CUET UG Biology Sample Paper - 13

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 7-celled, 8-nucleate embryo sac, which cell is centrally located and contains two polar nuclei?

(A) Synergid

(B) Antipodal

(C) Central cell

(D) Egg cell

Q2. Which of the following represents the correct sequence of events in double fertilization?

(A) Syngamy followed by Triple Fusion

(B) Triple Fusion followed by Syngamy

(C) Both occur simultaneously

(D) Only syngamy occurs in angiosperms

Q3. Cleistogamous flowers are strictly autogamous because:

(A) They remain closed and never open

(B) They lack reproductive organs

(C) They are pollinated by bats

(D) They show high genetic variability

Q4. The filiform apparatus is a characteristic feature of:

(A) Egg cell

(B) Synergids

(C) Antipodals

(D) Central cell

Q5. A pollen grain is shed at the 3-celled stage in approximately what percentage of angiosperms?

(A) 60%

(B) 40%

(C) 80%

(D) 100%

Q6. Identify the correct sequence of spermatogenesis:

(A) Spermatogonia → Spermatids → Secondary spermatocytes → Spermatozoa

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

(C) Spermatids → Spermatogonia → Primary spermatocytes → Spermatozoa

(D) Primary spermatocytes → Spermatogonia → Spermatids → Spermatozoa

Q7. Which hormone is primarily responsible for the "LH surge" that triggers ovulation?

(A) Progesterone
(B) Estrogen
(C) FSH
(D) GnRH

Q8. The layer of the uterus that undergoes cyclical changes during the menstrual cycle is:

(A) Perimetrium
(B) Myometrium
(C) Endometrium
(D) Mesometrium

Q9. Oogenesis is initiated during:

(A) Puberty
(B) Embryonic development stage
(C) Menarche
(D) At the time of fertilization

Q10. The secretion of which of the following is essential for the maturation and motility of sperms?

(A) Epididymis and Vas deferens
(B) Seminal vesicles and Prostate
(C) Both A and B
(D) None of the above

Q11. Match the following contraceptive methods with their functions:

Column A	Method	Column B	Function
(i)	Lippes loop	a.	Sterilization
(ii)	Multiload 375	b.	Non-medicated IUD
(iii)	Saheli	c.	Copper releasing IUD
(iv)	Tubectomy	d.	Once-a-week pill

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

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

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

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

Q12. In ZIFT (Zygote Intra Fallopian Transfer), the embryo is transferred at which stage?

(A) More than 8 blastomeres

(B) Up to 8 blastomeres

(C) 32-cell stage

(D) Only after implantation

Q13. GIFT (Gamete Intra Fallopian Transfer) is recommended for females who:

(A) Cannot produce an ovum

(B) Cannot provide a suitable environment for fertilization

(C) Have blocked fallopian tubes

(D) Are undergoing menopause

Q14. Which of the following is a non-hormonal, once-a-week oral contraceptive pill developed in India?

(A) Mala-D

(B) Saheli

(C) Quinolone

(D) LNG-20

Q15. Hepatitis-B and HIV can be transmitted through:

(A) Shared needles

(B) Infected mother to fetus

(C) Blood transfusion

(D) All of the above

Q16. If a plant with genotype RrYy is self-pollinated, what is the probability of getting a plant with genotype RRYY?

(A) 1/16

(B) 3/16

(C) 9/16

(D) 1/4

Q17. Down's syndrome is caused by the trisomy of which chromosome?

(A) 18th

(B) 21st

(C) 13th

(D) Sex chromosome

Q18. A person with Klinefelter's Syndrome has the sex chromosome complement:

(A) XO

(B) XXY

(C) XYY

(D) XXX

Q19. The frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes was explained by:

(A) T.H. Morgan

(B) Alfred Sturtevant

(C) Gregor Mendel

(D) Henking

Q20. Which of the following is an example of Polygenic Inheritance?

(A) Human skin color

(B) Phenylketonuria

(C) Sickle cell anemia

(D) Flower color in Mirabilis jalapa

Q21. In a dihybrid cross (F_2 generation), the phenotypic ratio 9 : 3 : 3 : 1 represents:

(A) Linkage

(B) Independent Assortment

(C) Segregation

(D) Incomplete dominance

Q22. The enzyme that catalyzes the synthesis of DNA on a DNA template is:

(A) DNA Ligase

(B) DNA-dependent DNA Polymerase

(C) RNA Polymerase

(D) Helicase

Q23. During Transcription, the DNA strand that acts as a template has the polarity:

(A) $5' \rightarrow 3'$

(B) $3' \rightarrow 5'$

(C) Both directions

(D) $3' \rightarrow 3'$

Q24. In the Lac Operon, the 'inducer' molecule is:

(A) Glucose

(B) Lactose (or Allolactose)

(C) Galactose

(D) Permease

Q25. The technique of DNA Fingerprinting involves the use of:

(A) VNTRs (Variable Number of Tandem Repeats)

(B) SNPs

(C) Exons only

(D) Introns only

Q26. Which of the following codons acts as an initiation codon and also codes for Methionine?

(A) UAA

(B) AUG

(C) UGA

(D) UAG

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

(A) Exons

(B) Introns

(C) Promoters

(D) Terminators

Q28. Chargaff's rule states that in a double-stranded DNA:

(A) $A + T = G + C$

(B) $A + G = T + C$

(C) $A/G = T/C$

(D) Ratio of A to T and G to C is constant and equals one

Q29. Which enzyme is known as "Molecular Glue"?

(A) Restriction Endonuclease

(B) DNA Ligase

(C) DNA Polymerase

(D) Topoisomerase

Q30. According to Hardy-Weinberg Principle, if p and q are allele frequencies, then $p^2 + 2pq + q^2 = ?$

(A) 0

(B) 1

(C) 0.5

(D) Variable

Q31. Adaptive Radiation refers to:

(A) Evolution of different species from a common ancestor in a given area

(B) Migration of species to different planets

(C) Power of adaptation to radiation

(D) Formation of new species due to mutation only

Q32. The first hominid-like being was:

(A) Homo erectus

(B) Homo habilis

(C) Neanderthal man

(D) Australopithecus

Q33. Industrial Melanism (in moths) is an example of:

(A) Natural Selection

(B) Genetic Drift

(C) Mutation

(D) Artificial Selection

Q34. The cranial capacity of Neanderthal man was approximately:

(A) 650cc

(B) 900cc

(C) 1400cc

(D) 1600cc

Q35. The Hardy-Weinberg equilibrium is affected by which of the following factors?

(A) Gene flow

(B) Genetic drift

(C) Mutation

(D) All of the above

Q36. In an angiosperm, if the haploid number of chromosomes is 12, what will be the chromosome number in the Endosperm?

(A) 12

(B) 24

(C) 36

(D) 48

Q37. The primary endosperm nucleus (PEN) is formed by the fusion of:

(A) One male gamete + Egg

(B) One male gamete + Two polar nuclei

(C) Two male gametes + One polar nucleus

(D) Synergid + Antipodal

Q38. Which part of the sperm contains enzymes that help in the penetration of the ovum?

(A) Nucleus

(B) Acrosome

(C) Middle piece

(D) Tail

Q39. Colostrum, the first milk produced by mothers, is rich in which antibody?

(A) IgG

(B) IgA

(C) IgM

(D) IgE

Q40. MTP (Medical Termination of Pregnancy) is considered relatively safe up to how many weeks of pregnancy?

(A) 12 weeks

(B) 20 weeks

(C) 24 weeks

(D) 8 weeks

Q41. In a DNA molecule, the distance between two consecutive base pairs is:

(A) 3.4 nm

(B) 0.34 nm

(C) 34 nm

(D) 2 nm

Q42. Identify the 'Stop' codons from the following:

(A) AUG, GUG, UUU

(B) UAA, UAG, UGA

(C) AAA, GGG, CCC

(D) UUU, UUC, UUA

Q43. The "Beads on a string" structure in chromatin are:

(A) Nucleosomes

(B) Genes

(C) Nucleotides

(D) Histones

Q44. Which theory was proposed by Hugo de Vries based on his work on evening primrose?

(A) Theory of Natural Selection

(B) Mutation Theory

(C) Theory of Inheritance of Acquired Characters

(D) Biogenetic Law

Q45. Which of the following is a vestigial organ in humans?

(A) Wisdom tooth

(B) Nictitating membrane

(C) Vermiform appendix

(D) All of the above

Q46. What is the result of 'Founder Effect'?

(A) Increase in genetic variation

(B) Genetic Drift

(C) Speciation in a small population

(D) Both B and C

Q47. The RNA polymerase II in eukaryotes transcribes:

(A) rRNA

(B) tRNA

(C) hnRNA (precursor of mRNA)

(D) snRNA

Q48. In sickle cell anemia, Glutamic acid is replaced by Valine at the 6th position of the beta-globin chain. This is an example of:

(A) Frame shift mutation

(B) Point mutation

(C) Deletion

(D) Duplication

Q49. Turners syndrome is characterized by:

(A) Sterile females

(B) Rudimentary ovaries

(C) Lack of secondary sexual characters

(D) All of the above

Q50. The semi-conservative nature of DNA replication was first shown in:

(A) Vicia faba

(B) Escherichia coli

(C) Drosophila melanogaster

(D) Streptococcus pneumoniae

Detailed Solutions

Q1.

Solution

Concept: In most flowering plants, the female gametophyte (embryo sac) develops from a single functional megaspore. At maturity, the embryo sac is characterized as a 7-celled, 8-nucleate structure, organized specifically to facilitate double fertilization.

Solution: The embryo sac consists of an egg apparatus at the micropylar end (one egg cell and two synergids), three antipodal cells at the chalazal end, and one large **Central Cell**. While the other six cells are uninucleate, the large central cell is located in the middle and contains the **two polar nuclei**, which eventually fuse with a male gamete to form the triploid endosperm.

Final Answer: Central cell

Answer: (C)

Q2.

Solution

Concept: Double fertilization is a unique and complex reproductive process found only in angiosperms. It involves the fusion of two male gametes with two different components of the embryo sac to ensure the simultaneous development of the embryo and its food supply.

Solution: When the pollen tube enters the embryo sac, it releases two male gametes. One male gamete (n) fuses with the egg cell (n) to form a diploid zygote ($2n$); this is called **Syngamy**. Almost simultaneously, the second male gamete (n) fuses with the two polar nuclei ($n + n$) in the central cell to form the triploid Primary Endosperm Nucleus ($3n$); this is called **Triple Fusion**. In biological sequences, Syngamy is typically listed as the primary event followed by Triple Fusion.

Final Answer: Syngamy followed by Triple Fusion

Answer: (A)

Q3.

Solution

Concept: Pollination is the transfer of pollen grains from the anther to the stigma. Some plants have evolved specific floral adaptations, like cleistogamy, to ensure seed setting even in the absence of pollinators.

Solution: **Cleistogamous flowers** are floral buds that **remain closed and never open**. Since the flower never opens, the stigma is only exposed to pollen from the anthers of the same flower. This physical barrier ensures that the flower is strictly autogamous (self-pollinating), providing an advantage in environments where pollinators are scarce, though it limits genetic diversity.

Final Answer: They remain closed and never open

Answer: (A)

Q4.

Solution

Concept: The egg apparatus, located at the micropylar end of the embryo sac, consists of two synergids and one egg cell. These cells work together to facilitate the entry and reception of the pollen tube.

Solution: The **Synergids** feature special cellular thickenings at the micropylar tip known as the **filiform apparatus**. This structure plays a critical role in guiding the pollen tube into the embryo sac by secreting chemotropic substances, ensuring that the male gametes are delivered precisely for fertilization.

Final Answer: Synergids

Answer: (B)

Q5.

Solution

Concept: The development of the male gametophyte occurs within the pollen grain. The stage at which the pollen is shed (released from the anther) varies among different species of angiosperms.

Solution: In over 60% of angiosperms, pollen grains are shed at the 2-celled stage (consisting of a vegetative cell and a generative cell). In the remaining **40%** of flowering plants, the generative cell divides mitotically to form two male gametes before the pollen is released, resulting in the **3-celled stage**.

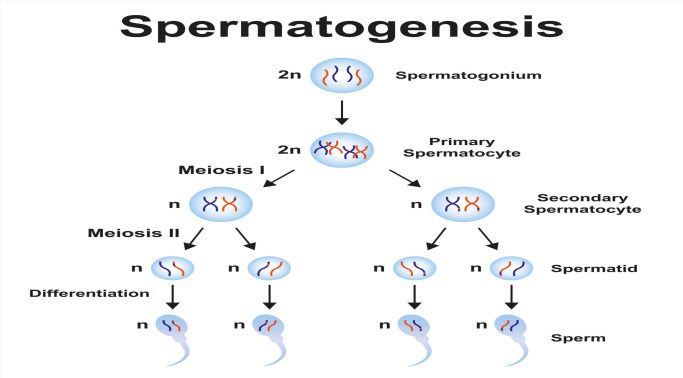
Final Answer: 40%

Answer: (B)

Q6.

Solution

Concept: Spermatogenesis is the process by which haploid spermatozoa develop from germ cells in the seminiferous tubules of the testis. It involves successive mitotic and meiotic divisions followed by a morphological transformation.



Solution: The process begins with diploid **Spermatogonia**, which multiply by mitosis. Some of these grow into **Primary spermatocytes** ($2n$). These undergo the first meiotic division to produce two equal haploid **Secondary spermatocytes** (n). These then undergo the second meiotic division to produce four haploid **Spermatids**. Finally, spermatids are transformed into **Spermatozoa** (sperm) through the process of spermiogenesis.

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

Answer: (B)

Q7.

Solution

Concept: The menstrual cycle is regulated by a complex feedback loop involving the hypothalamus, pituitary gland, and ovaries. A sudden spike in Luteinizing Hormone (LH) is the critical trigger for the release of the egg.

Solution: As the Graafian follicle matures, it secretes high levels of **Estrogen**. While low levels of estrogen normally inhibit LH, very high levels (at the peak of the follicular phase) exert a positive feedback effect on the pituitary gland. This results in a rapid, massive secretion of LH, known as the **LH surge**, which induces the rupture of the follicle and subsequent ovulation.

Final Answer: Estrogen

Answer: (B)

Q8.

Solution

Concept: The human uterus is composed of three tissue layers: the outer thin perimetrium, the middle muscular myometrium, and the inner glandular endometrium.

Solution: The **Endometrium** is the innermost layer that lines the uterine cavity. It is highly vascular and glandular. In response to fluctuating levels of ovarian hormones (estrogen and progesterone), this layer undergoes regular **cyclical changes**—thickening to prepare for potential implantation and breaking down (menstruation) if fertilization does not occur.

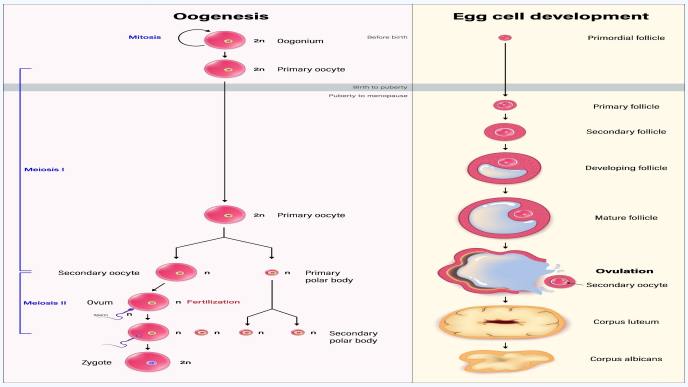
Final Answer: Endometrium

Answer: (C)

Q9.

Solution

Concept: Oogenesis is the process of formation of a mature female gamete. Unlike spermatogenesis, which starts at puberty, the timing of oogenesis is unique as it begins well before birth.



Solution: **Oogenesis** is initiated during the **embryonic development stage** when a couple of million gamete mother cells (oogonia) are formed within each fetal ovary. No more oogonia are formed or added after birth. These cells start division and enter prophase-I of meiotic division and get temporarily arrested at that stage, called primary oocytes.

Final Answer: Embryonic development stage

Answer: (B)

Q10.

Solution

Concept: The male reproductive system includes accessory ducts and glands that provide the necessary environment, nutrients, and biochemical signals for sperm functionality.

Solution: The transport and functional development of sperms require secretions from multiple sources. The **epididymis and vas deferens** (accessory ducts) are involved in the storage and physiological maturation of sperms, while the **seminal vesicles and prostate gland** (accessory glands) provide the bulk of the seminal plasma. Both are essential for providing the enzymes and medium required for **maturation and motility**.

Final Answer: Both A and B

Answer: (C)

Q11.

Solution

Concept: Contraceptive methods are categorized based on their mechanism—ranging from chemical barriers and hormonal regulation to permanent surgical intervention.

Solution: Matching the methods to their specific functions:

- **(i) Lippes loop:** A classic example of a **Non-medicated IUD** (b).
- **(ii) Multiload 375:** An IUD that functions by **releasing Copper ions** (c) to suppress sperm motility.
- **(iii) Saheli:** An oral contraceptive developed in India that is a **Once-a-week pill** (d).
- **(iv) Tubectomy:** A surgical procedure for female **Sterilization** (a) involving the blocking of fallopian tubes.

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

Answer: (A)

Q12.

Solution

Concept: Assisted Reproductive Technology (ART) includes various techniques used to help individuals or couples conceive. ZIFT is a specific type of embryo transfer where the fertilization happens *in vitro* (outside the body).

Solution: In **ZIFT (Zygote Intra Fallopian Transfer)**, the zygote or early embryo is transferred into the fallopian tube. This transfer must occur when the embryo is still in its very early stages, specifically **up to 8 blastomeres**. If the embryo develops beyond the 8-cell stage (into a morula or blastocyst), it is typically transferred directly into the uterus, a process known as IUT (Intra Uterine Transfer).

Final Answer: Up to 8 blastomeres

Answer: (B)

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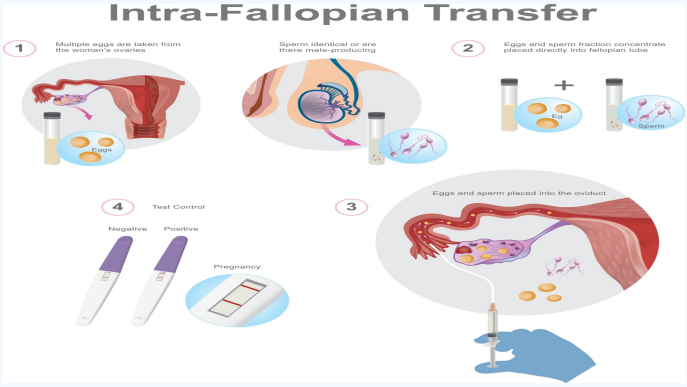
Q13.

Solution

Concept: GIFT is an ART procedure used when the biological hurdles to conception are related to ovulation rather than the environment of the reproductive tract.



Solution: **GIFT (Gamete Intra Fallopian Transfer)** involves collecting an ovum from a donor (or the patient) and transferring it along with sperm into the fallopian tube. It is specifically recommended for females who **cannot produce an ovum** but can still provide a suitable environment for fertilization and the subsequent development of the embryo within their own body.

Final Answer: Cannot produce an ovum

Answer: (A)

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Q14.

Solution

Concept: Contraceptive research in India has led to the development of unique formulations that minimize side effects associated with steroid-based hormonal pills.

Solution: **Saheli** is a world-first **non-hormonal**, non-steroidal oral contraceptive pill developed by the Central Drug Research Institute (CDRI) in Lucknow, India. Unlike daily steroidal pills, it is taken **once a week** and has very few side effects while maintaining high contraceptive value.

Final Answer: Saheli

Answer: (B)

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Q15.

Solution

Concept: Sexually Transmitted Infections (STIs) and certain viral infections can be spread through routes other than direct sexual contact, primarily involving the exchange of infected body fluids.

Solution: Both **Hepatitis-B and HIV** are highly infectious viruses found in blood and other body fluids. They can be transmitted through:

- **Shared needles:** Common among intravenous drug users or through accidental needle sticks.
- **Blood transfusion:** If the donated blood is not properly screened.
- **Infected mother to fetus:** Also known as vertical transmission, occurring during pregnancy, childbirth, or breastfeeding.

Final Answer: All of the above

Answer: (D)

Q16.

Solution

Concept: In a dihybrid cross involving two heterozygous parents ($RrYy \times RrYy$), the alleles for each gene segregate and assort independently during gamete formation. The resulting offspring distribution can be calculated using a Punnett square.

Solution: A parent with genotype $RrYy$ produces four types of gametes: RY, Ry, rY, and ry, each with a frequency of $1/4$. To get a plant with genotype **$RRYY$**, an RY gamete from the male must fuse with an RY gamete from the female. Calculation: $1/4(RY) \times 1/4(RY) = 1/16$. In a standard 16-square Punnett square, the $RRYY$ genotype occupies exactly one box.

Final Answer: 1/16

Answer: (A)

Q17.

Solution

Concept: Aneuploidy is a chromosomal aberration where an individual has an abnormal number of chromosomes. Trisomy refers to the presence of an extra copy of a specific chromosome.

Solution: **Down's syndrome** is a genetic disorder caused by the presence of an additional copy of chromosome number **21**. Instead of the usual pair, the individual has three copies of this autosome, resulting in a total of 47 chromosomes ($45A + XX$ or $45A + XY$). This is usually the result of non-disjunction during gamete formation.

Final Answer: 21st

Answer: (B)

Q18.

Solution

Concept: Sex chromosomal abnormalities occur due to the gain or loss of sex chromosomes (X or Y). These conditions often result in distinctive physical characteristics and sterility.

Solution: **Klinefelter's syndrome** is caused by the presence of an additional X chromosome in a male, resulting in a sex chromosome complement of **XXY**. These individuals have a total of 47 chromosomes. Physically, they are males with some feminine development (such as gynaecomastia) and are typically sterile.

Final Answer: XXY

Answer: (B)

Q19.

Solution

Concept: Genetic mapping is based on the principle that genes located further apart on a chromosome are more likely to undergo crossover and recombination than genes located close together.

Solution: While T.H. Morgan discovered linkage and recombination, it was his student **Alfred Sturtevant** who realized that the **frequency of recombination** could be used as a measure of the relative distance between genes. He used this data to construct the first "genetic maps," where 1% recombination frequency equals 1 centimorgan (cM).

Final Answer: Alfred Sturtevant

Answer: (B)

Q20.

Solution

Concept: Polygenic inheritance occurs when one characteristic is controlled by two or more genes. Often the genes are large in quantity but small in individual effect, leading to a continuous variation of the trait.

Solution: **Human skin color** is a classic example of polygenic inheritance. It is controlled by multiple genes (typically three: A, B, and C) that have an additive effect. The phenotype depends on the total number of dominant alleles, leading to a wide spectrum of shades rather than just two distinct colors. *Note: Phenylketonuria and Sickle cell anemia are examples of pleiotropy, and Mirabilis jalapa shows incomplete dominance.*

Final Answer: Human skin color

Answer: (A)

Q21.

Solution

Concept: Mendel's Law of Independent Assortment states that during gamete formation, the segregation of one pair of unit factors is independent of the segregation of another pair.

Solution: The phenotypic ratio of **9 : 3 : 3 : 1** in the F_2 generation of a dihybrid cross is the hallmark of **Independent Assortment**. It indicates that the traits (e.g., seed shape and seed color) are inherited independently, producing parental combinations as well as new "recombinant" combinations in predictable proportions.

Final Answer: Independent Assortment

Answer: (B)

Q22.

Solution

Concept: DNA replication is a highly accurate process that requires a template and a specific set of enzymes to ensure that the genetic information is copied correctly from one generation to the next.

Solution: The primary enzyme responsible for adding nucleotides to a growing DNA strand is **DNA-dependent DNA Polymerase**. It "reads" the existing DNA template and synthesizes a complementary strand. While Helicase unwinds the DNA and DNA Ligase seals fragments, the actual synthesis is performed by the polymerase.

Final Answer: DNA-dependent DNA Polymerase

Answer: (B)

Q23.

Solution

Concept: Transcription is the process where a segment of DNA is copied into RNA. Because RNA Polymerase can only add nucleotides in a $5' \rightarrow 3'$ direction, the physical orientation of the DNA strands determines which one can be "read."

Solution: The RNA strand is synthesized in the $5' \rightarrow 3'$ direction. To achieve this through complementary base pairing, the enzyme must read the DNA template in the opposite direction. Therefore, the **template strand** must have **$3' \rightarrow 5'$** polarity. The other strand ($5' \rightarrow 3'$) is called the coding strand.

Final Answer: $3' \rightarrow 5'$

Answer: (B)

Q24.

Solution

Concept: The Lac Operon is a classic model of gene regulation in bacteria. It is an inducible system, meaning it is usually "off" and is only turned "on" when a specific substrate is present in the environment.

Solution: In the Lac Operon, **Lactose (specifically its isomer Allolactose)** acts as the **inducer**. It binds to the repressor protein, causing a conformational change that prevents the repressor from binding to the operator. This "unlocks" the genes so that the cell can produce enzymes to digest lactose.

Final Answer: Lactose (or Allolactose)

Answer: (B)

Q25.

Solution

Concept: DNA Fingerprinting relies on the fact that while 99.9% of human DNA is identical, there are specific non-coding regions that show high levels of polymorphism (variation) between individuals.

Solution: The technique developed by Alec Jeffreys uses **VNTRs (Variable Number of Tandem Repeats)**. These are short sequences of DNA that are repeated multiple times. The number of repeats varies significantly between individuals (except identical twins), making them ideal markers for forensic identification and paternity testing.

Final Answer: VNTRs (Variable Number of Tandem Repeats)

Answer: (A)

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 includes specific start and stop signals to ensure the protein is built correctly.

Solution: The codon **AUG** has a dual function in protein synthesis. It serves as the **initiation (start) codon**, signaling the ribosome to begin translation at that specific point on the mRNA. Additionally, it codes for the amino acid **Methionine**. In contrast, UAA, UAG, and UGA are "stop" or "nonsense" codons that signal the termination of translation.

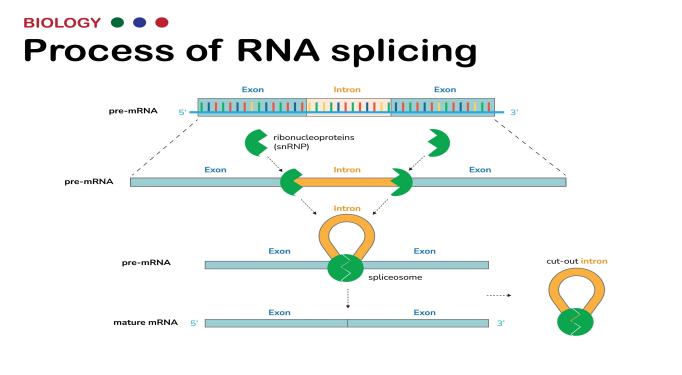
Final Answer: AUG

Answer: (B)

Q27.

Solution

Concept: In eukaryotes, the primary transcript (hnRNA) contains both coding and non-coding sequences. To become functional mRNA, it must undergo post-transcriptional processing.



Solution: The process of **splicing** involves the removal of non-coding sequences called **Introns** and the joining of coding sequences called **Exons** in a defined order. This ensures that the final mature mRNA contains only the necessary information to synthesize a protein.

Final Answer: Introns

Answer: (B)

Q28.

Solution

Concept: Erwin Chargaff's rules describe the base composition of DNA. These findings were instrumental in helping Watson and Crick determine the double-helix structure.

Solution: Chargaff's rule states that in a double-stranded DNA molecule, the amount of Adenine (A) is always equal to Thymine (T), and the amount of Guanine (G) is always equal to Cytosine (C). Mathematically, this implies that the sum of purines (A+G) is equal to the sum of pyrimidines (T+C), which can be represented as $**A + G = T + C**$.

Final Answer: $A + G = T + C$

Answer: (B)

Q29.

Solution

Concept: Biotechnology and genetic engineering utilize specific enzymes to manipulate DNA. These are often referred to as "molecular tools."

Solution: **DNA Ligase** is known as **"Molecular Glue"** because it catalyzes the formation of phosphodiester bonds between two DNA fragments, effectively "gluing" or joining them together. Conversely, Restriction Endonucleases are called "Molecular Scissors" because they cut DNA at specific sequences.

Final Answer: DNA Ligase

Answer: (B)

Q30.

Solution

Concept: The Hardy-Weinberg Principle provides a mathematical model to study evolutionary changes in a population. It states that allele frequencies remain constant from generation to generation in the absence of evolutionary influences.

Solution: If p represents the frequency of the dominant allele and q represents the frequency of the recessive allele, the sum of allele frequencies is $p + q = 1$. The distribution of genotypes in the population is given by the binomial expansion $(p + q)^2$, which is $**p^2 + 2pq + q^2 = 1**$. Here, p^2 is the frequency of homozygous dominant individuals, $2pq$ is the frequency of heterozygotes, and q^2 is the frequency of homozygous recessive individuals.

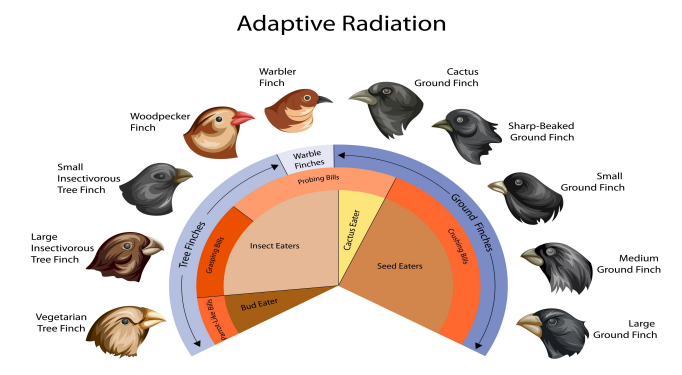
Final Answer: 1

Answer: (B)

Q31.

Solution

Concept: Evolution often occurs when a single ancestral species spreads into different habitats and adapts to diverse environmental niches.



Solution: **Adaptive Radiation** is the process of evolution of different species from a **common ancestor** in a given geographical area. A classic example is Darwin's finches in the Galápagos Islands, where a single ancestral finch species evolved into various forms with different beak shapes suited for specific food sources.

Final Answer: Evolution of different species from a common ancestor in a given geographical area

Answer: (A)

Q32.

Solution

Concept: Human evolution is characterized by a transition from ape-like ancestors to modern humans, involving significant changes in brain size, posture, and tool usage.

Solution: The first "hominid-like" (human-like) being was **Homo habilis**. They lived about 2 million years ago, had a cranial capacity between 650–800cc, and were likely the first to use stone tools. While *Australopithecus* preceded them, *Homo habilis* is recognized as the first member of the genus *Homo*.

Final Answer: Homo habilis

Answer: (B)

Q33.

Solution

Concept: Natural selection acts on existing variations within a population, favoring traits that provide a survival advantage in a changing environment.

Solution: **Industrial Melanism** in the peppered moth (*Biston betularia*) is a classic example of **Natural Selection**. Before industrialization, light-colored moths were favored due to lichen-covered trees. As soot darkened the trees during the industrial revolution, dark-colored (melanic) moths had a better survival rate due to camouflage, demonstrating how the environment selects for the most "fit" phenotype.

Final Answer: Natural Selection

Answer: (A)

Q34.

Solution

Concept: Cranial capacity is a measure of the volume of the interior of the skull, which serves as a rough indicator of brain size during human evolution.

Solution: The **Neanderthal man** (*Homo neanderthalensis*), who lived in Europe and central Asia roughly 100,000 to 40,000 years ago, had a large brain with a cranial capacity of approximately **1400cc**. This is comparable to, and in some cases larger than, the average cranial capacity of modern *Homo sapiens*.

Final Answer: 1400cc

Answer: (C)

Q35.

Solution

Concept: The Hardy-Weinberg equilibrium describes a theoretical state where a population's genetic variation remains constant in the absence of evolutionary forces. Any factor that changes the frequency of alleles in a gene pool disrupts this equilibrium.

Solution: Five major factors are known to affect Hardy-Weinberg equilibrium:

- **Gene flow (Migration):** Movement of alleles into or out of a population.
- **Genetic drift:** Random changes in allele frequencies, especially in small populations.
- **Mutation:** Introduction of new alleles into the gene pool.
- **Genetic recombination:** Shuffling of genes during meiosis.
- **Natural selection:** Differential survival and reproduction of genotypes.

Since all the listed options represent these forces, the answer is all of the above.

Final Answer: All of the above

Answer: (D)

Q36.

Solution

Concept: The ploidy (number of sets of chromosomes) varies in different parts of a plant. In angiosperms, the endosperm is a unique tissue formed through a process called triple fusion.

Solution: The haploid number (n) is given as 12. In angiosperms, the endosperm is formed by the fusion of one male gamete (n) with two polar nuclei ($n + n$) in the central cell. This results in a triploid ($3n$) tissue. Calculation: $3 \times n = 3 \times 12 = 36$.

Final Answer: 36

Answer: (C)

Q37.

Solution

Concept: Double fertilization involves two distinct fusion events. One produces the embryo, while the other produces the Primary Endosperm Nucleus (PEN), which later develops into the endosperm.

Solution: During the process of double fertilization, one male gamete moves toward the two polar nuclei located in the central cell and fuses with them to produce a triploid **Primary Endosperm Nucleus (PEN)**. Because this involves the fusion of three haploid nuclei, the process is specifically termed **triple fusion**.

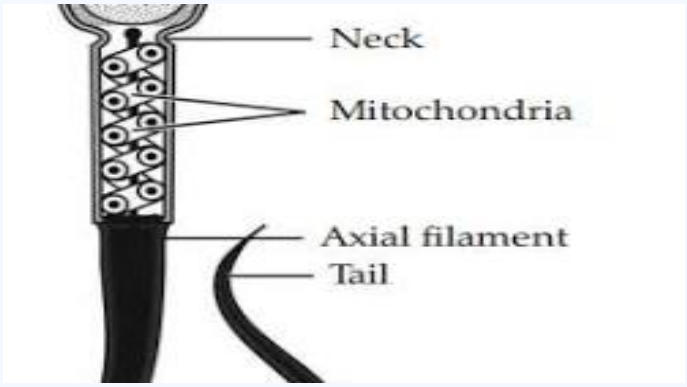
Final Answer: One male gamete + Two polar nuclei

Answer: (B)

Q38.

Solution

Concept: A mature human sperm consists of a head, neck, middle piece, and a tail. Each part is highly specialized for the task of reaching and fertilizing the ovum.



Solution: The head of the sperm contains an elongated haploid nucleus. Its anterior portion is covered by a cap-like structure called the **acrosome**. The acrosome is filled with specialized enzymes (such as hyaluronidase) that are released upon contact with the egg to dissolve the protective layers (zona pellucida) of the ovum, allowing the sperm to penetrate and fertilize it.

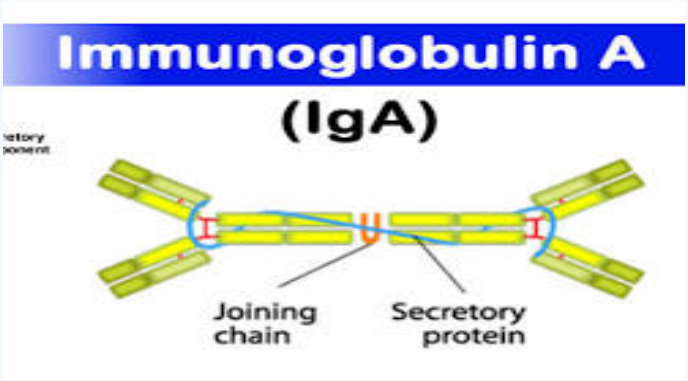
Final Answer: Acrosome

Answer: (B)

Q39.

Solution

Concept: Colostrum is the yellowish fluid secreted by the mother during the initial few days of lactation. It provides essential passive immunity to the newborn, whose immune system is not yet fully developed.



Solution: **Colostrum** contains several antibodies and nutrients, but it is specifically rich in **IgA** (Immunoglobulin A). These antibodies are crucial for protecting the infant's infant gastrointestinal tract and respiratory tract against pathogens.

Final Answer: IgA

Answer: (B)

Q40.

Solution

Concept: Medical Termination of Pregnancy (MTP) is the intentional or voluntary termination of pregnancy before full term. Its safety for the mother decreases significantly as the foetus develops.

Solution: MTP is considered relatively safe only during the first trimester, which is up to **12 weeks** of pregnancy. Beyond the first trimester (the second trimester), the procedure becomes much more complex and carries a significantly higher risk to the mother's health.

Final Answer: 12 weeks

Answer: (A)

Q41.

Solution

Concept: According to the Watson-Crick model, DNA is a double helix with specific dimensions. The structure is uniform due to the precise spacing of the sugar-phosphate backbone and nitrogenous bases.

Solution: The pitch of the DNA helix is 3.4 nm, and there are roughly 10 base pairs in each turn. Therefore, the distance between two consecutive base pairs is calculated by dividing the pitch by the number of base pairs per turn: 3.4 nm/10 = **0.34** nm.

Final Answer: 0.34 nm

Answer: (B)

Q42.

Solution

Concept: The genetic code consists of 64 codons. While 61 codons code for amino acids, 3 codons do not code for any amino acids and serve as "punctuation" to end the translation process.

Solution: The codons **UAA** (ochre), **UAG** (amber), and **UGA** (opal) are known as **Stop codons** or nonsense codons. They signal the ribosome to terminate protein synthesis and release the newly formed polypeptide chain.

Final Answer: UAA, UAG, UGA

Answer: (B)

Q43.

Solution

Concept: In eukaryotes, DNA is highly organized to fit into the small nucleus. This packaging involves wrapping negatively charged DNA around positively charged histone proteins.

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.

Final Answer: Nucleosomes

Answer: (A)

Q44.

Solution

Concept: Evolutionary theories attempt to explain the mechanisms of biological change over time. While Darwin emphasized gradual variations, Hugo de Vries focused on sudden, large changes.
Solution: Based on his experiments with the evening primrose (*Oenothera lamarckiana*), Hugo de Vries proposed the **Mutation Theory**. He believed that evolution is a jerky process where new species emerge in a single step due to large, sudden changes called mutations (or saltation), rather than the minor continuous variations described by Darwin.
Final Answer: Mutation Theory

Answer: (B)

Q45.

Solution

Concept: Vestigial organs are anatomical structures that have lost most or all of their original function through the course of evolution but remain present in the body.
Solution: Humans possess several vestigial structures:

- **Wisdom tooth:** Third molars that were useful for a diet of tougher vegetation in ancestors.
- **Nictitating membrane:** A vestigial "third eyelid" (seen as the plica semilunaris in the corner of the eye).
- **Vermiform appendix:** Once involved in digesting cellulose in herbivorous ancestors.

Since all three are examples, the correct choice is "All of the above."
Final Answer: All of the above

Answer: (D)

Q46.

Solution

Concept: The Founder Effect is a specific phenomenon related to genetic changes in small, isolated populations.
Solution: The **Founder Effect** occurs when a small group of individuals migrates away from a larger population to establish a new colony. This group carries only a fraction of the original genetic diversity. This is a form of **Genetic Drift** and often leads to the formation of a new species (**Speciation**) as the new population's gene pool evolves differently from the original.
Final Answer: Both B and C

Answer: (D)

Q47.

Solution

Concept: In eukaryotes, there is a clear division of labor among RNA polymerases, with each enzyme responsible for transcribing different types of RNA.
Solution: There are three main types of RNA polymerases in the nucleus:

- RNA polymerase I transcribes rRNAs (28*S*, 18*S*, and 5.8*S*).
- **RNA polymerase II** transcribes the precursor of mRNA, known as **hnRNA** (heterogeneous nuclear RNA).
- RNA polymerase III transcribes tRNA, 5*S* rRNA, and snRNAs.

Final Answer: hnRNA (precursor of mRNA)

Answer: (C)

Q48.

Solution

Concept: Mutations can occur at different scales, from the alteration of a single nucleotide to the duplication of entire chromosome segments.
Solution: Sickle cell anemia is caused by the substitution of a single nitrogenous base in the DNA (GAG to GUG), which leads to the replacement of Glutamic acid by Valine at the 6th position of the beta-globin chain. Because the change occurs in only a single base pair of DNA, it is a classic example of a **Point mutation**.
Final Answer: Point mutation

Answer: (B)

Q49.

Solution

Concept: Turner's syndrome is a chromosomal disorder caused by the absence of one of the X chromosomes, resulting in a 45, XO karyotype.
Solution: Individuals with **Turner's syndrome** are phenotypically female but exhibit several abnormalities:

- They are **sterile** due to **rudimentary ovaries**.
- They exhibit a **lack of other secondary sexual characters** (like breast development).
- They often have short stature and webbed necks.

Final Answer: All of the above

Answer: (D)

Q50.

Solution

Concept: The semi-conservative model of DNA replication suggests that each strand of the original DNA molecule acts as a template for a new strand.

Solution: The experimental proof for the semi-conservative nature of DNA replication was first provided by Matthew Meselson and Franklin Stahl in 1958 using the bacterium **Escherichia coli** and heavy nitrogen isotopes (^{15}N). Later, similar experiments by Taylor and colleagues using radioactive thymidine on *Vicia faba* also confirmed the finding in eukaryotes.

Final Answer: Escherichia coli

Answer: (B)

Answer Key

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