CUET UG Biology Sample Paper - 14

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, if the haploid number of a plant is 12, what will be the number of nuclei in the central cell and the synergids respectively?

(A) 12, 12

(B) 24, 12

(C) 12, 24

(D) 24, 24

Q2. Which of the following ensures that only one pollen tube enters the synergid?

(A) Filiform apparatus

(B) Antipodal cells

(C) Central cell

(D) Vegetative cell

Q3. Double fertilization is considered a unique event in angiosperms because:

(A) Two male gametes fuse with one egg.

(B) One male gamete fuses with the egg, and the other fuses with the secondary nucleus.

(C) Both male gametes fuse with the polar nuclei.

(D) It results in the formation of two embryos.

Q4. In Chasmogamy, the flowers are:

(A) Always closed to ensure self-pollination.

(B) Exposed anthers and stigma to allow cross-pollination.

(C) Characterized by the absence of pollinators.

(D) Only found in aquatic plants.

Q5. Identify the correct sequence of development in a dicot embryo:

(A) Proembryo → Heart-shaped → Globular → Mature embryo

(B) Globular → Proembryo → Heart-shaped → Mature embryo

(C) Proembryo → Globular → Heart-shaped → Mature embryo

(D) Heart-shaped → Globular → Proembryo → Mature embryo

Q6. During Oogenesis, the first meiotic division is completed within the:

(A) Primary follicle

(B) Secondary follicle

(C) Tertiary follicle

(D) Graafian follicle

Q7. Which hormone surge triggers ovulation on approximately the 14th day of the cycle?

(A) Estrogen

(B) Progesterone

(C) LH (Luteinizing Hormone)

(D) FSH (Follicle Stimulating Hormone)

Q8. Identify the correct path of sperm transport:

(A) Rete testis → Vasa efferentia → Epididymis → Vas deferens

(B) Rete testis → Epididymis → Vasa efferentia → Vas deferens

(C) Vas deferens → Epididymis → Rete testis → Vasa efferentia

(D) Seminiferous tubules → Rete testis → Vas deferens → Epididymis

Q9. The blastocyst implants into the uterine wall at which stage?

(A) 2-cell stage

(B) 8-cell stage

(C) Trophoblast formation stage

(D) Gastrula stage

Q10. The secretion of which gland helps in the lubrication of the penis?

(A) Prostate gland

(B) Seminal vesicles

(C) Bulbourethral (Cowper's) gland

(D) Bartholin's gland

Q11. Match List I (Method) with List II (Example/Action):

List I	Method	List II	Example/Action
(a)	Barrier	(i)	Lippes Loop
(b)	IUD	(ii)	Saheli
(c)	Oral Pill	(iii)	Vaults
(d)	Surgical	(iv)	Tubectomy

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

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

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

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

Q12. In GIFT (Gamete Intra-Fallopian Transfer), the procedure involves:

(A) Transfer of a zygote into the fallopian tube.

(B) Transfer of an ovum collected from a donor into the fallopian tube of another female.

(C) Fertilization of egg in a lab and then transferring to the uterus.

(D) Injecting sperm directly into the ovum.

Q13. Which of the following is a non-medicated IUD?

(A) Multiload 375

(B) Progestasert

(C) Lippes Loop

(D) LNG-20

Q14. In a dihybrid cross ($RrYy \times RrYy$), what is the probability of obtaining an offspring with the genotype $rrYy$?

(A) $1/16$

(B) $2/16$

(C) $4/16$

(D) $9/16$

Q15. A person with Klinefelter's syndrome has the karyotype:

(A) $45, XO$

(B) $47, XXY$

(C) $47, XYY$

(D) $47, +21$

Q16. Morgan observed that certain genes did not segregate independently. This is due to:

(A) Polyploidy

(B) Linkage

(C) Mutation

(D) Crossing over

Q17. Which of the following is an example of Pleiotropy?

(A) Skin color in humans

(B) Phenylketonuria

(C) ABO blood grouping

(D) Flower color in Snapdragon

Q18. If a hemophilic man marries a carrier woman, what percentage of their daughters will be hemophilic?

(A) 0%

(B) 25%

(C) 50%

(D) 100%

Q19. Thalassemia is an example of:

(A) Autosomal dominant disorder

(B) Sex-linked recessive disorder

(C) Autosomal recessive blood disorder

(D) Chromosomal aberration

Q20. The enzyme that breaks hydrogen bonds between nitrogenous bases during DNA replication is:

(A) DNA Polymerase

(B) Ligase

(C) Helicase

(D) Topoisomerase

Q21. In the Lac Operon, the 'inducer' molecule is:

(A) Glucose

(B) Galactose

(C) Lactose (allolactose)

(D) Permease

Q22. The process of splicing in eukaryotes involves the removal of:

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

Q23. According to Chargaff's rule, if DNA has 20% Adenine, what is the percentage of Cytosine?

(A) 20%
(B) 30%
(C) 40%
(D) 80%

Q24. The UTRs (Untranslated Regions) are present on mRNA at:

(A) 5′ end before start codon
(B) 3′ end after stop codon
(C) Both A and B
(D) Between exons and introns

Q25. DNA Fingerprinting relies on identifying:

(A) Single Nucleotide Polymorphisms (SNPs)
(B) Variable Number Tandem Repeats (VNTRs)
(C) Coding sequences
(D) Intron length only

Q26. The coding strand of DNA is 5′-ATGCATGC-3′. What will be the sequence of the mRNA?

(A) 5′-AUGCAUGC-3′

(B) 3′-UACGUACG-5′

(C) 5′-TACGTACG-3′

(D) 3′-AUGCAUGC-5′

Q27. The 'Beads on a string' structure in chromatin are:

(A) Genes

(B) Nucleosomes

(C) Chromomeres

(D) Centromeres

Q28. In a population in Hardy-Weinberg equilibrium, the frequency of a recessive allele is 0.4. What is the frequency of the homozygous dominant genotype?

(A) 0.16

(B) 0.36

(C) 0.48

(D) 0.60

Q29. The wings of a butterfly and the wings of a bird are examples of:

(A) Homologous organs (Divergent evolution)

(B) Analogous organs (Convergent evolution)

(C) Vestigial organs

(D) Phylogenetic organs

Q30. Which Hominid had a cranial capacity of approximately 900 cc and likely ate meat?

(A) Homo habilis

(B) Homo erectus

(C) Neanderthal man

(D) Australopithecus

Q31. Darwin's finches are an excellent example of:

(A) Adaptive radiation

(B) Industrial melanism

(C) Mutation theory

(D) Genetic drift

Q32. The "Founder Effect" is a type of:

(A) Natural selection

(B) Genetic drift

(C) Gene flow

(D) Mutation

Q33. A cross between a tall pea plant with round seeds (TTRr) and a dwarf pea plant with wrinkled seeds (ttrr) will yield:

(A) All tall and round

(B) 1:1 ratio of Tall Round to Tall Wrinkled

(C) 9:3:3:1 ratio

(D) 1:1:1:1 ratio

Q34. Which enzyme is used in DNA Fingerprinting to cut DNA at specific sites?

(A) DNA Ligase

(B) Restriction Endonuclease

(C) Taq Polymerase

(D) Reverse Transcriptase

Q35. The Miller-Urey experiment proved that:

(A) Life comes from pre-existing life.

(B) Organic molecules can be synthesized from inorganic gases.

(C) Oxygen was abundant in the primitive atmosphere.

(D) RNA was the first genetic material.

Q36. If the endosperm cell of an angiosperm has 24 chromosomes, the number of chromosomes in the root cell is:

(A) 8

(B) 16

(C) 24

(D) 48

Q37. Which part of the sperm contains the enzymes for penetrating the egg membrane?

(A) Nucleus

(B) Middle piece

(C) Acrosome

(D) Tail

Q38. Down's Syndrome is caused by:

(A) Monosomy of 21st chromosome

(B) Trisomy of 21st chromosome

(C) Nullisomy of X chromosome

(D) Trisomy of 18th chromosome

Q39. The template strand of DNA runs in the direction:

(A) $5' \rightarrow 3'$

(B) $3' \rightarrow 5'$

(C) $5' \rightarrow 5'$

(D) Randomly

Q40. How many codons code for amino acids in the genetic code?

(A) 64

(B) 61

(C) 3

(D) 20

Q41. Saheli, the new oral contraceptive, contains:

(A) High progestogen

(B) High estrogen

(C) Centchroman (Non-steroidal)

(D) Cortisol

Q42. The theory of Natural Selection was given by:

(A) Lamarck

(B) Hugo de Vries

(C) Charles Darwin

(D) Louis Pasteur

Q43. Sickle cell anemia is caused by a point mutation in the beta-globin chain where Glutamic acid is replaced by:

(A) Valine

(B) Lysine

(C) Serine

(D) Alanine

Q44. During translation, the peptide bond formation is catalyzed by:

(A) mRNA

(B) tRNA

(C) Ribozyme (23S rRNA)

(D) DNA Polymerase

Q45. The structural and functional unit between the developing embryo and maternal body is:

(A) Umbilical cord

(B) Placenta

(C) Amnion

(D) Yolk sac

Q46. The distance between genes on a chromosome is measured in:

(A) Nanometers

(B) Centimorgans

(C) Base pairs

(D) Daltons

Q47. Which of the following was NOT present in the primitive atmosphere?

(A) CH_4

(B) NH_3

(C) O_2

(D) H_2O (vapors)

Q48. The Satellite DNA is important because it:

(A) Codes for enzymes.

(B) Shows high degree of polymorphism.

(C) Is identical in all individuals.

(D) Codes for proteins of the cell membrane.

Q49. ZIFT involves the transfer of:

(A) Zygote into Uterus

(B) Zygote into Fallopian tube

(C) Embryo with more than 8 blastomeres into Fallopian tube

(D) Sperm into Uterus

Q50. A woman with blood group O marries a man with blood group AB. The possible blood groups of their children are:

(A) A and B

(B) AB and O

(C) Only O

(D) A, B, and AB

Detailed Solutions

Q1.

Solution

Concept: The typical angiosperm embryo sac (Polygonum type) is a **7-celled, 8-nucleate** structure. All nuclei within the embryo sac are genetically identical and haploid (n), as they are derived from a single functional megaspore via three successive mitotic divisions.
Solution: Given the haploid number (n) of the plant is 12:

- **Central Cell:** This cell contains **two polar nuclei**. Since each nucleus is haploid ($n = 12$), the total number of nuclei in the central cell is 1 + 1 = 2. However, if the question asks for the chromosomal count, it would be 12 + 12 = 24.
- **Synergids:** There are two synergids at the micropylar end. Each synergid is a separate cell containing **one haploid nucleus**. Thus, a single synergid has 12 chromosomes.

The question asks for the *number of nuclei* (referring to the numerical count or the chromosomal sum depending on context, but usually interpreted as the chromosomal content n vs $2n$ in these MCQ formats). * Central cell nuclei content: $n + n = 12 + 12 = 24$ * Synergid nucleus content: $n = 12$
Final Answer: The central cell has 24 chromosomes (across two nuclei) and each synergid has 12 chromosomes (in one nucleus).

Answer: (B)

Q2.

Solution

Concept: The entry of the pollen tube into the embryo sac is a highly regulated process guided by chemical signals. This interaction occurs at the micropylar end of the ovule, specifically involving the synergids.
Solution: The synergids possess special cellular thickenings at the micropylar tip called the **filiform apparatus**. Its primary functions include:

- **Guiding the Pollen Tube:** It secretes chemotropic substances that attract the pollen tube toward the embryo sac.
- **Regulating Entry:** It plays a critical role in ensuring that the pollen tube enters into one of the synergids and helps in the discharge of male gametes.

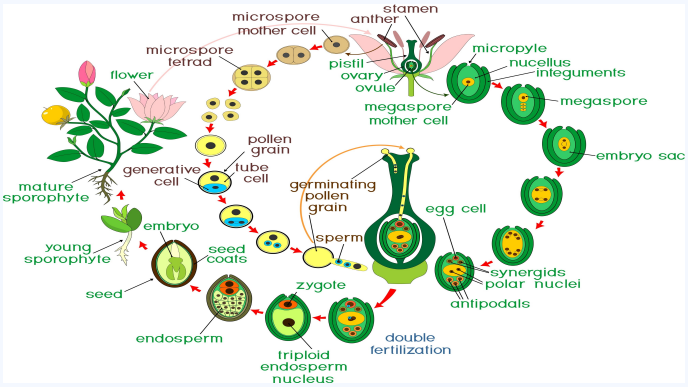
The other options—antipodal cells (chalazal end), central cell (triple fusion site), and vegetative cell (pollen tube growth)—do not perform this guidance function.
Final Answer: The filiform apparatus guides the entry of the pollen tube.

Answer: (A)

Q3.

Solution

Concept: Double fertilization is a complex fertilization mechanism specific to flowering plants (angiosperms). It involves two distinct fusion events occurring simultaneously within the embryo sac.



Solution: When a pollen tube enters the embryo sac, it releases two male gametes:

- **Syngamy:** One male gamete (n) fuses with the egg cell (n) to form a diploid **zygote** ($2n$), which eventually develops into the embryo.
- **Triple Fusion:** The second male gamete (n) fuses with the two polar nuclei (or the secondary nucleus) ($2n$) in the central cell to form the triploid **Primary Endosperm Nucleus (PEN)** ($3n$).

This dual fusion process (Syngamy + Triple Fusion) is what defines double fertilization.
Final Answer: One male gamete fuses with the egg, and the other fuses with the secondary nucleus.

Answer: (B)

Q4.

Solution

Concept: Plants exhibit different types of pollination mechanisms based on floral morphology. Chasmogamy and Cleistogamy are the two primary conditions related to the opening of flowers.
Solution:

- **Chasmogamous Flowers:** These are "open" flowers. They have exposed anthers and stigmas, making them accessible to various pollinating agents (wind, water, or insects), which facilitates cross-pollination.
- **Cleistogamous Flowers:** In contrast, these flowers never open, ensuring that only self-pollination occurs.

Since chasmogamous flowers are open to the environment, they promote genetic diversity through cross-pollination.
Final Answer: Exposed anthers and stigma to allow cross-pollination.

Answer: (B)

Q5.

Solution

Concept: Embryogenesis in dicots follows a very specific morphological progression. After the zygote divides, it undergoes a series of predictable structural changes.
Solution: The development of a dicot embryo follows these stages:

- **Proembryo:** The initial stage following the first few divisions of the zygote.
- **Globular Stage:** The embryo becomes a spherical mass of cells.
- **Heart-shaped Stage:** As the cotyledons begin to form, the embryo takes on a distinct notched, heart-like appearance.
- **Mature Embryo:** The final stage where the radicle, plumule, and cotyledons are fully differentiated.

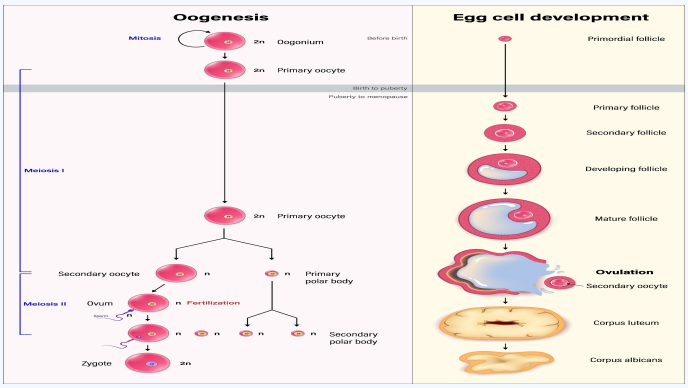
Therefore, the sequence is: Proembryo → Globular → Heart-shaped → Mature embryo.
Final Answer: Proembryo → Globular → Heart-shaped → Mature embryo

Answer: (C)

Q6.

Solution

Concept: Oogenesis is the process of formation of a mature female gamete. Unlike spermatogenesis, it begins during the embryonic development stage, but meiosis is arrested at Prophase I until puberty.



Solution: The primary oocyte within the primary follicle starts the first meiotic division but remains suspended. This division is only completed just prior to ovulation. This completion occurs specifically when the follicle has matured into a **tertiary follicle** (characterized by the presence of a fluid-filled cavity called the antrum). The completion of Meiosis I results in the formation of a large haploid secondary oocyte and a tiny first polar body.

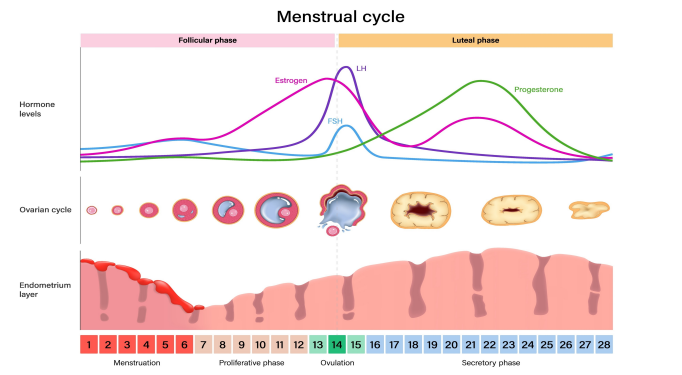
Final Answer: The first meiotic division is completed within the tertiary follicle.

Answer: (C)

Q7.

Solution

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



Solution: Both LH and FSH attain a peak level in the middle of the cycle (about the 14th day). Rapid secretion of **LH (Luteinizing Hormone)** leading to its maximum level during the mid-cycle is called the **LH surge**. This surge induces the rupture of the Graafian follicle and thereby the release of the ovum (ovulation).

Final Answer: LH (Luteinizing Hormone) surge triggers ovulation.

Answer: (C)

Q8.

Solution

Concept: The male reproductive system consists of a series of ducts that transport sperm from the site of production (seminiferous tubules) to the exterior.

Solution: The correct anatomical pathway for sperm movement is:

(a) **Seminiferous Tubules:** Site of sperm production.

(b) **Rete Testis:** A network of tubules.

(c) **Vasa Efferentia:** Fine ciliated ductules.

(d) **Epididymis:** Where sperm are stored and mature.

(e) **Vas Deferens:** The duct that ascends into the abdomen to join the urethra.

Comparing this to the options, Choice A provides the correct sequential order of these accessory ducts.

Final Answer: Rete testis → Vasa efferentia → Epididymis → Vas deferens.

Answer: (A)

Q9.

Solution

Concept: After fertilization in the ampulla, the zygote undergoes cleavage while moving toward the uterus, eventually forming a blastocyst.

Solution: The blastocyst is a hollow ball of cells organized into an outer layer called the **trophoblast** and an inner cell mass. The trophoblast layer attaches to the endometrium (uterine wall) during implantation. This occurs roughly 7 days after fertilization. Stages like the 2-cell or 8-cell stage occur while the embryo is still in the fallopian tube, and the gastrula stage occurs after implantation.

Final Answer: Implantation occurs at the trophoblast formation stage (Blastocyst).

Answer: (C)

Q10.

Solution

Concept: Male accessory glands (seminal vesicles, prostate, and bulbourethral glands) secrete fluids that constitute the seminal plasma, which is rich in fructose, calcium, and certain enzymes.

Solution:

- **Seminal Vesicles:** Provide energy (fructose) for sperm.
- **Prostate Gland:** Contributes to sperm motility and neutralizes acidity.
- **Bulbourethral (Cowper's) Glands:** These glands secrete an alkaline, mucus-like fluid during sexual arousal that helps in the **lubrication of the penis** and neutralizes traces of acidic urine in the urethra.

Bartholin's glands are found in females.

Final Answer: Bulbourethral (Cowper's) gland helps in lubrication.

Answer: (C)

Q11.

Solution

Concept: Contraceptive methods are classified based on their mechanism of action to prevent conception. These include physical barriers, chemical devices, hormonal preparations, and permanent surgical procedures.

Solution: Matching the methods with their specific examples:

- **(a) Barrier:** **Vaults** (iii) are rubber domes inserted into the female reproductive tract to cover the cervix.
- **(b) IUD:** **Lippes Loop** (i) is a classic example of a non-medicated Intrauterine Device.
- **(c) Oral Pill:** **Saheli** (ii) is a once-a-week, non-steroidal oral contraceptive pill developed in India.
- **(d) Surgical:** **Tubectomy** (iv) is a permanent sterilization method in females where a small part of the fallopian tube is removed or tied.

Matching these gives: a-iii, b-i, c-ii, d-iv.

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

Answer: (A)

Q12.

Solution

Concept: Assisted Reproductive Technologies (ART) are used to help couples conceive when natural methods are not successful. GIFT is a specific technique used when the female cannot produce an ovum but can provide a suitable environment for fertilization.

Solution:

- **GIFT (Gamete Intra-Fallopian Transfer):** This involves the transfer of an **ovum** collected from a donor into the **fallopian tube** of another female who cannot produce one. Fertilization then occurs *in vivo* (inside the body).
- **ZIFT (Zygote Intra-Fallopian Transfer):** This involves the transfer of a zygote (fertilized outside) into the fallopian tube.
- **ICSI (Intracytoplasmic Sperm Injection):** This involves injecting sperm directly into the ovum.

Final Answer: Transfer of an ovum collected from a donor into the fallopian tube of another female.

Answer: (B)

Q13.

Solution

Concept: Intrauterine Devices (IUDs) are inserted by doctors in the uterus through the vagina. They are categorized into three types based on their components.

Solution:

- **Non-medicated IUDs:** These increase phagocytosis of sperm within the uterus. Example: **Lippes Loop**.
- **Copper-releasing IUDs:** These release Cu ions which suppress sperm motility and fertilizing capacity. Examples: CuT, Cu7, **Multiload 375**.
- **Hormone-releasing IUDs:** These make the uterus unsuitable for implantation and the cervix hostile to sperm. Examples: **Progestasert**, **LNG-20**.

Final Answer: Lippes Loop is a non-medicated IUD.

Answer: (C)

Q14.

Solution

Concept: In a Mendelian dihybrid cross involving two heterozygous parents ($RrYy \times RrYy$), the offspring genotypes follow the probability rules of independent assortment. The probability of the combined genotype is the product of the individual probabilities for each gene.

Solution: Break the cross into two monohybrid crosses:

- **For Gene R ($Rr \times Rr$):** The probability of getting rr is $1/4$.
- **For Gene Y ($Yy \times Yy$):** The probability of getting Yy is $2/4$ (or $1/2$).

To find the probability of $rrYy$, multiply the independent probabilities:

$$\text{Probability} = \frac{1}{4}(rr) \times \frac{2}{4}(Yy) = \frac{2}{16}$$

Final Answer: The probability is $2/16$.

Answer: (B)

Q15.

Solution

Concept: Chromosomal disorders are caused by the absence, excess, or abnormal arrangement of one or more chromosomes. Aneuploidy results from the non-disjunction of chromatids during cell division.

Solution:

- **Klinefelter's Syndrome:** Caused by the presence of an additional copy of the X-chromosome, resulting in a karyotype of **47, XXY**. Affected individuals are masculine but express feminine development (e.g., Gynaecomastia).
- **Turner's Syndrome:** 45, XO.
- **Down's Syndrome:** 47, +21 (Trisomy 21).

Final Answer: The karyotype is 47, XXY.

Answer: (B)

Q16.

Solution

Concept: T.H. Morgan conducted several dihybrid crosses in *Drosophila melanogaster* to study genes that were sex-linked. He discovered that the Law of Independent Assortment does not apply when genes are located on the same chromosome.

Solution: Morgan coined the term **Linkage** to describe the physical association of genes on a chromosome. When two genes in a dihybrid cross are situated on the same chromosome, the proportion of parental gene combinations is much higher than the non-parental (recombinant) type, meaning they do not segregate independently.

Final Answer: This is due to linkage.

Answer: (B)

Q17.

Solution

Concept: While most genes affect a single phenotype, some genes have a multiple phenotypic effect. This phenomenon is known as pleiotropy.
Solution:

- **Phenylketonuria (PKU):** An example of pleiotropy in humans. It is caused by a mutation in the gene that codes for the enzyme phenylalanine hydroxylase. The single gene mutation manifests as multiple phenotypic traits: mental retardation and a reduction in hair and skin pigmentation.
- **Skin color:** Polygenic inheritance.
- **ABO grouping:** Multiple allelism/Codominance.
- **Snapdragon:** Incomplete dominance.

Final Answer: Phenylketonuria is an example of pleiotropy.

Answer: (B)

Q18.

Solution

Concept: Haemophilia is a sex-linked recessive disorder. The gene is located on the X-chromosome. Females need two copies of the defective gene (X^hX^h) to be affected, while males need only one (X^hY).
Solution: Parental genotypes: Hemophilic man (X^hY) $\times$ Carrier woman (X^HX^h). The possible genotypes of the daughters are:

- X^HX^h: Carrier daughter (Normal phenotype)
- X^hX^h: **Hemophilic daughter**

Out of the total daughters, 1 out of 2 (50%) will be hemophilic.
Final Answer: 50% of their daughters will be hemophilic.

Answer: (C)

Q19.

Solution

Concept: Thalassemia is a Mendelian disorder involving the blood. It is a quantitative problem where too few globin molecules are synthesized.

Solution: Thalassemia is an **autosomal recessive blood disorder**. It is transmitted from parents to offspring when both partners are unaffected carriers for the gene (heterozygous). It results in the reduced rate of synthesis of one of the globin chains (α or β) that make up hemoglobin, leading to anemia.

Final Answer: Autosomal recessive blood disorder.

Answer: (C)

Q20.

Solution

Concept: DNA replication requires the double helix to be unwound so that each strand can act as a template. This unwinding involves breaking the hydrogen bonds that hold the complementary nitrogenous bases together.

Solution:

- **Helicase:** Often referred to as the "unzipping enzyme," it moves along the DNA backbone and breaks the hydrogen bonds between Adenine-Thymine and Guanine-Cytosine.
- **DNA Polymerase:** Synthesizes the new DNA strand.
- **Ligase:** Joins Okazaki fragments together.
- **Topoisomerase:** Relieves the tension (supercoiling) ahead of the replication fork.

Final Answer: The enzyme is Helicase.

Answer: (C)

Q21.

Solution

Concept: The Lac Operon is a regulated system in *E. coli* that controls the metabolism of lactose. An "inducer" is a molecule that inactivates the repressor protein to switch the operon "on."
Solution: In the presence of **lactose**, a small amount of it is converted into **allolactose**. Allolactose acts as the **inducer** by binding to the repressor protein. This binding changes the shape of the repressor, preventing it from binding to the operator. This allows RNA polymerase to access the promoter and transcribe the structural genes (z, y, a).
Final Answer: The inducer molecule is Lactose (allolactose).

Answer: (C)

Q22.

Solution

Concept: In eukaryotes, the primary transcript (hnRNA) contains both functional and non-functional sequences. It must undergo post-transcriptional processing to become mature mRNA.
Solution: The primary transcript contains:

- **Exons:** Coding sequences that appear in mature mRNA.
- **Introns:** Intervening non-coding sequences that do not appear in mature mRNA.

Splicing is the process where **introns are removed** and exons are joined together in a defined order.
Final Answer: Splicing involves the removal of Introns.

Answer: (B)

Q23.

Solution

Concept: Chargaff's rule states that in a double-stranded DNA, the ratio between Adenine (A) and Thymine (T) and Guanine (G) and Cytosine (C) are constant and equal ($A = T$ and $G = C$). Therefore, $A + G = T + C = 50\%$.
Solution: Given $A = 20\%$.

(a) According to the rule, $A = T$, so $T = 20\%$.

(b) Combined, $A + T = 20\% + 20\% = 40\%$.

(c) The remaining percentage must be $G + C$: $100\% - 40\% = 60\%$.

(d) Since $G = C$, then $C = 60\%/2 = 30\%$.

Final Answer: The percentage of Cytosine is 30%.

Answer: (B)

Q24.

Solution

Concept: mRNA contains regions that are translated into proteins (from start codon to stop codon), but it also contains sequences that are not translated, known as Untranslated Regions (UTRs).
Solution: UTRs are required for an efficient translation process and are located at two positions:

- At the **5′ end** (upstream of the start codon).
- At the **3′ end** (downstream of the stop codon).

These regions play a role in mRNA stability and translation initiation.
Final Answer: UTRs are present at both A and B.

Answer: (C)

Q25.

Solution

Concept: DNA Fingerprinting involves identifying differences in specific regions of DNA sequence that are very specific to each individual.
Solution: The technique focuses on "Satellite DNA," which are regions of repetitive DNA. A specific category of these repetitions is known as **VNTRs (Variable Number Tandem Repeats)**. Because the number of repeats varies significantly between individuals (except identical twins), they serve as excellent genetic markers for identification.
Final Answer: DNA Fingerprinting relies on VNTRs.

Answer: (B)

Q26.

Solution

Concept: During transcription, the DNA strand with $3' \rightarrow 5'$ polarity acts as the template. The other strand, called the **coding strand** ($5' \rightarrow 3'$), has the same sequence as the mRNA, except that Thymine (T) is replaced by Uracil (U).
Solution: The coding strand sequence is given as: $5' - ATGCATGC - 3'$. Since the mRNA is synthesized complementary to the template strand, its sequence becomes identical to the coding strand (maintaining the $5' \rightarrow 3'$ polarity), with the substitution of T for U. Therefore, mRNA: $5' - AUGCAUGC - 3'$.
Final Answer: The mRNA sequence is $5' - AUGCAUGC - 3'$.

Answer: (A)

Q27.

Solution

Concept: In eukaryotes, DNA is organized into a complex structure to fit inside the nucleus. This packaging involves wrapping negatively charged DNA around positively charged histone octamers.
Solution: The fundamental unit of this packaging is the **nucleosome**. Under an electron microscope, the chromatin appears as a "beads-on-a-string" structure, where the "beads" are the nucleosomes and the "string" is the linker DNA. Each nucleosome contains approximately 200 base pairs of DNA helix.
Final Answer: The beads-on-a-string are nucleosomes.

Answer: (B)

Q28.

Solution

Concept: The Hardy-Weinberg principle uses the equation $p^2 + 2pq + q^2 = 1$, where p is the frequency of the dominant allele and q is the frequency of the recessive allele.
Solution: Given: Frequency of recessive allele $(q) = 0.4$.

(a) Since $p + q = 1$, then $p = 1 - 0.4 = 0.6$.

(b) The frequency of the homozygous dominant genotype is represented by p^2.

(c) $p^2 = (0.6)^2 = 0.36$.

Final Answer: The frequency of the homozygous dominant genotype is 0.36.

Answer: (B)

Q29.

Solution

Concept: Organs can be classified based on whether they share a common ancestry (homology) or a common function despite different origins (analogy).
Solution: The wings of a butterfly (composed of chitinous membrane) and the wings of a bird (composed of bony forelimbs and feathers) have different anatomical structures and embryonic origins but perform the same function (flying). Such organs are called **analogous organs**, and they are a result of **convergent evolution**, where different structures evolve for the same function due to similar environmental pressures.
Final Answer: Analogous organs (Convergent evolution).

Answer: (B)

Q30.

Solution

Concept: Human evolution is characterized by an increase in brain size (cranial capacity) and changes in dietary habits and skeletal structure.

Solution:

- **Homo habilis:** 650–800 cc; probably did not eat meat.
- **Homo erectus:** Appeared about 1.5 million years ago; large brain around **900 cc**; likely ate meat.
- **Neanderthal man:** 1400 cc; lived in central Asia.

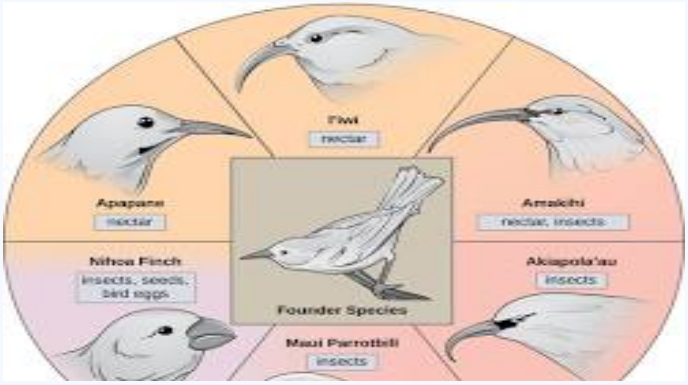
Final Answer: Homo erectus had a 900 cc cranial capacity.

Answer: (B)

Q31.

Solution

Concept: Adaptive radiation is the process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats).



Solution: Darwin observed a variety of finches on the Galapagos Islands. He realized that all varieties evolved from an original seed-eating ancestor. Due to the availability of different food sources in different islands, their beaks altered (becoming insectivorous, cactus-eating, etc.), allowing them to occupy different niches.

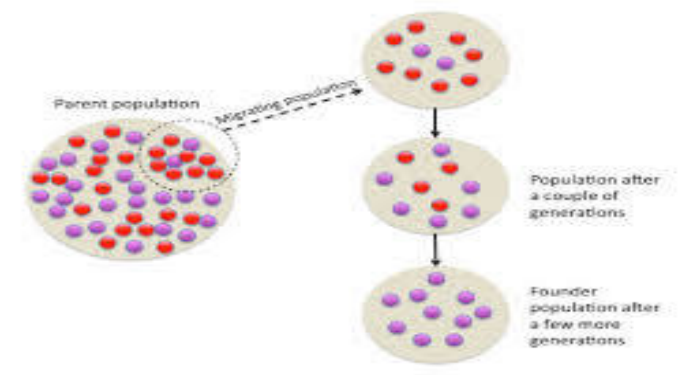
Final Answer: Darwin's finches are an example of adaptive radiation.

Answer: (A)

Q32.

Solution

Concept: Genetic drift refers to random changes in the allele frequencies of a population, which has a more significant impact in small populations.



Solution: The **Founder Effect** occurs when a small group of individuals becomes isolated from a larger population and establishes a new colony. Because this small "founder" group carries only a fraction of the original population's genetic diversity, the new population's gene pool will be different from the source. This is a specific instance of genetic drift.

Final Answer: Founder effect is a type of genetic drift.

Answer: (B)

Q33.

Solution

Concept: This is a dihybrid cross involving one trait in a homozygous condition (TT) and the other in a heterozygous condition (Rr), crossed with a double recessive parent (ttrr).

	TR	Tr	tR	tr
TR	TTRR (tall, red)	TTRr (tall, pink)	TtRR (tall, red)	TtRr (tall, pink)
Tr	TTRr (tall, pink)	TTrr (tall, white)	TtRr (tall, pink)	Ttrr (tall, white)
tR	TtRR (tall, red)	TtRr (tall, pink)	ttRR (dwarf, red)	ttRr (dwarf, pink)
	TtRr	Ttrr	ttRr	ttrr

Solution: Parent 1: **TTRr** (Produces gametes: TR and Tr) Parent 2: **ttrr** (Produces gametes: tr) Perform the cross:

- TR × tr → **Ttrr** (Tall Round)
- Tr × tr → **Ttrr** (Tall Wrinkled)

Since there are only two possible genotypic combinations in equal frequency, the phenotypic ratio is 1:1 for Tall Round and Tall Wrinkled.
Final Answer: 1:1 ratio of Tall Round to Tall Wrinkled.

Answer: (B)

Q34.

Solution

Concept: DNA Fingerprinting requires the fragmentation of genomic DNA into smaller pieces to observe polymorphisms in the length of repetitive sequences.
Solution:

- **Restriction Endonucleases:** Often called "molecular scissors," these enzymes recognize specific palindromic sequences in DNA and cut the phosphodiester backbone.
- **DNA Ligase:** Used to join DNA fragments.
- **Taq Polymerase:** Used in PCR for DNA amplification.
- **Reverse Transcriptase:** Used to synthesize cDNA from RNA.

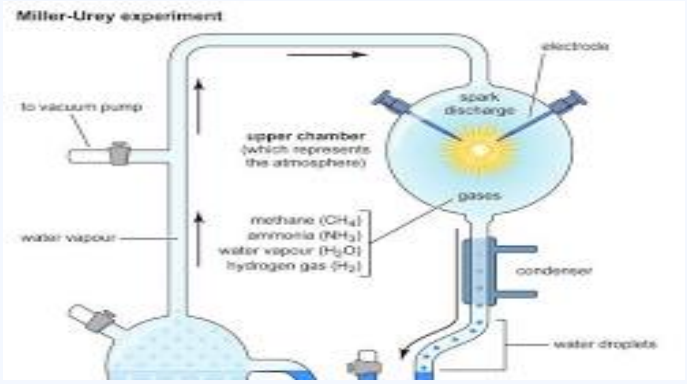
Final Answer: Restriction Endonuclease is used to cut DNA.

Answer: (B)

Q35.

Solution

Concept: The Miller-Urey experiment (1953) provided experimental evidence for the "chemical evolution" theory proposed by Oparin and Haldane.



Solution: Miller created conditions in a closed flask similar to those of the primitive earth: high temperature, electric discharge (simulating lightning), and a reduced atmosphere containing CH_4, NH_3, H_2, and water vapor. After some time, he observed the formation of **amino acids** and other organic compounds. This proved that organic molecules (the building blocks of life) could be synthesized from inorganic precursors.

Final Answer: Organic molecules can be synthesized from inorganic gases.

Answer: (B)

Q36.

Solution

Concept: Different tissues in an angiosperm have different ploidy levels based on their origin. Root cells are somatic ($2n$), while endosperm is formed via triple fusion ($3n$).

Solution: Given: Endosperm ($3n$) = 24.

(a) To find the haploid number (n): $3n = 24 \implies n = 8$.

(b) Root cells are diploid ($2n$).

(c) Therefore, the number of chromosomes in the root cell = $2 \times 8 = 16$.

Final Answer: The number of chromosomes in the root cell is 16.

Answer: (B)

Q37.

Solution

Concept: A human sperm is composed of a head, neck, middle piece, and tail. Each part has a specialized function for fertilization.

Solution: The anterior portion of the sperm head is covered by a cap-like structure called the **acrosome**. The acrosome is filled with hydrolytic enzymes (like hyaluronidase and acrosin) that help the sperm penetrate the zona pellucida and plasma membrane of the ovum during fertilization.

Final Answer: The acrosome contains the enzymes for penetration.

Answer: (C)

Q38.

Solution

Concept: Down's Syndrome is a genetic disorder caused by aneuploidy, specifically the presence of an extra autosome.

Solution: Down's Syndrome is caused by the **Trisomy of the 21st chromosome**. This means the affected individual has three copies of chromosome 21 instead of the usual two, resulting in a total of 47 chromosomes. Symptoms include a flat face, slanted eyes, and mental retardation.

Final Answer: Trisomy of 21st chromosome.

Answer: (B)

Q39.

Solution

Concept: DNA replication and transcription are directional processes. Enzymes read the parent/template strand in one direction to synthesize the new strand in the opposite direction.

Solution: The enzyme RNA polymerase (during transcription) or DNA polymerase (during replication) reads the DNA template in the **$3' \rightarrow 5'$ direction**. This allows the enzyme to synthesize the new complementary strand in the **$5' \rightarrow 3'$ direction**, which is the only direction these enzymes can add nucleotides.

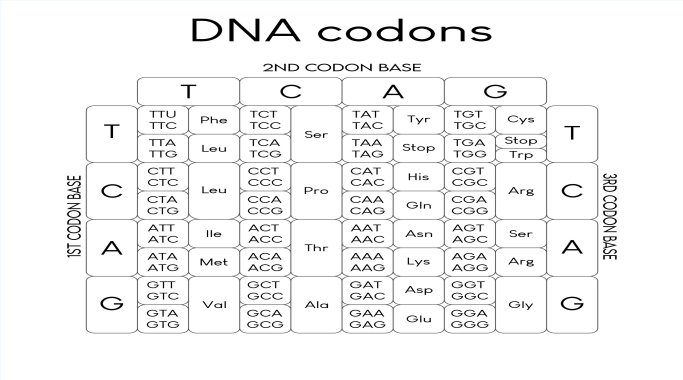
Final Answer: The template strand runs in the $3' \rightarrow 5'$ direction.

Answer: (B)

Q40.

Solution

Concept: The genetic code is a triplet code, meaning three nitrogenous bases form one codon. Since there are 4 types of bases ($4^3 = 64$), there are a total of 64 possible codons.



Solution: Out of the 64 total codons:

- **61 codons** code for amino acids.
- **3 codons** (UAA, UAG, UGA) are "stop codons" or termination codons, which do not code for any amino acid and signal the end of translation.

Although there are 61 codons, they only code for 20 standard amino acids, a phenomenon known as the degeneracy of the genetic code.

Final Answer: 61 codons code for amino acids.

Answer: (B)

Q41.

Solution

Concept: Saheli is a unique oral contraceptive pill developed by the Central Drug Research Institute (CDRI) in Lucknow, India.

Solution: Unlike traditional contraceptive pills that contain high doses of hormones (estrogen/progestogen), **Saheli** is a **non-steroidal** preparation. Its active ingredient is **Centchroman**. It works by blocking estrogen receptors in the uterus, thereby preventing the implantation of the blastocyst. It is a "once-a-week" pill with very few side effects.

Final Answer: Saheli contains Centchroman (Non-steroidal).

Answer: (C)

Q42.

Solution

Concept: Evolutionary theories attempt to explain the mechanism by which species change over time. Different scientists proposed different drivers for these changes.
Solution:

- **Charles Darwin:** Proposed the theory of **Natural Selection**, suggesting that individuals with favorable variations are better adapted to survive and reproduce.
- **Lamarck:** Proposed the theory of Inheritance of Acquired Characters.
- **Hugo de Vries:** Proposed the Mutation Theory.
- **Louis Pasteur:** Demonstrated that life comes only from pre-existing life (Biogenesis).

Final Answer: Natural Selection was given by Charles Darwin.

Answer: (C)

Q43.

Solution

Concept: Sickle cell anemia is an autosomal recessive disorder caused by a substitution mutation (specifically a transversion) in the gene coding for the β-globin chain of hemoglobin.
Solution: The mutation occurs at the **sixth position** of the β-globin chain. The triplet codon GAG (which codes for **Glutamic acid**) is mutated to GUG (which codes for **Valine**). This single amino acid substitution causes the hemoglobin molecule to polymerize under low oxygen tension, changing the shape of the RBC from a biconcave disc to a sickle-like structure.
Final Answer: Glutamic acid is replaced by Valine.

Answer: (A)

Q44.

Solution

Concept: Translation is the process of synthesizing a polypeptide chain from an mRNA template. The formation of a peptide bond between two amino acids is a kinetic process requiring a catalyst.
Solution: In bacteria, the large subunit of the ribosome ($50S$) contains the **23S rRNA**, which acts as an enzyme. This is a classic example of a **Ribozyme** (an RNA molecule with catalytic activity). It facilitates the formation of the peptide bond between the amino acid on the tRNA at the P-site and the amino acid on the tRNA at the A-site.
Final Answer: Peptide bond formation is catalyzed by Ribozyme (23S rRNA).

Answer: (C)

Q45.

Solution

Concept: During pregnancy, the developing embryo requires a specialized interface for the exchange of nutrients, gases, and waste products with the mother's circulatory system.
Solution: The **placenta** is an organic connection formed by the interdigitation of chorionic villi (from the embryo) and uterine tissue (from the mother). It acts as the **structural and functional unit** between the fetus and the maternal body.

- **Placenta:** Facilitates the supply of oxygen and nutrients and the removal of CO_2 and excretory wastes.
- **Umbilical Cord:** Connects the placenta to the embryo to transport these substances.
- **Amnion:** A protective sac filled with fluid that cushions the fetus.

Final Answer: The structural and functional unit is the placenta.

Answer: (B)

Q46.

Solution

Concept: Genetic mapping is used to determine the relative distance between genes based on the frequency of recombination between them.
Solution: The distance between genes on a chromosome is measured in **Centimorgans (cM)**, also known as map units. One centimorgan represents a 1% chance that two markers on a chromosome will be separated from each other due to a recombination event (crossing over) during a single generation. This unit was named in honor of T.H. Morgan.
Final Answer: The distance is measured in Centimorgans.

Answer: (B)

Q47.

Solution

Concept: The primitive atmosphere of Earth was "reducing," meaning it lacked the oxidizing power found in our current atmosphere.
Solution: In the early Earth's atmosphere, there was **no free oxygen (O_2)**. The gases present were methane (CH_4), ammonia (NH_3), water vapor (H_2O), and hydrogen (H_2). Free oxygen only began to accumulate much later after the evolution of photosynthetic organisms (like cyanobacteria), which released oxygen as a byproduct of water splitting.
Final Answer: Free O_2 was not present in the primitive atmosphere.

Answer: (C)

Q48.

Solution

Concept: A large portion of the human genome consists of non-coding, repetitive DNA sequences that separate into distinct bands during density gradient centrifugation.
Solution: Satellite DNA consists of highly repetitive sequences that do not code for any proteins. Its significance lies in the fact that it **shows a high degree of polymorphism** (variation at the genetic level). This polymorphism is inheritable from parents to children and forms the basis of DNA fingerprinting and genetic mapping.
Final Answer: It is important because it shows a high degree of polymorphism.

Answer: (B)

Q49.

Solution

Concept: In-vitro fertilization (IVF) is followed by Embryo Transfer (ET) into the female reproductive tract. The site of transfer depends on the developmental stage of the embryo.
Solution:

- **ZIFT (Zygote Intra-Fallopian Transfer):** The zygote or early embryo (with up to 8 blastomeres) is transferred into the **fallopian tube**.
- **IUT (Intra-Uterine Transfer):** Embryos with more than 8 blastomeres are transferred into the **uterus**.

ZIFT allows the early embryo to travel down the tube naturally for implantation in the uterus.
Final Answer: ZIFT involves the transfer of the zygote into the Fallopian tube.

Answer: (B)

Q50.

Solution

Concept: The ABO blood group system is governed by the I gene, which has three alleles: I^A, I^B, and i. I^A and I^B are codominant, while i is recessive.

Solution:

- **Woman (Blood Group O):** Genotype must be ii.
- **Man (Blood Group AB):** Genotype must be I^AI^B.

The cross ($ii \times I^AI^B$) produces the following offspring genotypes:

- I^Ai: Resulting in **Blood Group A**.
- I^Bi: Resulting in **Blood Group B**.

There is a 0% probability of having children with blood group O or AB.

Final Answer: The possible blood groups are A and B.

Answer: (A)

Answer Key

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