CUET UG Biology Sample Paper - 15

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. If a pollen grain of a plant with 2n = 28 is used to pollinate a plant with 2n = 42, the chromosome number in the resulting endosperm will be:

(A) 35

(B) 49

(C) 56

(D) 63

Q2. The filiform apparatus is characteristic of:

(A) Nucellus

(B) Egg

(C) Synergids

(D) Suspensor

Q3. Even in the absence of pollinating agents, seed-setting is assured in:

(A) Commelina

(B) Zostera

(C) Salvia

(D) Fig

Q4. Identify the incorrect statement regarding the 8-nucleate embryo sac:

(A) Six of the eight nuclei are surrounded by cell walls.

(B) The polar nuclei are situated below the egg apparatus in the large central cell.

(C) The egg apparatus consists of two synergids and one egg cell.

(D) The antipodals are located at the micropylar end.

Q5. In an angiosperm, how many microspore mother cells are required to produce 100 pollen grains?

(A) 25

(B) 50

(C) 100

(D) 400

Q6. The shared terminal duct of the reproductive and urinary system in the human male is:

(A) Ureter

(B) Urethra

(C) Vas deferens

(D) Vasa efferentia

Q7. Which layer of the uterus undergoes cyclical changes during the menstrual cycle?

(A) Perimetrium

(B) Myometrium

(C) Endometrium

(D) Mesometrium

Q8. Capacitation occurs in:

(A) Epididymis

(B) Vas deferens

(C) Female reproductive tract

(D) Rete testis

Q9. The correct sequence of hormonal dominance in a 28-day cycle is:

(A) Estrogen → LH → Progesterone

(B) LH → Estrogen → Progesterone

(C) Progesterone → Estrogen → LH

(D) LH → Progesterone → Estrogen

Q10. During oogenesis, the secondary oocyte halts its division at:

(A) Prophase I

(B) Metaphase I

(C) Metaphase II

(D) Anaphase II

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

(A) Multiload 375

(B) LNG-20

(C) Lippes loop

(D) Cu-7

Q12. The method of directly injecting a sperm into the ovum in assisted reproductive technology is called:

(A) GIFT

(B) ZIFT

(C) ICSI

(D) ET

Q13. Assertion (A): Saheli is an oral contraceptive for females containing a non-steroidal preparation.
Reason (R): It is a "once-a-week" pill with very few side effects.

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is not the correct explanation.

(C) A is true, R is false.

(D) Both are false.

Q14. Emergency contraceptives are effective if used within 72 hours of:

(A) Ovulation

(B) Menstruation

(C) Coitus

(D) Implantation

Q15. Which surgical method of contraception involves the removal of a small part of the fallopian tube?

(A) Vasectomy

(B) Tubectomy

(C) Castration

(D) Hysterectomy

Q16. How many types of gametes will be produced by a plant with genotype $AABbCc$?

(A) 2

(B) 4

(C) 8

(D) 6

Q17. A woman with normal vision, whose father was colorblind, marries a colorblind man. What is the probability of their first daughter being colorblind?

(A) 0%

(B) 25%

(C) 50%

(D) 100%

Q18. The recombination frequency between genes A and B is 9%, B and C is 17%, and A and C is 26%. The sequence of genes on the chromosome is:

(A) A-B-C

(B) B-A-C

(C) A-C-B

(D) C-A-B

Q19. In sickle cell anemia, glutamic acid is replaced by valine. Which codon change is responsible for this?

(A) GAG to GUG

(B) GAG to GAG

(C) GUG to GAG

(D) GGG to GUG

Q20. Which of the following disorders is caused by the trisomy of an autosome?

(A) Klinefelter's Syndrome

(B) Turner's Syndrome

(C) Down's Syndrome

(D) Phenylketonuria

Q21. The inheritance of flower color in Antirrhinum majus is an example of:

(A) Complete dominance

(B) Incomplete dominance

(C) Co-dominance

(D) Epistasis

Q22. The distance between two genes and the percentage of recombination shows:

(A) Inverse relationship

(B) Direct relationship

(C) No relationship

(D) Parallel relationship

Q23. Which enzyme is known as the "Key tool" for DNA replication that adds nucleotides in the $5' \rightarrow 3'$ direction?

(A) DNA Ligase

(B) DNA Polymerase III

(C) Helicase

(D) Topoisomerase

Q24. The "Beads on a string" structure in chromatin are:

(A) Nucleotides

(B) Nucleosomes

(C) Genes

(D) Codons

Q25. If the sequence of the coding strand in a transcription unit is $5'\breve{}ATGCATGC\breve{}3'$, the sequence of mRNA will be:

(A) $3'\breve{}UACGUACG\breve{}5'$

(B) $5'\breve{}UAGCUACG\breve{}3'$

(C) $5'\breve{}AUGCAUGC\breve{}3'$

(D) $3'\breve{}AUGCAUGC\breve{}5'$

Q26. In the Lac Operon, when Lactose is present:

(A) Repressor binds to Operator.

(B) RNA polymerase cannot transcribe.

(C) Repressor binds to Lactose and becomes inactive.

(D) Structural genes are switched off.

Q27. VNTRs (Variable Number of Tandem Repeats) belong to which category of DNA?

(A) Coding DNA

(B) Satellite DNA

(C) Exons

(D) Promoter DNA

Q28. During translation, the formation of a peptide bond is catalyzed by:

(A) mRNA

(B) tRNA

(C) 23S rRNA (Ribozyme)

(D) DNA polymerase

Q29. The tailing process in hnRNA involves the addition of:

(A) Methyl guanosine triphosphate at 3′ end

(B) Adenylate residues at 3′ end

(C) Methyl guanosine triphosphate at 5′ end

(D) Adenylate residues at 5′ end

Q30. Which site of the ribosome does the incoming aminoacyl-tRNA typically bind to first?

(A) P-site

(B) A-site

(C) E-site

(D) Central dogma site

Q31. In a population of 1000 individuals, 360 belong to genotype AA, 480 to Aa, and 160 to aa. What is the frequency of allele A?

(A) 0.6

(B) 0.4

(C) 0.36

(D) 0.7

Q32. The "Industrial Melanism" in the peppered moth Biston betularia is an example of:

(A) Stabilizing selection

(B) Directional selection

(C) Disruptive selection

(D) Artificial selection

Q33. The wings of a bird and the wings of a butterfly are:

(A) Homologous structures

(B) Analogous structures

(C) Vestigial structures

(D) Phylogenetic structures

Q34. The first mammals to evolve were similar to:

(A) Shrews

(B) Monkeys

(C) Rats

(D) Chimpanzees

Q35. The concept of "Saltation" (single-step large mutation) was given by:

(A) Charles Darwin

(B) Hugo de Vries

(C) Lamarck

(D) Hardy-Weinberg

Q36. Fossils of Homo erectus were discovered in:

(A) Ethiopia

(B) Java

(C) Germany

(D) France

Q37. During DNA fingerprinting, why is the DNA digested with restriction endonucleases?

(A) To multiply DNA

(B) To cut DNA into fragments of different lengths

(C) To denature DNA

(D) To separate DNA based on charge

Q38. The stage of the embryo that implants in the uterine wall is:

(A) Zygote

(B) Morula

(C) Blastocyst

(D) Gastrula

Q39. Identify the incorrect pair:

(A) Turner's Syndrome — 45 with XO

(B) Klinefelter's Syndrome — 47 with XXY

(C) Down's Syndrome — 21st Trisomy

(D) Colour Blindness — Y-linked

Q40. The process of "Splicing" in eukaryotes involves:

(A) Removal of Exons

(B) Removal of Introns

(C) Addition of Poly-A tail

(D) Methylation

Q41. Pollen-Pistil interaction is a:

(A) Physical process

(B) Chemical dialogue

(C) Random process

(D) Nuclear fusion

Q42. The genetic material of the Tobacco Mosaic Virus (TMV) is:

(A) dsDNA

(B) ssDNA

(C) RNA

(D) Protein

Q43. Which hormone is primarily responsible for the "Milk-Ejection Reflex"?

(A) Prolactin

(B) Oxytocin

(C) Estrogen

(D) Progesterone

Q44. What is the significance of the "Triple Fusion" in angiosperms?

(A) Formation of zygote

(B) Formation of PEN (Primary Endosperm Nucleus)

(C) Formation of seed coat

(D) Formation of fruit wall

Q45. Which of the following is a "Vestigial Organ" in humans?

(A) Nictitating membrane

(B) Appendix

(C) Wisdom teeth

(D) All of the above

Q46. In the Hardy-Weinberg equation, $2pq$ represents:

(A) Frequency of dominant allele

(B) Frequency of recessive allele

(C) Frequency of heterozygous genotype

(D) Frequency of homozygous dominant genotype

Q47. The "Theory of Pangenesis" was given by:

(A) Lamarck

(B) Darwin

(C) Weismann

(D) Mendel

Q48. In human females, the first polar body is formed during:

(A) Mitosis

(B) Meiosis I

(C) Meiosis II

(D) Fertilization

Q49. A transcription unit in DNA is defined primarily by three regions. These are:

(A) Enhancer, Exon, Intron

(B) Promoter, Structural gene, Terminator

(C) Start codon, Stop codon, Anticodon

(D) Replication fork, Okazaki fragments, Template

Q50. Which hominid was the first to use tools and had a brain capacity of 650–800cc?

(A) Homo erectus

(B) Homo habilis

(C) Australopithecus

(D) Ramapithecus

Detailed Solutions

Q1.

Solution

Concept: In angiosperms, the endosperm is formed through **triple fusion**, which involves the fusion of one haploid male gamete with the two polar nuclei of the central cell. The formula for the chromosome number in the endosperm is:

$$\text{Endosperm chromosomes} = (\text{n from male gamete}) + (2 \times \text{n from female polar nuclei})$$

Solution: Given the diploid numbers ($2n$) of the two plants:

- **Male Parent (Pollen donor):** $2n = 28$. Therefore, the haploid male gamete (n_m) contains:
$$\frac{28}{2} = 14 \text{ chromosomes}$$
- **Female Parent (Seed bearer):** $2n = 42$. Therefore, the haploid polar nuclei (n_f) each contain:
$$\frac{42}{2} = 21 \text{ chromosomes}$$

Calculation of the resulting endosperm:

- The central cell of the female parent contains two polar nuclei: $21 + 21 = 42$.
- The male gamete provides: 14.
- Total chromosomes = 42 + 14 = 56.

Final Answer: The chromosome number in the resulting endosperm will be 56.

Answer: (C)

Q2.

Solution

Concept: The filiform apparatus is a specialized cellular structure located at the micropylar tip of the embryo sac. It plays a vital role in the process of **double fertilization** in angiosperms.
Solution: Within the 7-celled, 8-nucleate embryo sac:

- **Synergids:** These are two cells located at the micropylar end. They possess highly thickened, finger-like projections called the **filiform apparatus**.
- **Function:** This apparatus functions as a guide, directing the entry of the pollen tube into the synergid and helping in the discharge of male gametes.
- **Other Options:** The nucellus provides nutrition, the egg cell fuses with a male gamete to form a zygote, and the suspensor anchors the embryo to the embryo sac.

Final Answer: The filiform apparatus is a characteristic feature of the synergids.

Answer: (C)

Q3.

Solution

Concept: Assured seed-set in the absence of pollinators is a characteristic of **cleistogamy**. Cleistogamous flowers are bisexual flowers which do not open at all. In such flowers, the anthers and stigma lie close to each other, making self-pollination (autogamy) inevitable.
Solution: Analyzing the given options:

- **Commelina:** This plant produces **cleistogamous flowers** in addition to normal chasmogamous flowers. Because cleistogamous flowers remain closed, they do not require pollinating agents to achieve fertilization.
- **Zostera:** It is an aquatic plant that requires water as a medium for pollination (hydrophily).
- **Salvia:** It possesses a lever mechanism and requires insects (entomophily).
- **Fig:** It has an obligate mutualistic relationship with a specific wasp species for pollination.

Final Answer: Seed-setting is assured in *Commelina* due to the presence of cleistogamous flowers.

Answer: (A)

Q4.

Solution

Concept:

The mature angiosperm embryo sac is a 7-celled, 8-nucleate structure. The distribution of cells is highly specific: the egg apparatus is at the micropylar end, the antipodals are at the chalazal end, and the central cell occupies the middle.

Solution:

Evaluating the statements regarding the embryo sac:

- **Cells vs Nuclei:** 6 nuclei are walled into individual cells; the 2 polar nuclei share the central cell. (Statement A is true).
- **Central Cell:** Polar nuclei are indeed situated below the egg apparatus. (Statement B is true).
- **Egg Apparatus:** It consists of one egg and two synergids. (Statement C is true).
- **Polarity:** The antipodals are always located at the chalazal end, whereas the micropylar end houses the egg apparatus. (Statement D is false).

Final Answer:

The incorrect statement is D.

Answer: (D)

Q5.

Solution

Concept: Microsporogenesis is the process where a diploid Microspore Mother Cell (MMC) undergoes meiosis to form four haploid microspores, which then mature into pollen grains.

Solution: The mathematical relationship between MMCs and pollen grains is:

$$\text{Number of Pollen Grains} = \text{Number of MMCs} \times 4$$

Given we need 100 pollen grains:

$$100 = \text{MMCs} \times 4$$

$$\text{MMCs} = \frac{100}{4} = 25$$

Final Answer:25 microspore mother cells are required to produce 100 pollen grains.

Answer: (A)

Q6.

Solution

Concept: Male reproductive anatomy features a "urogenital" duct. In males, unlike females, the urinary and reproductive systems share a final exit path.

Solution: The urethra originates from the urinary bladder and extends through the penis to its external opening. It receives the ducts from the reproductive glands (seminal vesicles, prostate, and bulbourethral glands), thus acting as a shared terminal duct for both urine and semen.

Final Answer: The shared terminal duct is the urethra.

Answer: (B)

Q7.

Solution

Concept: The uterus consists of three layers: the outer perimetrium, the middle muscular myometrium, and the inner glandular endometrium.

Solution: The endometrium is the layer that responds to estrogen and progesterone levels. It proliferates during the follicular phase and, if pregnancy does not occur, disintegrates and is shed during menstruation. This cycle of buildup and breakdown constitutes the "cyclical changes."

Final Answer: The endometrium undergoes cyclical changes.

Answer: (C)

Q8.

Solution

Concept: Capacitation is the functional maturation of sperm. Even though sperm are motile after leaving the epididymis, they cannot fertilize an ovum immediately.

Solution: Capacitation involves the removal of cholesterol and glycoproteins from the plasma membrane over the acrosome. This process is triggered by the biochemical environment (pH and enzymes) of the female reproductive tract (vagina and uterus).

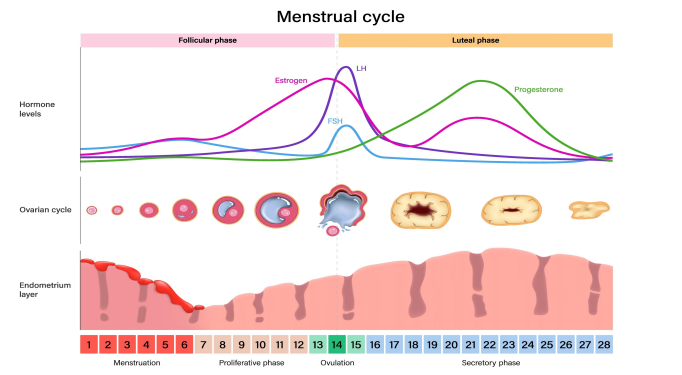
Final Answer: Capacitation occurs in the female reproductive tract.

Answer: (C)

Q9.

Solution

Concept: The menstrual cycle is regulated by a specific interplay of pituitary (FSH, LH) and ovarian (Estrogen, Progesterone) hormones.



Solution: Estrogen: High during the proliferative phase to rebuild the uterine lining.LH: Spikes sharply (LH surge) to induce ovulation at the mid-point of the cycle.Progesterone: Becomes the dominant hormone after ovulation, secreted by the corpus luteum to maintain the lining for possible implantation.

Final Answer: The sequence is Estrogen → LH → Progesterone.

Answer: (A)

Q10.

Solution

Concept: Oogenesis is an interrupted process. It begins before birth, pauses, resumes at puberty, and pauses again before completion.

Solution: The secondary oocyte is formed after the completion of Meiosis I. It enters Meiosis II but the process is arrested at Metaphase II. The division is only completed when a sperm penetrates the zona pellucida of the ovum, triggering the completion of Meiosis II and the release of the second polar body.

Final Answer: Division halts at Metaphase II.

Answer: (C)

Q11.

Solution

Concept: Intrauterine Devices (IUDs) are inserted by doctors in the uterus through the vagina. They are classified into non-medicated, copper-releasing, and hormone-releasing types.
Solution: Analyzing the provided options:

- **Lippes loop:** A non-medicated IUD.
- **Multiload 375 and Cu-7:** These are copper-releasing IUDs ($CuT, Cu7, Multiload\,375$) which increase phagocytosis of sperm.
- **LNG-20:** This is a hormone-releasing IUD that releases levonorgestrel. It makes the uterus unsuitable for implantation and the cervix hostile to the sperm.

Final Answer: The hormone-releasing IUD is LNG-20.

Answer: (B)

Q12.

Solution

Concept: In vitro fertilization (IVF) includes various specialized techniques to assist couples with infertility. When the sperm count is very low or sperm cannot penetrate the egg, direct injection methods are used.
Solution: The terminology for these ART techniques is as follows:

- **GIFT:** Gametes are transferred into the fallopian tube.
- **ZIFT:** The zygote is transferred into the fallopian tube.
- **ICSI:** Stands for **Intra-Cytoplasmic Sperm Injection**. In this procedure, a sperm is directly injected into the ovum using a microscopic needle.
- **ET:** Embryo Transfer is the final step where the embryo is moved into the uterus.

Final Answer: The method of directly injecting sperm into the ovum is ICSI.

Answer: (C)

Q13.

Solution

Concept:

Saheli is a landmark in Indian reproductive medicine. It works by blocking estrogen receptors in the uterus, preventing the eggs from implanting (anti-implantation), rather than preventing ovulation entirely.

Solution: Evaluating the statements:

- **Assertion (A):** Saheli is a non-steroidal oral contraceptive. This is true. Its active ingredient, Centchroman, is a Selective Estrogen Receptor Modulator (SERM), not a steroid.
- **Reason (R):** It is taken once a week and is associated with minimal side effects compared to steroidal pills. This is also true.
- **Analysis:** While both statements are factually correct, the Reason describes the benefits and schedule of the pill rather than providing a causal explanation for its chemical nature (non-steroidal). However, in most biology assessment contexts, they are treated as complementary facts where R supports the clinical profile of A.

Final Answer:

Both A and R are true, but R is not the correct explanation of A (though some keys accept A if the "explanation" is viewed as the clinical justification for its design). Based on strict logic:

Answer: (B)

Q14.

Solution

Concept:

Emergency contraceptives (such as the "morning-after" pill or IUD insertion) are designed to provide a "rescue" window following unprotected sexual activity to prevent pregnancy before it begins.

Solution:

Emergency contraceptive methods, including high-dose progestogen or progestogen-estrogen combinations, are administered to prevent a potential pregnancy. For maximum efficacy, these must be taken within 72 hours of coitus.

- They are not effective if used after implantation has already occurred.
- They are not timed relative to menstruation or ovulation in an emergency context, as the exact timing of those events may be unknown to the user.

Final Answer:

Emergency contraceptives are effective if used within 72 hours of coitus.

Answer: (C)

Q15.

Solution

Concept:

Sterilization is a terminal method used to prevent any further pregnancies. It blocks the transport of gametes, thereby preventing conception.

Solution:

Analyzing the surgical procedures:

- **Tubectomy:** In this procedure, a small part of the fallopian tubes is removed or tied up. This is the female sterilization method.
- **Vasectomy:** The sterilization procedure in males where the vas deferens is cut or tied.
- **Castration:** The removal of the testes (not a contraceptive method, but a form of mutilation/sterilization).
- **Hysterectomy:** Surgical removal of the uterus, usually performed for medical reasons rather than simple contraception.

Final Answer:

The surgical method involving the fallopian tube is tubectomy.

Answer: (B)

Q16.

Solution

Concept: The number of genetically different gametes produced by an individual is calculated using the formula 2^n, where n is the number of heterozygous loci (alleles that are different, e.g., Aa).

Solution: Given the genotype $AABbCc$:

- AA: Homozygous (does not contribute to variation).
- Bb: Heterozygous ($n = 1$).
- Cc: Heterozygous ($n = 1$).

Total $n = 2$. Applying the formula:

$$\text{Types of gametes} = 2^2 = 4$$

The four types are: ABC, ABc, AbC, Abc.

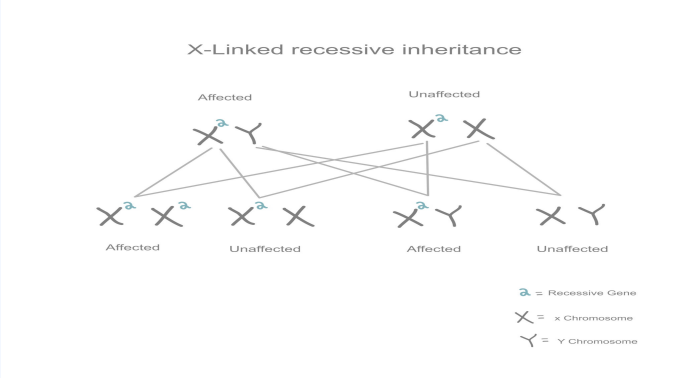
Final Answer: The plant will produce 4 types of gametes.

Answer: (B)

Q17.

Solution

Concept: Colorblindness is an X-linked recessive trait. Because the gene is located on the X chromosome, males (XY) express the trait if their single X is affected, while females (XX) only express it if both X chromosomes carry the recessive allele (X^c). A female with only one affected X ($X^C X^c$) has normal vision but is a "carrier.



Solution: To find the probability, we determine the genotypes of the parents:

- **The Mother:** She has normal vision but her father was colorblind ($X^c Y$). She must have inherited the X^c chromosome from him. Therefore, her genotype is $X^C X^c$ (Carrier).
- **The Father:** He is colorblind, so his genotype is $X^c Y$.

When we cross these genotypes ($X^C X^c \times X^c Y$), the possible combinations for daughters are:

(a) $X^C X^c$: Normal vision (Carrier daughter)

(b) $X^c X^c$: Colorblind (Affected daughter)

Since there are two possible genotypes for a daughter and one of them results in colorblindness, the probability is 1 out of 2, or 50%.

Final Answer: The probability of their first daughter being colorblind is 50%.

Answer: (C)

Q18.

Solution

Concept:
Recombination frequency indicates the relative distance between genes on a chromosome. To find the sequence, identify the two genes with the greatest distance; these will be the flanking (outermost) genes.
Solution:
Given frequencies:

- AC=26% (Greatest distance)
- AB=9%
- BC=17%

Because A and C are the farthest apart, they are the ends of the map. Since 9+17=26, B fits perfectly in the middle.
A 9 B 17 C The sequence is A-B-C.
Final Answer:
The sequence of genes is A-B-C.

Answer: (A)

Q19.

Solution

Concept: Sickle cell anemia is caused by a point mutation (transversion) in the *HBB* gene. This results in the substitution of a polar amino acid with a non-polar one, changing the shape of hemoglobin under low oxygen tension.
Solution: At the molecular level, the triplet *CTC* in the DNA template strand is transcribed into GAG in mRNA, coding for Glutamic acid. In the mutant DNA, *CTC* becomes *CAC*, which is transcribed into GUG in mRNA. This new codon codes for Valine.

- Normal: GAG (Glutamic acid)
- Mutant: GUG (Valine)

Final Answer: The codon change responsible is GAG to GUG.

Answer: (A)

Q20.

Solution

Concept: Chromosomal disorders can be categorized as aneuploidy (gain or loss of chromosomes). Trisomy refers to the presence of three copies of a particular chromosome instead of the usual two.
Solution: Analyzing the disorders:

- **Klinefelter's Syndrome:** Trisomy of sex chromosomes ($44 + XXY$).
- **Turner's Syndrome:** Monosomy of sex chromosomes ($44 + X$).
- **Down's Syndrome:** Trisomy of autosome 21 ($45 + XX$ or $45 + XY$).
- **Phenylketonuria:** A gene-level mutation, not a chromosomal count error.

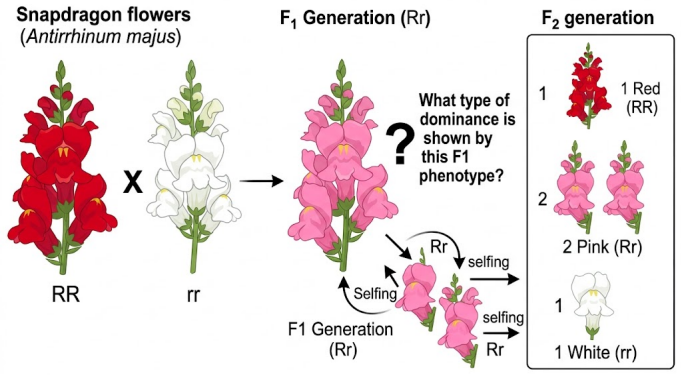
Final Answer: Down's Syndrome is caused by trisomy of an autosome.

Answer: (C)

Q21.

Solution

Concept: Incomplete dominance occurs when the phenotype of the F_1 hybrid does not resemble either parent but is an intermediate between the two.



Solution: In *Antirrhinum* (Snapdragon) or *Mirabilis jalapa*:

- Red flowers (RR) × White flowers (rr) yields Pink flowers (Rr).
- The phenotypic ratio and genotypic ratio in F_2 are both $1 : 2 : 1$, which deviates from the Mendelian $3 : 1$ dominant-recessive ratio.

Final Answer: This is an example of incomplete dominance.

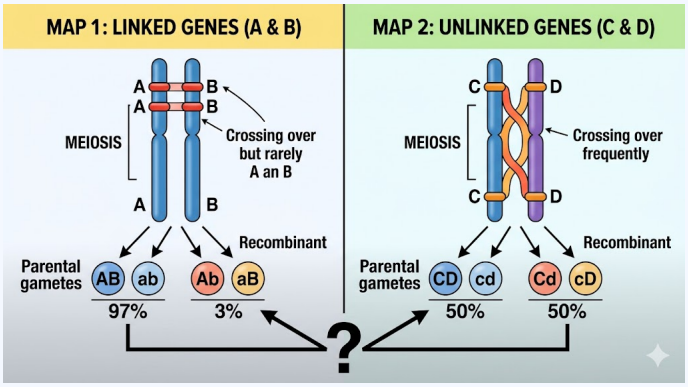
Answer: (B)

Q22.

Solution

Concept:

Crossing over and recombination are more likely to occur when genes are located far apart on the same chromosome.



Solution:

The distance between genes is measured in map units or centiMorgans (cM).

- If distance increases, the percentage of recombination increases (up to 50
- If distance decreases (linkage increases), the recombination frequency decreases.
- This is a direct relationship.

Final Answer:

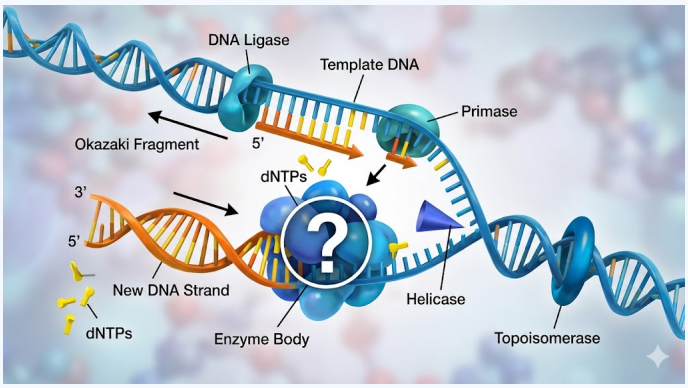
The relationship is a direct relationship.

Answer: (B)

Q23.

Solution

Concept:DNA replication is semi-conservative and semi-discontinuous. The main enzyme, DNA polymerase, requires a primer and can only polymerize in one specific direction due to the chemical nature of the deoxyribose sugar.



Solution:

- **DNA Polymerase III:** This is the "key tool" that catalyzes the polymerization of deoxynucleotides. It specifically adds new bases to the free $3' - OH$ group of the previous nucleotide, thus moving in the $5' \rightarrow 3'$ direction.
- **Other Tools:** Helicase (unzipping), Topoisomerase (tension relief), and Ligase (glueing Okazaki fragments) are auxiliary but essential.

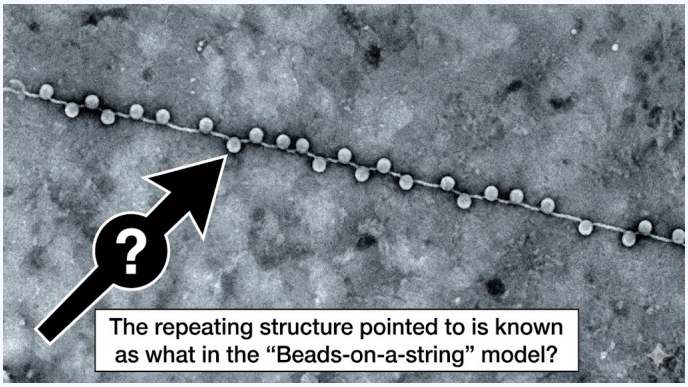
Final Answer: The enzyme is DNA Polymerase III.

Answer: (B)

Q24.

Solution

Concept: To fit approximately 2.2 meters of DNA into a microscopic nucleus, DNA undergoes levels of packaging. The basic repeating unit of this packaging is the nucleosome.



Solution: Negatively charged DNA is wrapped around a positively charged histone octamer (containing $H2A, H2B, H3$, and $H4$). This structure is called a nucleosome. When viewed under an electron microscope, chromatin looks like "beads-on-a-string," where the beads are the nucleosomes and the string is the linker DNA.

Final Answer: The "beads on a string" are nucleosomes.

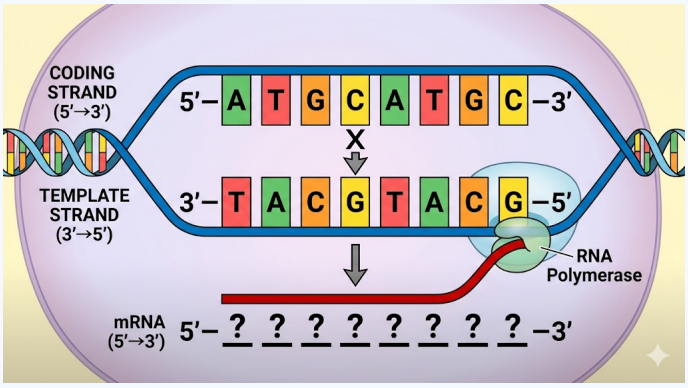
Answer: (B)

Q25.

Solution

Concept:

In transcription, the DNA strand with 3 →5 polarity acts as the template. The other strand, with 5 →3 polarity, is called the coding strand. Its sequence is identical to the resulting mRNA, except T is replaced by U.



Solution:

Given Coding Strand: 5 –ATGCATGC–3

- The mRNA is synthesized complementary to the template strand (3 –TACGTACG–5).
- Consequently, the mRNA sequence is exactly the same as the coding strand, substituting Uracil for Thymine.
- mRNA: 5 –AUGCAUGC–3

Final Answer:

The mRNA sequence is 5 –AUGCAUGC–3 .

Answer: (C)

Q26.

Solution

Concept:

The *Lac* operon is an inducible operon where the substrate (lactose) regulates its own metabolism by inhibiting the repressor.

Solution:

When lactose is present in the medium:

- Lactose enters the cell and is converted to allolactose, which acts as an inducer.
- The inducer binds to the repressor protein produced by the *i* gene.
- This binding causes a conformational change that renders the repressor inactive, preventing it from binding to the operator.
- Consequently, RNA polymerase can move past the operator to transcribe the structural genes.

Final Answer:

Repressor binds to Lactose and becomes inactive.

Answer: (C)

Q27.

Solution

Concept:

A large portion of the human genome consists of repetitive sequences. If these sequences form a bulk of the DNA but do not code for proteins, they are classified as satellite DNA.

Solution:

- **Satellite DNA:** Classified into micro-satellites and mini-satellites based on the length of segments and number of repetitive units.
- **VNTRs:** Variable Number of Tandem Repeats are mini-satellites used in DNA profiling.
- They belong to the non-coding satellite DNA category, showing high degrees of polymorphism.

Final Answer:

VNTRs belong to Satellite DNA.

Answer: (B)

Q28.

Solution

Concept:

The formation of a peptide bond is a dehydration synthesis reaction occurring between the carboxyl group of one amino acid and the amino group of another.

Solution:

During the elongation phase of translation:

- The ribosome acts as a structural site and a catalyst.
- In bacteria (prokaryotes), the 23S rRNA (a component of the 50S large ribosomal subunit) acts as the enzyme peptidyl transferase.
- This is a classic example of a ribozyme, where an RNA molecule performs enzymatic catalysis.

Final Answer:

The formation of a peptide bond is catalyzed by 23S rRNA.

Answer: (C)

Q29.

Solution

Concept: Post-transcriptional modifications convert heterogeneous nuclear RNA (hnRNA) into functional messenger RNA (mRNA). These modifications are essential for stability and translation initiation. **Solution:**Tailing, or polyadenylation, involves the addition of a poly-A tail.

- About 200–300 adenylate residues are added.
- This addition occurs at the 3′ end of the transcript.
- Note: Capping occurs at the 5′ end and involves methyl guanosine triphosphate.

Final Answer: The tailing process involves the addition of adenylate residues at the 3′ end.

Answer: (B)

Q30.

Solution

Concept: The ribosome has three slots for tRNA molecules to facilitate the translation of mRNA into a polypeptide chain.

Solution: The sequence of tRNA movement through the ribosome is generally A → P → E.

- The A-site acts as the "landing site" for the next aminoacyl-tRNA that matches the mRNA codon.
- The P-site holds the tRNA linked to the growing chain.
- The E-site is the exit for the empty tRNA.

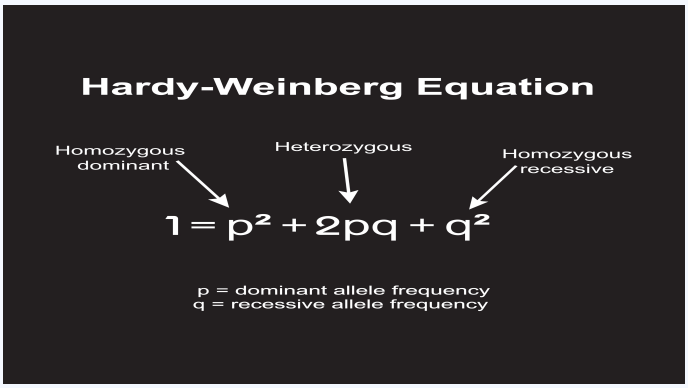
Final Answer: The incoming aminoacyl-tRNA binds first to the A-site.

Answer: (B)

Q31.

Solution

Concept: Allele frequency can be calculated using the genotype counts. The frequency of allele A (p) and a (q) must sum to 1.



Solution: Given population size = 1000. Total alleles = 2000.

- Alleles from AA: $360 \times 2 = 720$
- Alleles from Aa: $480 \times 1 = 480$
- Total A alleles = 720 + 480 = 1200
- Frequency of A (p) = $\frac{1200}{2000} = 0.6$

Alternatively, using $p^2 = 0.36$, then $p = \sqrt{0.36} = 0.6$.

Final Answer: The frequency of allele A is 0.6.

Answer: (A)

Q32.

Solution

Concept: Natural selection can be stabilizing (favors average), directional (favors one extreme), or disruptive (favors both extremes).
Solution: In Industrial Melanism:

- The environmental change (soot on trees) favored the previously rare dark-colored moths.
- The population distribution "directed" itself toward the melanic trait.
- This is a textbook example of directional selection where the phenotype at one end of the spectrum is favored over others.

Final Answer: Industrial Melanism is an example of directional selection.

Answer: (B)

Q33.

Solution

Concept: Evolutionary structures are classified based on their origin and function. **Homology** indicates common ancestry, whereas **Analogy** indicates similar functional adaptation in unrelated lineages.
Solution: Birds and butterflies both use wings for flight, but their structural composition is entirely different:

- **Bird Wing:** Modification of the bony forelimb (pentadactyl limb structure).
- **Butterfly Wing:** Thin membranous extension of the integument (exoskeleton).

Since they have different origins but similar functions, they are **analogous structures** resulting from convergent evolution.
Final Answer: The wings of a bird and butterfly are analogous structures.

Answer: (B)

Q34.

Solution

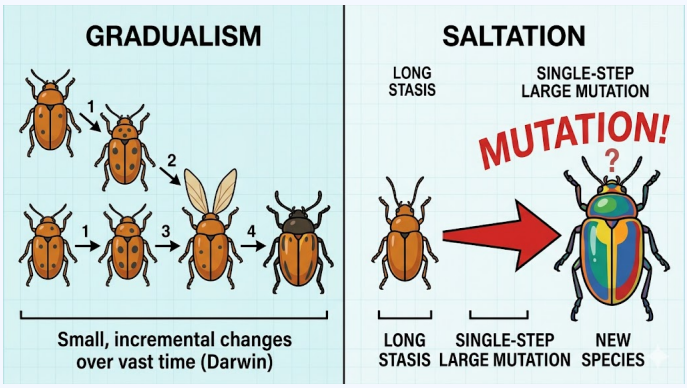
Concept: The fossil record provides a timeline of mammalian evolution, showing a transition from small, inconspicuous creatures during the age of dinosaurs to the diverse forms seen today.
Solution: Early mammals (such as *Morganucodon*) were tiny, egg-laying or primitive placental insectivores. Their fossils are small, and their teeth were specialized for eating insects, very similar to modern-day **shrews**. They lived in the shadows of the dominant reptiles of that era.
Final Answer: The first mammals were similar to shrews.

Answer: (A)

Q35.

Solution

Concept: The Mutation Theory of evolution stands in contrast to Darwinian Gradualism. It suggests that new species are formed not by gradual changes but by sudden jumps.



Solution:

- **Hugo de Vries:** Conducted experiments on *Oenothera lamarckiana* and proposed that mutations are the primary engine of evolution.
- **Saltation:** He coined this term to describe a single-step large mutation that leads to speciation.

Final Answer: The concept of saltation was given by Hugo de Vries.

Answer: (B)

Q36.

Solution

Concept: Human evolution is tracked through fossil remains found across the "Old World." Different species are often named after the locations where their type-specimens were first unearthed.

Solution:

- **Homo erectus:** The first significant find was in 1891 in **Java**, an island in Indonesia.
- **Other sites:** *Homo habilis* fossils are famously from Ethiopia/Tanzania, and Neanderthals were first found in Germany.

Final Answer: Fossils of *Homo erectus* were discovered in Java.

Answer: (B)

Q37.

Solution

Concept:

DNA fingerprinting relies on the polymorphism in repetitive DNA. To analyze these variations, the long strands of genomic DNA must be broken down into manageable pieces.

Solution:

- **Restriction Endonucleases:** These enzymes act as molecular scissors that cut DNA at specific palindromic sequences.
- **Purpose:** Since the distance between restriction sites varies due to Variable Number Tandem Repeats (VNTRs), digestion results in DNA fragments of different lengths (RFLPs).
- **Other Options:** Multiplication is done by PCR; denaturation is done by heat; separation by charge is done by electrophoresis.

Final Answer:

DNA is digested to cut it into fragments of different lengths.

Answer: (B)

Q38.

Solution

Concept:

Following fertilization, the zygote undergoes a series of mitotic divisions (cleavage) as it moves toward the uterus.

Solution:

The developmental stages are:

- **Zygote:** Single cell.
- **Morula:** 8–16 celled solid ball.
- **Blastocyst:** A hollow sphere with an inner cell mass and an outer trophoblast layer. It is this blastocyst stage that implants in the uterine wall.
- **Gastrula:** Follows implantation, involving the formation of germ layers.

Final Answer:

The stage that implants is the blastocyst.

Answer: (C)

Q39.

Solution

Concept:

Genetic and chromosomal disorders are classified by their mode of inheritance or the specific chromosomal abnormality involved.

Solution:

Evaluating the pairs:

- **Turner's (XO):** Correct.
- **Klinefelter's (XXY):** Correct.
- **Down's (21st Trisomy):** Correct.
- **Colour Blindness:** This is an X-linked recessive trait. Traits linked to the Y-chromosome are called holandric traits and are only passed from father to son.

Final Answer:

The incorrect pair is D (Colour Blindness — Y-linked).

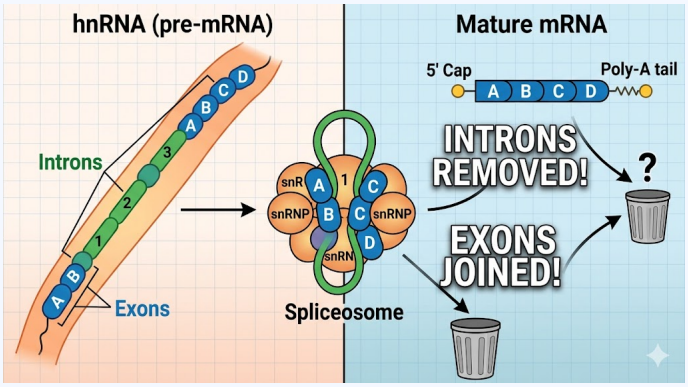
Answer: (D)

Q40.

Solution

Concept:

Eukaryotic genes are "split," meaning they contain non-functional sequences that must be edited out before protein synthesis can occur.



Solution:

The processing of hnRNA includes:

- **Splicing:** The removal of non-coding introns and the ligation of coding exons.
- **Capping/Tailing:** These are additions, not splicing.

Final Answer:

Splicing involves the removal of introns.

Answer: (B)

Q41.

Solution

Concept:

The pistil has the ability to recognize whether the pollen is of the right type (compatible) or the wrong type (incompatible).

Solution:

This recognition is mediated by chemical components of the pollen interacting with those of the pistil. The pistil accepts compatible pollen and promotes post-pollination events, while rejecting incompatible ones. This continuous chemical dialogue determines the success of fertilization.

Final Answer:

Pollen-Pistil interaction is a chemical dialogue.

Answer: (B)

Q42.

Solution

Concept:

Viruses are obligate intracellular parasites containing either DNA or RNA as their genetic material, but never both.

Solution:

The Tobacco Mosaic Virus (TMV) is a rod-shaped virus. Its structure consists of a helical capsid made of capsomeres that encloses a single-stranded RNA molecule. In most plant viruses, RNA is the primary genetic material.

Final Answer:

The genetic material of TMV is RNA.

Answer: (C)

Q43.

Solution

Concept:

Lactation involves two distinct hormonal processes: milk secretion (synthesis) and milk let-down (ejection).

Solution:

- **Prolactin:** Secreted by the anterior pituitary; stimulates milk production.
- **Oxytocin:** Secreted by the posterior pituitary; stimulates the contraction of myoepithelial cells for milk ejection. This is a neuroendocrine reflex.

Final Answer:

The hormone responsible for the milk-ejection reflex is Oxytocin.

Answer: (B)

Q44.

Solution

Concept:

Angiosperms exhibit a unique process called double fertilization, consisting of syngamy and triple fusion.

Solution:

Triple fusion occurs when a male gamete (n) fuses with the two polar nuclei (n+n) of the central cell. This results in the formation of a triploid (3n) nucleus known as the Primary Endosperm Nucleus (PEN). The PEN provides the genetic blueprint for the endosperm, a nutrient-rich tissue.

Final Answer:

Triple fusion results in the formation of the Primary Endosperm Nucleus (PEN).

Answer: (B)

Q45.

Solution

Concept:

Vestigial organs are anatomical structures that are fully developed and functional in related ancestral species but are reduced and functionless in the current species.

Solution:

In humans, several structures fall under this category:

- **Nictitating membrane:** A small fold at the inner corner of the eye.
- **Appendix:** A finger-like projection of the cecum.
- **Wisdom teeth:** The last set of molars to erupt.

Since all three are examples of vestigial structures in humans, the correct choice is D.

Final Answer:

All of the listed organs are vestigial in humans.

Answer: (D)

Q46.

Solution

Concept:

The Hardy-Weinberg principle provides a mathematical model to study gene frequencies in a non-evolving population.

Solution:

In the expression (p+q) 2 =p 2 +2pq+q 2 :

- p is the frequency of the dominant allele.
- q is the frequency of the recessive allele.
- p 2 is the frequency of individuals with genotype AA.
- q 2 is the frequency of individuals with genotype aa.
- 2pq represents the frequency of the heterozygous genotype (Aa).

Final Answer:

2pq represents the frequency of the heterozygous genotype.

Answer: (C)

Q47.

Solution

Concept:

Before the modern understanding of genetics, various hypotheses were proposed to explain how traits were inherited from parents to offspring.

Solution:

The Theory of Pangenesis was proposed by Charles Darwin in 1868. He postulated that small hereditary particles (gemmules) were shed by all cells of the body and reached the gametes. This was his attempt to explain the inheritance of acquired characteristics and variation, though it was later replaced by Mendelian genetics.

Final Answer:

The Theory of Pangenesis was given by Darwin.

Answer: (B)

Q48.

Solution

Concept:

Oogenesis is the process of formation of a mature female gamete. It is characterized by unequal cytoplasmic divisions.

Solution:

The primary oocyte completes its first meiotic division (Meiosis I) within the tertiary follicle. This is an unequal division that results in:

- A large haploid secondary oocyte.
- A tiny haploid first polar body.

The second polar body is only formed later, during Meiosis II, upon the entry of a sperm.

Final Answer:

The first polar body is formed during Meiosis I.

Answer: (B)

Q49.

Solution

Concept:

Transcription is the process of copying genetic information from one strand of the DNA into RNA. This process is restricted to specific segments of DNA.

Solution:

A transcription unit in DNA is defined by three regions:

(a) **A Promoter:** The binding site for RNA polymerase, defining the start and direction of transcription.

(b) **The Structural gene:** The area between the promoter and terminator that actually codes for the RNA.

(c) **A Terminator:** The sequence that signals the end of the transcription process.

Final Answer:

The regions are Promoter, Structural gene, and Terminator.

Answer: (B)

Q50.

Solution

Concept:

Human evolution is characterized by a progressive increase in cranial capacity and the development of manual dexterity (tool use).

Solution:

Based on the fossil record:

- **Homo habilis:** Cranial capacity of 650–800cc; first to use stone tools.
- **Homo erectus:** Cranial capacity of 900cc; first to use fire and walk fully upright.
- **Australopithecus:** Smaller brain (450–600cc); "Lucy" is a famous example.
- **Ramapithecus:** More ape-like, though walked on two legs.

Final Answer:

The hominid is Homo habilis.

Answer: (B)

Answer Key

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