the egg cell to form a diploid zygote ($2n$). This is called **Syngamy**. 2. The other male gamete fuses with the two polar nuclei (or the secondary nucleus) to form the triploid primary endosperm nucleus ($3n$). This is called **Triple fusion**.

Final Answer: Syngamy and Triple fusion

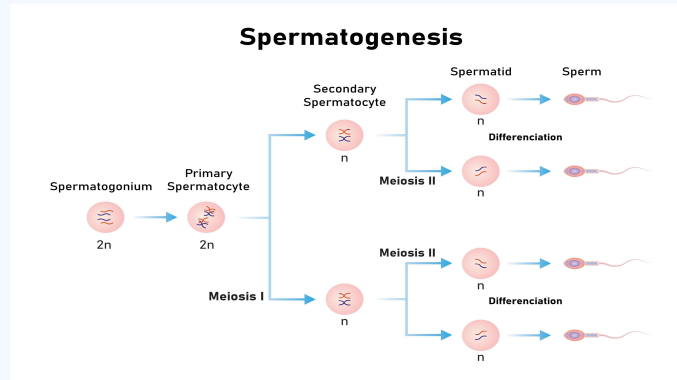
Answer: (A)



Q6.

Solution

Concept: Spermatogenesis is the process of sperm production in the testes, involving a precise series of mitotic and meiotic divisions.



Solution: The correct order of development is: **Spermatogonia:** Diploid germ cells. **Primary spermatocytes:** Formed by mitosis; undergo Meiosis I. **Secondary spermatocytes:** Haploid cells formed after Meiosis I; undergo Meiosis II. **Spermatids:** Haploid cells formed after Meiosis II. **Spermatozoa:** Mature sperm cells formed through spermiogenesis.

Final Answer: Spermatogonia → Primary spermatocytes → Secondary spermatocytes → Spermatids → Spermatozoa

Answer: (B)

Q7.

Solution

Concept: The menstrual cycle is regulated by a feedback loop of pituitary and ovarian hormones. **Solution:** Toward the middle of the cycle (around day 14), high levels of estrogen induce a rapid secretion of **Luteinizing Hormone (LH)**. This event, known as the **LH surge**, causes the Graafian follicle to rupture and release the ovum (ovulation).

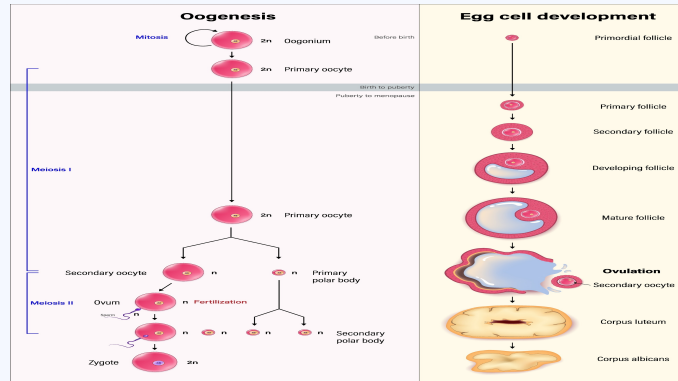
Final Answer: LH

Answer: (C)

Q8.

Solution

Concept: Oogenesis in humans is a discontinuous process. The primary oocyte is arrested in Prophase I until puberty. After puberty, the secondary oocyte is arrested in **Metaphase II**.



Solution: The second meiotic division of the secondary oocyte is only triggered and completed by the **entry of a sperm**. Therefore, the division is completed **at the time of fertilization**, resulting in the formation of a haploid ootid (ovum) and a second polar body.

Final Answer: At the time of fertilization

Answer: (B)

Q9.

Solution

Concept: The blastocyst is a hollow ball of cells consisting of an outer layer (trophoblast) and an inner cell mass. Implantation is the process where this blastocyst embeds itself into the uterine wall.

Solution: The **trophoblast** layer of the blastocyst attaches specifically to the **endometrium**, which is the innermost glandular layer of the uterus. After attachment, the uterine cells divide rapidly and cover the blastocyst, leading to successful implantation.

Final Answer: Endometrium

Answer: (C)

Q10.

Solution

Concept: Passive immunity is the transfer of ready-made antibodies to an individual. In infants, this occurs through the placenta and later through breast milk.

Solution: **Colostrum** contains several nutrients and antibodies necessary for the infant's immune system. It is particularly rich in **IgA** (Immunoglobulin A), which protects the infant's mucosal surfaces against pathogens.

Final Answer: IgA

Answer: (C)

Q11.

Solution

Concept: Contraceptive methods are categorized based on their mechanism of action.

- **IUDs (Intrauterine Devices):** Objects inserted into the uterus; can be non-medicated, copper-releasing, or hormone-releasing.
- **Barriers:** Physical devices that prevent sperm from reaching the ovum.
- **Surgical Methods:** Permanent sterilization procedures.

Solution: (i) IUD → (b) Multiload 375: This is a copper-releasing IUD. (ii) Barrier → (c) Condoms: These are physical barriers used to prevent the meeting of sperm and ovum. (iii) Surgical → (a) Vasectomy: This is the sterilization procedure for males involving the cutting/tying of the vasa deferentia.

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

Answer: (A)

Q12.

Solution

Concept: Assisted Reproductive Technologies (ART) are specialized techniques used to achieve pregnancy. The naming usually indicates what is being transferred and where it is going.

Solution: The question describes a process where fertilization happens in a lab (In-vitro), and the resulting **zygote** (or early embryo up to 8 blastomeres) is transferred into the **fallopian tube**. **ZIFT (Zygote Intra Fallopian Transfer):** Specifically refers to the transfer of the zygote into the fallopian tube. **IUT (Intra Uterine Transfer):** Transfer of embryos with more than 8 blastomeres into the uterus. **GIFT (Gamete Intra Fallopian Transfer):** Transfer of an ovum (gamete) into the fallopian tube. **ICSI (Intra Cytoplasmic Sperm Injection):** A lab procedure where a single sperm is injected directly into an ovum.

Final Answer: ZIFT

Answer: (B)



Q13.

Solution

Concept: Saheli is a unique oral contraceptive developed by the Central Drug Research Institute (CDRI) in Lucknow. Unlike traditional pills, it is non-steroidal and contains centchroman.

Solution: Saheli works by acting as a Selective Estrogen Receptor Modulator (SERM). It prevents the estrogen from preparing the endometrium for the arrival of a zygote. This makes the uterine environment hostile, thereby **inhibiting implantation**. It is known for having very few side effects and a "once-a-week" dosage.

Final Answer: Implantation

Answer: (C)

Q14.

Solution

Concept: A cross between a heterozygous individual (Tt) and a homozygous recessive individual (tt) is known as a **test cross**.

Solution: We can determine the results using a Punnett Square:

	T	t
t	Tt (Tall)	tt (Dwarf)
t	Tt (Tall)	tt (Dwarf)

The offspring are 50% Tall (Tt) and 50% Dwarf (tt). This results in a **1:1** phenotypic ratio.

Final Answer: 1:1

Answer: (B)

Q15.

Solution

Concept: Down's syndrome is a genetic disorder caused by aneuploidy, specifically the presence of an extra copy of a chromosome (trisomy).

Solution: Down's syndrome is caused by the **trisomy of chromosome 21**. This means the affected individual has 47 chromosomes instead of the usual 46. It results in physical growth delays, characteristic facial features, and mild to moderate intellectual disability.

Final Answer: 21

Answer: (B)



Q16.

Solution

Concept: Klinefelter's syndrome is a genetic condition that results when a boy is born with at least one extra copy of the X chromosome. This is an example of aneuploidy caused by non-disjunction during meiosis.

Solution: An individual with Klinefelter's syndrome typically has a total of 47 chromosomes. The sex chromosome complement is **XXY**. These individuals are phenotypically male but often show feminine characters (such as gynaecomastia) and are usually sterile. **XO** corresponds to Turner's Syndrome. **XYY** corresponds to Jacob's Syndrome. **XXX** corresponds to Triple X Syndrome.

Final Answer: XXY

Answer: (C)

Q17.

Solution

Concept: Recombination frequency is a measure of genetic linkage and is used in the creation of a genetic linkage map. A frequency of 50% is the maximum possible value.

Solution: A recombination frequency of **50%** means that the genes behave as if they are not linked at all. This happens in two scenarios: 1. The genes are located on **different chromosomes** (segregating independently). 2. The genes are located **very far apart on the same chromosome**, such that crossing over occurs between them nearly 100% of the time, leading to **independent assortment**.

Final Answer: Both B and C are possible

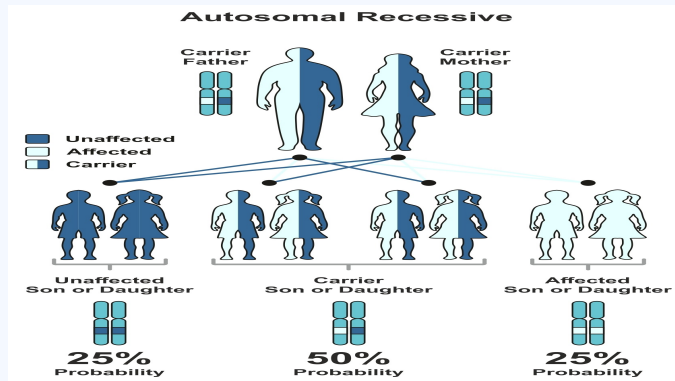
Answer: (D)



Q18.

Solution

Concept: Genetic disorders are classified based on the type of chromosome they affect (autosomes vs. sex chromosomes) and whether the trait is dominant or recessive.



Solution: **Thalassemia** is a group of inherited blood disorders characterized by decreased hemoglobin production. It is an **autosomal-linked recessive** blood disease. This means the gene responsible for the disorder is located on an autosome (specifically chromosome 16 for α -thalassemia and chromosome 11 for β -thalassemia) and a child must inherit two defective genes (one from each parent) to manifest the disease.

Final Answer: Autosome

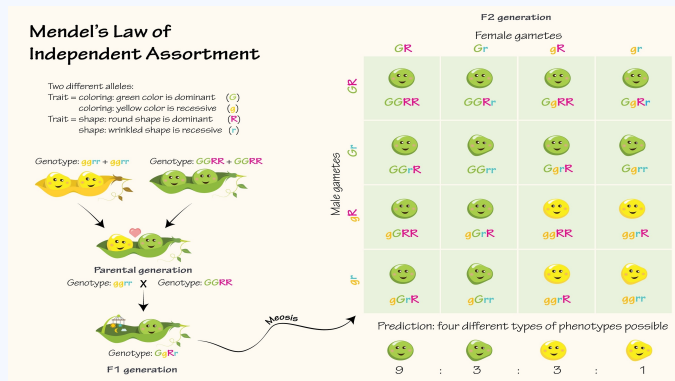
Answer: (A)



Q19.

Solution

Concept: Mendel's laws describe different aspects of heredity. A monohybrid cross follows the inheritance of a **single** pair of contrasting characters.



Solution: **Law of Dominance:** Explained by a monohybrid cross (e.g., *Tt* plants are tall). **Law of Segregation:** Explained by a monohybrid cross (alleles separate during gamete formation). **Law of Independent Assortment:** This law describes how different genes separate from one another when reproductive cells develop. To observe this, you must track two or more different traits at once. Therefore, it can only be explained by a **diybrid cross**, not a monohybrid cross.

Final Answer: Law of Independent Assortment

Answer: (C)

Q20.

Solution

Concept: DNA replication is a highly coordinated process involving several specific enzymes that act upon the double helix to ensure accurate copying of the genetic material.

Solution: The roles of the enzymes listed are as follows: **Helicase:** This enzyme is responsible for "unzipping" the DNA molecule. It breaks the hydrogen bonds between the complementary nitrogenous bases, thereby **unwinding the DNA helix** and creating the replication fork. **DNA Polymerase:** Adds nucleotides to the growing DNA strand and performs proofreading. **DNA Ligase:** Joins DNA fragments (Okazaki fragments) together by forming phosphodiester bonds. **Primase:** Synthesizes a short RNA primer to provide a starting point for DNA polymerase.

Final Answer: Helicase

Answer: (C)

Q21.

Solution

Concept: The **Lac Operon** is a classic example of an inducible operon system in *E. coli* that regulates the metabolism of lactose. Its activity is controlled by the presence or absence of an **inducer** (allolactose/lactose).

Solution: The regulation happens as follows: **In the absence of an inducer:** The regulatory gene produces a **repressor protein**, which binds to the **operator** region. This physically blocks RNA polymerase from transcribing the structural genes, turning the operon **'off'**. **In the presence of an inducer (Lactose):** The **inducer binds to the repressor** protein. This causes a conformational change in the repressor, making it unable to bind to the operator. **With the operator free, RNA polymerase can move forward to transcribe the structural genes (z, y, a), turning the operon 'on'**.

Final Answer: Inducer binds to the repressor

Answer: (B)

Q22.

Solution

Concept: The division of labor among RNA polymerases in eukaryotes is a key regulatory feature: **RNA Polymerase I:** Transcribes most ribosomal RNAs (rRNAs), specifically the **28S, 18S, and 5.8S** subunits. **RNA Polymerase II:** Transcribes precursors of messenger RNA (**hnRNA** or heterogeneous nuclear RNA) and most small nuclear RNAs (snRNAs). **RNA Polymerase III:** Transcribes smaller, stable RNAs.

Solution: **RNA Polymerase III** is responsible for the synthesis of: 1. **tRNA** (transfer RNA). 2. **5S rRNA** (the smallest subunit of ribosomal RNA). 3. Some snRNAs (small nuclear RNAs).

Therefore, option (C) correctly identifies the products of RNA Polymerase III.

Final Answer: tRNA and 5S rRNA

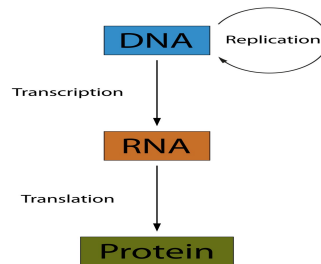
Answer: (C)



Q23.

Solution

Concept: The Central Dogma explains that once "information" has passed into protein, it cannot get out again. Specifically, the transfer of information from nucleic acid to nucleic acid, or from nucleic acid to protein, is possible, but transfer from protein to protein, or from protein to nucleic acid, is impossible.

The central dogma of molecular biology

Solution: The Central Dogma was proposed by **Francis Crick** in 1957. It outlines the one-way flow of genetic information:



* **Watson and Crick** together proposed the double helix model of DNA. * **Meselson and Stahl** experimentally proved the semi-conservative nature of DNA replication. * **Har Gobind Khorana** was instrumental in deciphering the genetic code.

Final Answer: Crick

Answer: (B)



Q24.

Solution

Concept: Transcription involves using a DNA strand as a template to build RNA. * **The Coding Strand:** The DNA strand with the 5' → 3' polarity. Its sequence is identical to the mRNA, except that Thymine (T) in DNA is replaced by Uracil (U) in RNA. * **The Template Strand:** The DNA strand with 3' → 5' polarity. The RNA polymerase reads this strand to build the mRNA in the 5' → 3' direction using complementary base pairing.

Solution: By convention, if a single DNA sequence is provided without a label, it is often considered the **coding strand** (sense strand). * DNA Coding Strand: 5'-ATGCATGC-3' * mRNA Sequence: 5'-AUGCAUGC-3' (Simply replace T with U).

If we treat the given sequence as the **template strand**: * DNA Template: 5'-ATGCATGC-3' (which is 3'-CGTACGTA-5') * mRNA Sequence: 5'-GCAUGC-3' (Complementary and antiparallel).

However, in standard multiple-choice questions like CUET, if the sequence provided matches the mRNA sequence with only the T/U swap, the question is referring to the **coding strand**.

Final Answer: 5'-AUGCAUGC-3'

Answer: (D)

Q25.

Solution

Concept: **VNTRs** belong to a class of satellite DNA referred to as mini-satellites. These are short nucleotide sequences that are arranged tandemly in many copy numbers, which vary from person to person (except in monozygotic twins).

Solution: Due to their high degree of polymorphism (variation), **VNTRs** are used as probes in **DNA Fingerprinting**. This technique allows for the identification of individuals based on their unique DNA profiles, which is essential in forensic science and paternity testing.

Final Answer: DNA Fingerprinting

Answer: (B)

Q26.

Solution

Concept: The genetic code is a set of rules used by living cells to translate information encoded within genetic material into proteins. It is nearly universal and consists of 64 codons.

Solution: The codon **AUG** has a dual function in protein synthesis: 1. It acts as the **initiator codon** (start codon), signaling the beginning of translation. 2. It codes for the amino acid **Methionine**.

* *Valine* is typically coded by GUA, GUG, GUC, and GUU. * *Lysine* is coded by AAA and AAG.

* *Glycine* is coded by GGU, GGC, GGA, and GGG.

Final Answer: Methionine

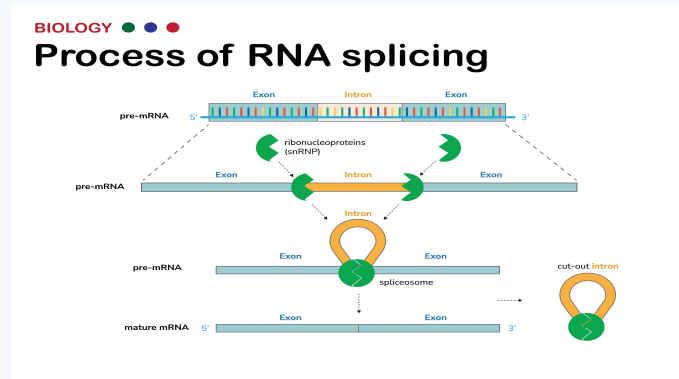
Answer: (B)



Q27.

Solution

Concept: In eukaryotes, the primary transcript (hnRNA) contains both functional and non-functional sequences. These must be processed to form functional mRNA before translation.



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.

* **Exons:** Joined together to form the mature mRNA. * **Promoters/Terminators:** DNA sequences that signal the start and end of transcription, not removed during RNA splicing.

Final Answer: Introns

Answer: (B)



Q29.

Solution

Concept: Evolutionary patterns describe how different species change over time based on their environment and ancestry. * **Divergent Evolution:** Related species evolve different traits (usually due to different environments). * **Convergent Evolution:** Unrelated species evolve similar traits.

Solution: When organisms with **different evolutionary histories** (unrelated or distantly related) develop **similar phenotypic adaptations** because they live in similar habitats or face a **common environmental challenge**, it is called **Convergent Evolution**. * **Example:** The streamlined body shapes of sharks (fish) and dolphins (mammals), or the wings of butterflies and birds.

Final Answer: Convergent Evolution

Answer: (B)

Q30.

Solution

Concept: The evolution of man involved several stages, moving from arboreal primates to modern humans with increased cranial capacity and upright posture.

Solution: Among the given options, **Homo erectus** is considered the direct ancestor in the lineage leading to modern **Homo sapiens**. * **Ramapithecus/Australopithecus:** Much earlier hominids/ape-like ancestors. * **Homo habilis:** Known as the "handy man," he preceded **Homo erectus**. * **Homo erectus:** Appeared about 1.5 million years ago, had a large brain (900cc), and likely migrated out of Africa, eventually evolving into **Homo sapiens** (often through intermediate stages like **Homo heidelbergensis** or Neanderthals).

Final Answer: Homo erectus

Answer: (B)

Q31.

Solution

Concept: Evolutionary structures are classified based on their origin and function: * **Homologous structures:** Similar anatomy/origin but different functions (result of divergent evolution). * **Analogous structures:** Different anatomy/origin but similar functions (result of convergent evolution).

Solution: The wings of a bird (composed of bones and feathers) and the wings of an insect (composed of chitinous membranes) have **different anatomical structures and origins**. However, they both perform the **same function** (flight). Therefore, they are **Analogous structures**.

Final Answer: Analogous structures

Answer: (B)



Q32.

Solution

Concept: *Plasmodium* (the malarial parasite) has a complex life cycle involving two hosts: the female *Anopheles* mosquito and humans.

Solution: The life cycle stages are as follows: **Sporozoite:** The form that is stored in the salivary glands of the mosquito and injected into the human bloodstream during a bite. This is the **infective stage for humans**. **Trophozoite/Merozoite:** Stages that occur within the human liver and red blood cells after infection. **Gametocyte:** The sexual stage that develops in humans but is taken up by the mosquito to continue the cycle.

Final Answer: Sporozoite

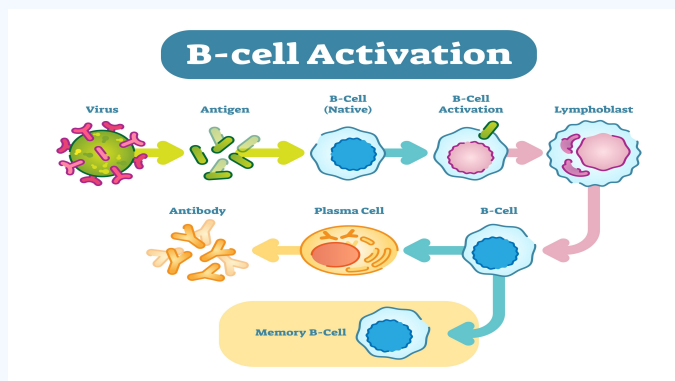
Answer: (B)

Q33.

Solution

Concept: The adaptive immune system is divided into two main branches:

- **Cell-mediated immunity:** Mediated by T-lymphocytes.
- **Humoral (Antibody-mediated) immunity:** Mediated by antibodies produced by B-lymphocytes.



Solution: **Humoral immunity** is mediated by **B-lymphocytes**. When these cells encounter an antigen, they differentiate into plasma cells that secrete antibodies into the "humors" (body fluids like blood and lymph) to neutralize pathogens.

Final Answer: B-lymphocytes

Answer: (B)

Q34.

Solution

Concept: An autoimmune disease occurs when the body's immune system loses the ability to distinguish between "self" and "non-self," resulting in the immune system attacking the body's own cells and tissues.

Solution: **Rheumatoid Arthritis** is a classic example of an **autoimmune disease**, where the immune system attacks the linings of the joints, causing inflammation and pain. **AIDS:** An immunodeficiency disease caused by HIV. **Cancer:** A disease characterized by uncontrolled cell division. **Malaria:** An infectious disease caused by the protozoan parasite *Plasmodium*.

Final Answer: Rheumatoid Arthritis

Answer: (C)

Q35.

Solution

Concept: Normal cells contain genes that regulate growth and differentiation. When these genes undergo mutations or are "activated" abnormally, they can cause the cell to become cancerous.

Solution: The genes that normally control cell growth but can cause cancer when activated (mutated) are called **Proto-oncogenes**. Once activated, they are referred to as **oncogenes**.

* **Regulatory/Structural genes:** Part of standard gene expression systems (like the Lac Operon).

* **Jumping genes:** Also known as transposons; these are DNA sequences that move from one location to another in the genome.

Final Answer: Proto-oncogenes

Answer: (A)

Q36.

Solution

Concept: Microbes are used in various industrial processes to ferment sugars into specific organic compounds.

Solution: **Saccharomyces cerevisiae**, commonly known as Brewer's yeast, is used for the commercial production of **Ethanol** by fermenting malted cereals and fruit juices. **Clostridium butylicum:** Used for the production of Butyric acid. **Aspergillus niger:** A fungus used for the production of Citric acid. **Lactobacillus:** Used for the production of Lactic acid (converting milk to curd).

Final Answer: Saccharomyces cerevisiae

Answer: (B)



Q37.

Solution

Concept: Sewage treatment is divided into two main stages:

- **Primary Treatment:** A physical process involving the removal of large and small particles through mechanical means.
- **Secondary Treatment:** A biological process involving microbes.

Solution: The **primary treatment** of sewage specifically uses **Filtration and Sedimentation**. Floating debris is removed by sequential filtration, while the grit (soil and small pebbles) is removed by sedimentation. *Aeration* and *Microbial digestion* are part of Secondary (Biological) Treatment. *Chlorination* is often the final chemical step (Tertiary Treatment) to disinfect water.

Final Answer: Filtration and Sedimentation

Answer: (B)

Q38.

Solution

Concept: Mycorrhiza is a mutualistic relationship where the fungus receives carbohydrates from the plant, and in return, the fungus enhances the plant's ability to extract nutrients from the soil.

Solution: Fungi of the genus *Glomus* form mycorrhiza and are particularly well-known for helping the plant in the absorption of **Phosphorus** from the soil. Plants with such associations also show resistance to root-borne pathogens and tolerance to salinity and drought.

Final Answer: Phosphorus

Answer: (B)

Q39.

Solution

Concept: Restriction endonucleases are "molecular scissors" that recognize a specific palindromic nucleotide sequence in DNA. A palindromic sequence reads the same on the two strands when the orientation of reading is kept the same ($5' \rightarrow 3'$).

Solution: The enzyme **EcoRI** (isolated from *Escherichia coli* RY 13) recognizes and cuts the DNA between the bases Guanine (G) and Adenine (A) only when the sequence **GAATTC** is present. **Sequence:**

$$5' - \text{GAATTC} - 3'$$

$$3' - \text{CTTAAG} - 5'$$

Final Answer: GAATTC

Answer: (B)



Q40.

Solution

Concept: The Polymerase Chain Reaction (PCR) is used to amplify a specific segment of DNA. It consists of three main steps performed in a cycle.

Solution: 1. **Denaturation:** High temperature (94°C) separates the double-stranded DNA into single strands. 2. **Annealing:** The temperature is lowered (50–65°C) to allow two sets of primers to attach (bind) to their complementary sequences on the DNA template. 3. **Extension:** Thermostable DNA polymerase (Taq polymerase) adds nucleotides to the primers to extend the new DNA strands (72°C).

Final Answer: Annealing

Answer: (B)

Q41.

Solution

Concept: DNA is naturally colorless and cannot be seen under normal light. In agarose gel electrophoresis, a specific fluorescent dye is required to make the DNA fragments visible.

Solution: The DNA fragments are stained with **Ethidium bromide** (EtBr). Once stained, the DNA fragments can be visualized as bright orange-colored bands when exposed to **UV light**. * *Methylene blue* and *Acetocarmine* are used for staining nuclei or chromosomes in general microscopy. * *Bromophenol blue* is a tracking dye used to monitor the progress of the electrophoresis run, but it does not stain the DNA itself for visualization.

Final Answer: Ethidium bromide

Answer: (B)

Q42.

Solution

Concept: A bioreactor is a vessel in which raw materials are biologically converted into specific products using microbial, plant, or animal cells. It must provide optimal growth conditions, including temperature, pH, and oxygen.

Solution: Large-scale biological reactions generate heat, which can denature proteins or kill the microbes. To maintain the optimal temperature, the bioreactor is equipped with a **Cooling jacket** (a space around the vessel where cold water circulates) or an internal cooling coil. *

Agitator system: Ensures mixing of the contents. * **Foam control system:** Breaks down foam produced during the process. * **Sparger:** Bubbles air into the medium to provide oxygen.

Final Answer: Cooling jacket

Answer: (C)



Q43.

Solution

Concept: Bt cotton contains genes from the bacterium *Bacillus thuringiensis* that produce a specific crystalline protein. This protein is a **protoxin** (inactive) when it is inside the bacterium or the plant.

Solution: When an insect (like a bollworm) ingests the plant tissue, the inactive protoxin is converted into an active form. This conversion is triggered by the **alkaline pH of the insect's midgut**, which solubilizes the crystals. The activated toxin then binds to the surface of midgut epithelial cells, creating pores that cause cell swelling and lysis, eventually leading to the death of the insect.

Final Answer: Protoxin activated by alkaline pH of insect gut

Answer: (A)

Q44.

Solution

Concept: **RNA interference (RNAi)** is a biological process in which RNA molecules inhibit gene expression or translation. In agriculture, it is used to develop plants resistant to specific parasites.

Solution: RNAi was specifically used to protect tobacco plants from the nematode *Meloidogyne incognita*, which infects the roots and reduces yield. The process involves producing both sense and anti-sense RNA in the host plant, which forms double-stranded RNA (dsRNA). When the nematode consumes the plant, this dsRNA initiates the silencing of a specific mRNA essential for the nematode's survival.

Final Answer: *Meloidogyne incognita*

Answer: (A)

Q45.

Solution

Concept: Human insulin (Humulin) is a hormone consisting of two short polypeptide chains: **Chain A** and **Chain B**. In its mature, functional form, these chains must be physically connected to maintain the protein's tertiary structure.

Solution: The two polypeptide chains of Humulin are linked together by **Disulfide bridges** (bonds between Sulfur atoms of Cysteine residues). * In natural pro-insulin, there is an extra stretch called the **C-peptide**, which is removed during maturation. * When Eli Lilly produced the first genetically engineered insulin, they synthesized Chain A and B separately and combined them by creating these disulfide bonds.

Final Answer: Disulfide bridges

Answer: (C)



Q46.

Solution

Concept: An age pyramid is a graphical representation of the distribution of various age groups in a population. The shape tells us if the population is growing, stable, or declining.

Solution: A **Triangular-shaped** age pyramid represents an **Expanding** population. * It has a very high proportion of young individuals (pre-reproductive age) at the base. * As these individuals move into the reproductive age, the population size increases rapidly.

* **Bell-shaped:** Represents a **Stable** population where pre-reproductive and reproductive age groups are roughly equal. * **Urn-shaped:** Represents a **Declining** population where the number of pre-reproductive individuals is smaller than the reproductive ones.

Final Answer: Triangular

Answer: (B)

Q47.

Solution

Concept: Population interactions are classified based on whether the species involved are benefited (+), harmed (-), or unaffected (0).

Solution: The interaction between an orchid and a mango tree is an example of **Commensalism** (+, 0). * The **Orchid** (epiphyte) benefits by getting a high perch for better sunlight and support. * The **Mango tree** is neither harmed nor benefited by the presence of the orchid.

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

* **Amensalism:** One is harmed, the other is unaffected (-, 0).

Final Answer: Commensalism

Answer: (C)

Q48.

Solution

Concept: Productivity in an ecosystem is the rate at which organic matter is created by producers. * **Gross Primary Productivity (GPP):** The total rate at which solar energy is captured and converted into chemical energy (organic matter) by photosynthesis. * **Respiration (R):** The energy consumed by the plants for their own metabolic needs.

Solution: **Net Primary Productivity (NPP)** is the biomass available to consumers (heterotrophs) after the plants have accounted for their own respiratory losses. It is calculated as:

$$NPP = GPP - R$$

Final Answer: GPP - R

Answer: (B)



Q49.

Solution

Concept: Conservation strategies are categorized based on where the species is protected: * **In-situ (On-site):** Protecting the species in its natural habitat. This involves protecting the entire ecosystem. * **Ex-situ (Off-site):** Protecting the species outside its natural habitat in a controlled environment.

Solution: A **Biosphere Reserve** is an **In-situ** conservation method. It is a large protected area where the ecosystem and its genetic resources are preserved in their natural setting.

* **Botanical Gardens, Cryopreservation, and Wildlife Safari Parks** are all **Ex-situ** methods because the organisms are removed from their original natural habitats and maintained under human care.

Final Answer: Biosphere Reserve

Answer: (C)

Q50.

Solution

Concept: The "Evil Quartet" is a term used to describe the four major drivers of species extinction and the current ecological crisis.

Solution: The "Evil Quartet" refers to the four major causes of **Biodiversity loss**: 1. **Habitat Loss and Fragmentation:** The most important cause (e.g., tropical rainforests). 2. **Over-exploitation:** When "need" turns to "greed" (e.g., Steller's sea cow). 3. **Alien Species Invasions:** Non-native species outcompeting locals (e.g., Nile perch, Lantana). 4. **Co-extinctions:** When a host goes extinct, its unique parasites/symbionts also die out.

Final Answer: Biodiversity loss

Answer: (C)



Answer Key

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

