CUET UG Biology Sample Paper - 19

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 an angiosperm, if the megaspore mother cell has 24 chromosomes, the number of chromosomes in the synergid and the antipodal cells respectively will be:

(A) 12, 12

(B) 24, 24

(C) 12, 24

(D) 24, 12

Q2. The "Polygonum type" of embryo sac is:

(A) 7-celled, 7-nucleate

(B) 8-celled, 8-nucleate

(C) 7-celled, 8-nucleate

(D) 8-celled, 7-nucleate

Q3. During double fertilization, if the first male gamete fuses with the egg, and the second male gamete fuses with the secondary nucleus, the resulting structures are:

(A) Zygote and Nucellus

(B) Zygote and PEN

(C) Synergid and PEN

(D) Endosperm and Embryo

Q4. Which of the following prevents both autogamy and geitonogamy?

(A) Monoecious condition (e.g., Castor)

(B) Dioecious condition (e.g., Papaya)

(C) Cleistogamy (e.g., Commelina)

(D) Dichogamy in bisexual flowers

Q5. The ploidy level of the cells of the nucellus, MMC, functional megaspore, and female gametophyte are respectively:

(A) 2n, 2n, n, n

(B) n, 2n, n, 2n

(C) 2n, n, 2n, n

(D) n, n, n, n

Q6. The correct sequence of spermatogenesis in human males is:

(A) Spermatogonia → Secondary Spermatocytes → Primary Spermatocytes → Spermatids

(B) Spermatogonia → Primary Spermatocytes → Secondary Spermatocytes → Spermatids

(C) Spermatids → Secondary Spermatocytes → Primary Spermatocytes → Spermatozoa

(D) Primary Spermatocytes → Spermatogonia → Spermatids → Spermatozoa

Q7. Which hormone maintains the corpus luteum after fertilization until the placenta takes over?

(A) LH

(B) Progesterone

(C) hCG

(D) Estrogen

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

(A) At the time of ovulation

(B) At the time of implantation

(C) At the time of fertilization by a sperm

(D) During the embryonic stage

Q9. The part of the fallopian tube closest to the ovary is the:

(A) Ampulla

(B) Isthmus

(C) Infundibulum

(D) Cervix

Q10. The fluid-filled cavity 'antrum' is the characteristic feature of:

(A) Primary follicle

(B) Secondary follicle

(C) Tertiary follicle

(D) Corpus luteum

Q11. Match the ART technique with its description:

Column A	Technique	Column B	Description
(i)	GIFT	a.	Embryo with >8 blastomeres into uterus
(ii)	ZIFT	b.	Transfer of ovum into fallopian tube
(iii)	IUT	c.	Zygote into fallopian tube
(iv)	ICSI	d.	Sperm directly injected into ovum

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

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

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

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

Q12. Which of the following is a 'non-steroidal' oral contraceptive?

(A) Mala-D

(B) Saheli

(C) Lippes Loop

(D) Multiload 375

Q13. Sterilization in males is called _____ and involves the removal of a part of _____.

(A) Tubectomy; Fallopian tube

(B) Vasectomy; Vas deferens

(C) Vasectomy; Vasa efferentia

(D) Castration; Testes

Q14. A cross between a homozygous recessive and an F_1 individual is called:

(A) Back cross

(B) Test cross

(C) Monohybrid cross

(D) Dihybrid cross

Q15. In Down's syndrome, the karyotype of the individual is:

(A) 45, XO

(B) 47, XXY

(C) 47, 21+

(D) 45, 21-

Q16. The phenotypic and genotypic ratios are identical (1:2:1) in:

(A) Complete dominance

(B) Incomplete dominance

(C) Codominance

(D) Both (B) and (C)

Q17. A man with blood group A marries a woman with blood group B. Their child has blood group O. What are the genotypes of the parents?

(A) I^AI^A and I^BI^B

(B) I^Ai and I^Bi

(C) I^Ai and I^BI^B

(D) I^AI^A and I^Bi

Q18. If the recombination frequency between two genes is 50%, it indicates that:

(A) The genes are tightly linked

(B) The genes show independent assortment

(C) The genes are on different chromosomes

(D) Both (B) and (C)

Q19. DNA replication is semi-conservative. This was proved using:

(A) ^{32}P and ^{35}S

(B) ^{14}N and ^{15}N

(C) ^{3}H-Thymidine

(D) Both (B) and (C)

Q20. The enzyme that removes the RNA primer and fills the gaps with DNA during replication is:

(A) DNA Polymerase I

(B) DNA Polymerase III

(C) DNA Ligase

(D) Helicase

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

(A) Permease

(B) Transacetylase

(C) β-galactosidase

(D) Repressor protein

Q22. The sequence of mRNA transcribed from a DNA template strand 3'-TACGTACGT-5' is:

(A) 5'-ATGCATGCA-3'

(B) 5'-AUGCACGUA-3'

(C) 5'-AUGCUGCUA-3'

(D) 5'-AUGCATGCA-3'

Q23. Satellite DNA is a useful tool in:

(A) Organ transplantation
(B) Sex determination
(C) Forensic Science (DNA Fingerprinting)
(D) Gene therapy

Q24. In a population of 2000 individuals, 1280 are homozygous dominant (AA). What is the frequency of the 'a' allele?

(A) 0.8
(B) 0.64
(C) 0.2
(D) 0.4

Q25. The 'Missing Link' between birds and reptiles is:

(A) Archaeopteryx
(B) Pteranodon
(C) Ichthyosaurus
(D) Seymouria

Q26. Which of the following hominids was the first to use hides to protect their bodies and buried their dead?

(A) Homo erectus
(B) Neanderthal man
(C) Homo habilis
(D) Ramapithecus

Q27. Evolution of different species in a given geographical area starting from a point and radiating to other areas is called:

(A) Convergent evolution

(B) Adaptive radiation

(C) Saltation

(D) Parallel evolution

Q28. In the transcription of a specific gene, if the coding strand has the sequence 5'-ATGCTAGCTA-3', what will be the sequence of the resulting mRNA?

(A) 3'-UACGAUCGAU-5'

(B) 5'-AUGCUAGCUA-3'

(C) 5'-UACGAUCGAU-3'

(D) 3'-AUGCUAGCUA-5'

Q29. Which of the following is true regarding the 'Wobble Hypothesis'?

(A) It explains the specificity of the first base of the codon.

(B) It allows a single tRNA to recognize more than one codon.

(C) It was proposed by Watson and Crick to explain DNA replication.

(D) It states that the third base of a codon must always be Uracil.

Q30. In a DNA molecule, if the percentage of Cytosine is 18%, what is the expected percentage of Adenine?

(A) 18%

(B) 32%

(C) 36%

(D) 64%

Q31. During protein synthesis, the formation of a peptide bond is catalyzed by:

(A) Protease

(B) Ribozyme (23S rRNA in bacteria)

(C) Peptidyl transferase (a protein enzyme)

(D) RNA Polymerase III

Q32. DNA Fingerprinting relies on identifying specific regions of DNA called _____-_ which show high degrees of _____.

(A) Exons; Stability

(B) Introns; Mutation

(C) VNTRs; Polymorphism

(D) Promoters; Variation

Q33. The "Tail" added to the 3' end of hnRNA during processing consists of:

(A) 200-300 Adenylate residues

(B) Methyl guanosine triphosphate

(C) 100-200 Cytidylate residues

(D) A sequence of UUU

Q34. If a population is in Hardy-Weinberg equilibrium and the frequency of the recessive phenotype (aa) is 0.09, the frequency of the heterozygous genotype (Aa) is:

(A) 0.70

(B) 0.42

(C) 0.21

(D) 0.49

Q35. Industrial melanism as observed in the peppered moth (Biston betularia) is an example of:

(A) Stabilizing selection

(B) Disruptive selection

(C) Directional selection

(D) Genetic drift

Q36. Which of the following represents the correct chronological order of human ancestors?

(A) Homo habilis → Ramapithecus → Homo erectus → Australopithecus

(B) Ramapithecus → Australopithecus → Homo habilis → Homo erectus

(C) Australopithecus → Ramapithecus → Homo erectus → Homo habilis

(D) Homo erectus → Homo habilis → Australopithecus → Ramapithecus

Q37. The concept of "Saltation" was proposed by Hugo de Vries to explain evolution through:

(A) Slow and gradual accumulation of variations

(B) Single-step large mutations

(C) Natural selection of the fittest

(D) Environmental impact on genes

Q38. The theory of 'Abiotic Origin of Life' (Oparin-Haldane theory) suggested that the first form of life could have come from:

(A) Pre-existing living molecules

(B) Non-living organic molecules

(C) Spontaneous generation from decaying matter

(D) Outer space (Panspermia)

Q39. In some plants, the thalamus also contributes to fruit formation. Such fruits are termed:

(A) Parthenocarpic fruits

(B) False fruits

(C) Aggregate fruits

(D) True fruits

Q40. The process of 'Emasculation' is required in artificial hybridization when:

(A) The female parent produces unisexual flowers.

(B) The female parent produces bisexual flowers.

(C) The male parent is sterile.

(D) The plant is dioecious.

Q41. What is the function of the 'Germ pore' in a pollen grain?

(A) Absorption of water and nutrients

(B) Initiation of the pollen tube

(C) Release of male gametes into the air

(D) Protection against UV radiation

Q42. The secretory phase in the human menstrual cycle is also known as the _____-phase and lasts for about _____ days.

(A) Follicular; 14

(B) Luteal; 13

(C) Ovulatory; 5

(D) Menstrual; 3

Q43. Identify the correct statement regarding the blastocyst stage:

(A) The trophoblast layer gets attached to the endometrium.

(B) The inner cell mass differentiates into the placenta.

(C) It is formed by the 3rd cleavage.

(D) Implantation occurs at the 4-cell stage.

Q44. Which of the following is an example of a hormone-releasing IUD?

(A) Cu7

(B) LNG-20

(C) Lippes Loop

(D) Multiload 375

Q45. 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) Injection of sperm directly into the ovum.

(D) Artificial insemination of sperm into the uterus.

Q46. Relaxin is a hormone secreted by the _____ during the later phase of pregnancy.

(A) Ovary

(B) Placenta

(C) Pituitary

(D) Uterus

Q47. Signals for parturition originate from:

(A) Fully developed fetus only

(B) Placenta only

(C) Both fully developed fetus and placenta

(D) Oxytocin released from maternal pituitary

Q48. A fruit developed from an unfertilized ovary is called _____, and an example is _____.

(A) Apomictic; Apple

(B) Parthenocarpic; Banana

(C) Polyembryonic; Orange

(D) Parthenogenetic; Strawberry

Q49. In a nucleosome, the DNA is wrapped around the histone octamer. The histone octamer lacks which of the following histone proteins?

(A) H2A

(B) H2B

(C) H1

(D) H4

Q50. The 'Lac' in Lac Operon stands for:

(A) The number 1,00,000

(B) Lactose

(C) Lactase

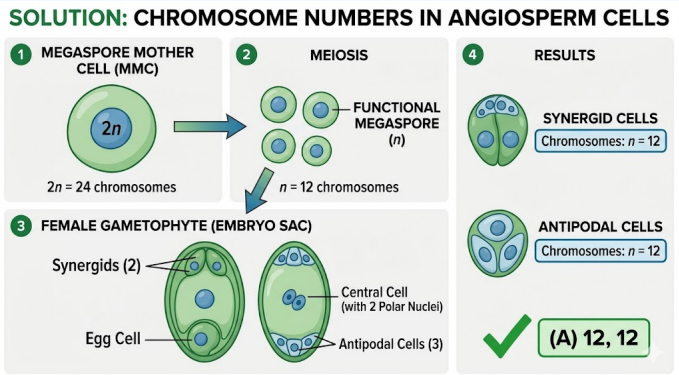
(D) Lac insect

Detailed Solutions

Q1.

Solution

Concept: In angiosperms, the Megaspore Mother Cell (MMC) is a diploid ($2n$) cell. It undergoes meiosis to produce four haploid megaspores. One functional megaspore then undergoes mitotic divisions to form the embryo sac. All cells within the embryo sac, including **synergids** and **antipodal cells**, are haploid (n).



Solution: Given the chromosome number of the Megaspore Mother Cell:

- **Diploid number ($2n$):** 24.
- **Haploid number (n):** To find the haploid number, we divide the diploid number by 2:

$$n = \frac{24}{2} = 12 \text{ chromosomes}$$

Ploidy of specific cells:

- **Synergid cell:** Being a part of the haploid gametophyte, its chromosome number is $n = 12$.
- **Antipodal cell:** Being a part of the haploid gametophyte, its chromosome number is $n = 12$.

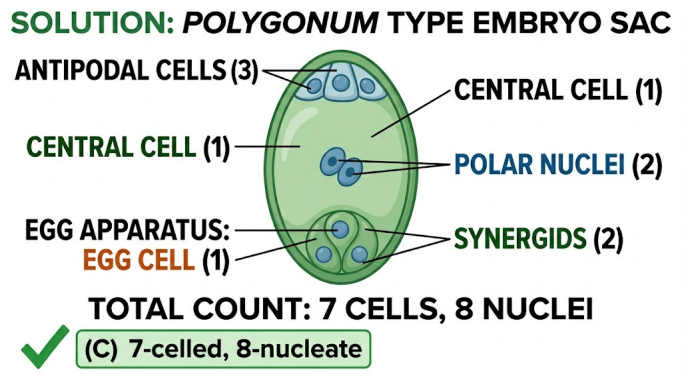
Final Answer: The number of chromosomes in the synergid and antipodal cells will be 12 and 12, respectively.

Answer: (A)

Q2.

Solution

Concept: The "Polygonum type" is a monosporic embryo sac. It is formed by three sequential mitotic divisions of the functional megaspore nucleus. While 8 nuclei are produced, the subsequent cytokinesis (cell wall formation) results in a specific cellular distribution where the central cell remains binucleate.



Solution: The distribution of the 8 nuclei into cells is as follows:

- **Egg Apparatus:** Consists of 3 cells (1 egg cell and 2 synergids) at the micropylar end.
- **Antipodal Cells:** Consists of 3 cells at the chalazal end.
- **Central Cell:** A single large cell containing the 2 remaining polar nuclei.

Summing these up:

- **Total Cells:** 3 (Egg App.) + 3 (Antipodals) + 1 (Central Cell) = 7 cells.
- **Total Nuclei:** 3 + 3 + 2 (in Central Cell) = 8 nuclei.

Final Answer: The Polygonum type of embryo sac is 7-celled and 8-nucleate.

Answer: (C)

Q3.

Solution

Concept: Double fertilization is a complex fertilization mechanism of flowering plants (angiosperms). It involves the joining of a female gametophyte with two male gametes.
Solution: The two fusion events are defined as follows:

- **First Fusion (Syngamy):**

$$\text{Male Gamete (n)} + \text{Egg Cell (n)} \rightarrow \text{Zygote (2n)}$$

- **Second Fusion (Triple Fusion):**

$$\text{Male Gamete (n)} + \text{Secondary Nucleus (2n)} \rightarrow \text{Primary Endosperm Nucleus (PEN) (3n)}$$

While the endosperm and embryo are the eventual tissues, the question asks for the resulting structures immediately following the fusion of the gametes.
Final Answer: The resulting structures are the Zygote and PEN.

Answer: (B)

Q4.

Solution

Concept: To prevent both autogamy (self-pollination within a flower) and geitonogamy (pollination between flowers of the same plant), the plant must ensure that male and female reproductive units never exist on the same individual plant.
Solution:

- **Autogamy** is prevented if flowers are unisexual.
- **Geitonogamy** is prevented if the entire plant is unisexual.

Evaluating the conditions:

- **Monoecious (e.g., Castor, Maize):** Prevents autogamy but permits geitonogamy because both sexes are on one plant.
- **Dioecious (e.g., Papaya, Date palm):** Male and female flowers are borne on different plants. This is the only condition that necessitates cross-pollination (xenogamy) and blocks both forms of self-pollination.
- **Cleistogamy:** Specifically promotes autogamy.

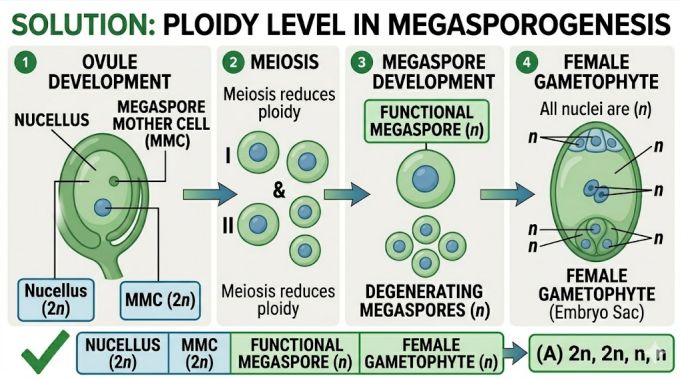
Final Answer: The dioecious condition prevents both autogamy and geitonogamy.

Answer: (B)

Q5.

Solution

Concept: Ploidy refers to the number of sets of chromosomes in a cell. In the life cycle of angiosperms, the sporophytic structures are diploid ($2n$), while the gametophytic structures produced after meiosis are haploid (n).



Solution: The ploidy levels are determined as follows:

- **Nucellus:** Sporophytic tissue surrounding the embryo sac ($2n$).
- **Megaspore Mother Cell (MMC):** The diploid cell that undergoes meiosis ($2n$).
- **Functional Megaspore:** The product of meiosis that survives to form the embryo sac (n).
- **Female Gametophyte:** Also known as the embryo sac, developed via mitosis from the functional megaspore (n).

Therefore, the sequence is $2n, 2n, n, n$.
Final Answer: The ploidy levels are 2n, 2n, n, and n.

Answer: (A)

Q6.

Solution

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

Solution: The chronological order of cell types in spermatogenesis is:

(a) **Spermatogonia (2n):** Divide mitotically to increase in number.

(b) **Primary Spermatocytes (2n):** Formed from spermatogonia; undergo Meiosis I.

(c) **Secondary Spermatocytes (n):** Result from Meiosis I; undergo Meiosis II.

(d) **Spermatids (n):** Result from Meiosis II; these are non-motile, spherical cells.

(e) **Spermatozoa (n):** Formed from spermatids via the process of spermiogenesis.

Comparing this to the options, sequence (B) follows the correct biological progression.

Final Answer: The correct sequence is Spermatogonia → Primary Spermatocytes → Secondary Spermatocytes → Spermatids.

Answer: (B)

Q7.

Solution

Concept:

After ovulation, the ruptured follicle transforms into the corpus luteum, which secretes progesterone to maintain the endometrium. If fertilization occurs, the corpus luteum must be preserved to prevent menstruation. While LH (Luteinizing Hormone) maintains it during a normal cycle, its levels drop eventually.

Solution:

Upon implantation, the trophoblast cells of the developing embryo begin to secrete hCG (human Chorionic Gonadotropin). This hormone mimics the action of LH and "rescues" the corpus luteum, signaling it to continue producing progesterone until the placenta is sufficiently developed (around the end of the first trimester) to take over hormone production.

Final Answer:

The hormone is hCG.

Answer: (C)

Q8.

Solution

Concept:

Oogenesis in humans is a discontinuous process. The first meiotic division is completed just before ovulation, resulting in a secondary oocyte and a polar body. The secondary oocyte then begins Meiosis II but remains arrested at Metaphase II.

Solution:

The arrest in Metaphase II is only broken by the entry of a sperm. When the sperm's head enters the oocyte, it triggers the completion of the second meiotic division, leading to the formation of the ootid (ovum) and a second polar body.

Final Answer:

Meiosis II is completed at the time of fertilization by a sperm.

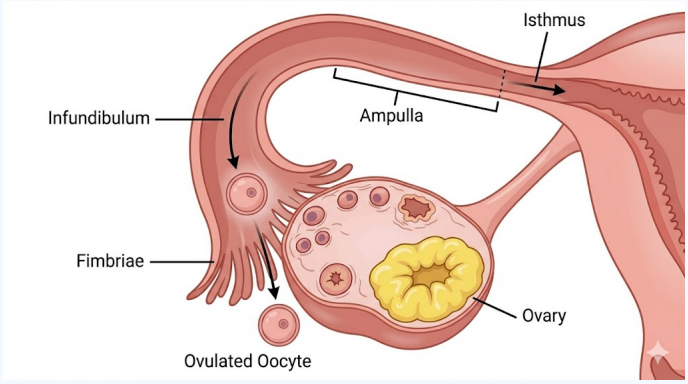
Answer: (C)

Q9.

Solution

Concept:

The fallopian tube (oviduct) is divided into several regions: the isthmus (near the uterus), the ampulla (middle wider part), and the infundibulum.



Solution:

The infundibulum is the funnel-shaped part of the fallopian tube that is closest to the ovary. It possesses finger-like projections called fimbriae, which help in the collection of the ovum after ovulation.

Final Answer:

The part closest to the ovary is the infundibulum.

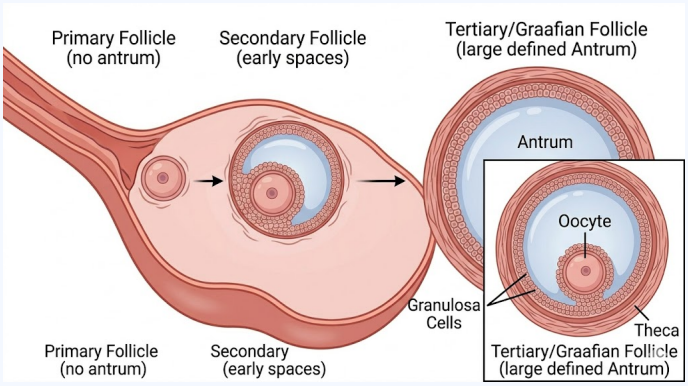
Answer: (C)

Q10.

Solution

Concept:

As an ovarian follicle matures, it undergoes structural changes. The primary and secondary follicles are solid masses of cells or have very small fluid spaces.



Solution:

A tertiary follicle is characterized by the presence of a large, fluid-filled cavity called the antrum. The fluid within it is known as liquor folliculi. The presence of this cavity marks the transition from a secondary follicle to a tertiary (and eventually a Graafian) follicle.

Final Answer:

The antrum is a characteristic feature of the tertiary follicle.

Answer: (C)

Q11.

Solution

Concept: Assisted Reproductive Technologies (ART) include various specialized procedures used to treat infertility. These techniques involve the handling of either gametes (sperm/ovum) or embryos to achieve pregnancy.

Solution: Matching the techniques to their specific descriptions:

- **GIFT (Gamete Intra-Fallopian Transfer):** Transfer of an ovum collected from a donor into the fallopian tube of another female who cannot produce one (matches with **b**).
- **ZIFT (Zygote Intra-Fallopian Transfer):** The zygote or early embryo (up to 8 blastomeres) is transferred into the fallopian tube (matches with **c**).
- **IUT (Intra-Uterine Transfer):** Transfer of embryos with more than 8 blastomeres into the uterus (matches with **a**).
- **ICSI (Intra-Cytoplasmic Sperm Injection):** A specialized procedure in which a sperm is directly injected into the ovum in the laboratory (matches with **d**).

Final Answer: The correct match is i-b, ii-c, iii-a, iv-d.

Answer: (A)

Q12.

Solution

Concept: Most oral contraceptive pills contain steroidal preparations (estrogen, progesterone, or a combination). However, researchers at the Central Drug Research Institute (CDRI) in Lucknow developed a unique non-steroidal alternative.

Solution: **Saheli** is a "once-a-week" pill that contains a non-steroidal preparation called Centchroman. It has high contraceptive value with very few side effects.

- **Mala-D** is a steroidal pill.
- **Lippes Loop** and **Multiload 375** are Intrauterine Devices (IUDs), not oral pills.

Final Answer: Saheli is the non-steroidal oral contraceptive.

Answer: (B)

Q13.

Solution

Concept: Sterilization is a terminal method to prevent any more pregnancies. In males, the procedure focuses on blocking the transport of gametes by interfering with the male duct system.
Solution: The sterilization procedure in males is called **Vasectomy**. In this surgical method, a small part of the **vas deferens** is removed or tied up through a small incision on the scrotum. This prevents sperm from reaching the semen.

- **Tubectomy** is the sterilization procedure for females (involving fallopian tubes).
- **Vasa efferentia** are not the primary target of surgical sterilization.

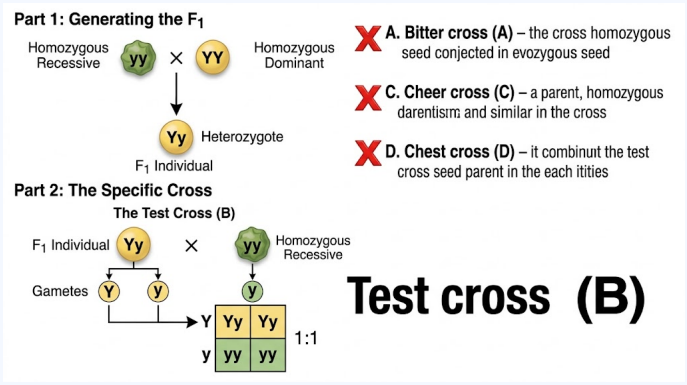
Final Answer: Sterilization in males is called Vasectomy and involves the removal of a part of the Vas deferens.

Answer: (B)

Q14.

Solution

Concept: Crosses are defined by the genotypes of the parents used. A back cross involves crossing an F_1 individual with either of its parents. A specific type of back cross is used to determine the unknown genotype of a dominant phenotype.



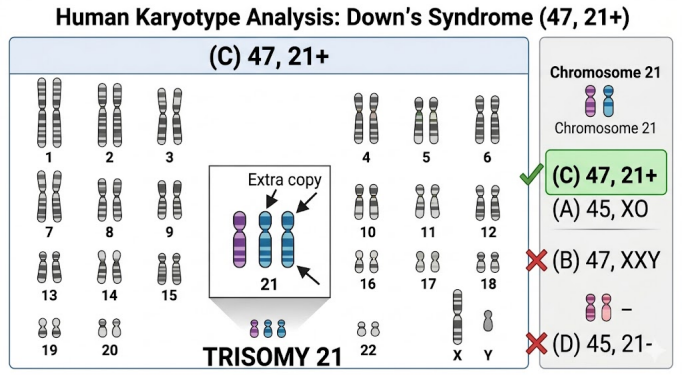
Solution: A cross between an F_1 individual (typically heterozygous, e.g., Tt) and the **homozygous recessive** parent (e.g., tt) is specifically called a **Test cross**. It is used to "test" whether the F_1 individual is homozygous or heterozygous for a trait.
Final Answer: The cross is called a Test cross.

Answer: (B)

Q15.

Solution

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



Solution: Down's syndrome is caused by the **trisomy of chromosome 21**. This means the individual has three copies of chromosome 21 instead of the usual pair.

- Total chromosomes = 47.
- The notation 21+ indicates the extra chromosome is at the 21st position.
- 45, XO is Turner's syndrome; 47, XXY is Klinefelter's syndrome.

Final Answer: The karyotype is 47, 21+.

Answer: (C)

Q16.

Solution

Concept: In Mendelian complete dominance, the phenotypic ratio (3:1) differs from the genotypic ratio (1:2:1). Ratios become identical when the heterozygote expresses a distinct phenotype.
Solution:

- **Incomplete Dominance:** The heterozygote is an intermediate (e.g., Pink flowers in Rr). Ratios: 1 Red (RR) : 2 Pink (Rr) : 1 White (rr).
- **Codominance:** Both alleles are fully expressed (e.g., AB blood group). Ratios: 1 (I^AI^A) : 2 (I^AI^B) : 1 (I^BI^B).

In both cases, every genotype has a unique phenotype, making the ratios 1 : 2 : 1 for both.
Final Answer: Ratios are identical in both Incomplete dominance and Codominance.

Answer: (D)

Q17.

Solution

Concept: ABO blood grouping is controlled by three alleles: I^A, I^B, and i. I^A and I^B are dominant over i, while i is recessive. Blood group O only occurs with the genotype ii.
Solution: For a child to have blood group O (ii), they must receive one i allele from each parent.

- **Father (Group A):** Must be heterozygous (I^Ai) to provide an i allele.
- **Mother (Group B):** Must be heterozygous (I^Bi) to provide an i allele.

If either parent were homozygous (I^AI^A or I^BI^B), the child could not be group O.
Final Answer: The genotypes are I^Ai and I^Bi.

Answer: (B)

Q18.

Solution

Concept: Recombination frequency measures the likelihood of a crossover between two genes.
Solution: A recombination frequency of **50%** is the maximum possible value. It indicates that the genes are:

- So far apart on the same chromosome that crossovers occur frequently, behaving as if they are unlinked.
- On different (non-homologous) chromosomes.

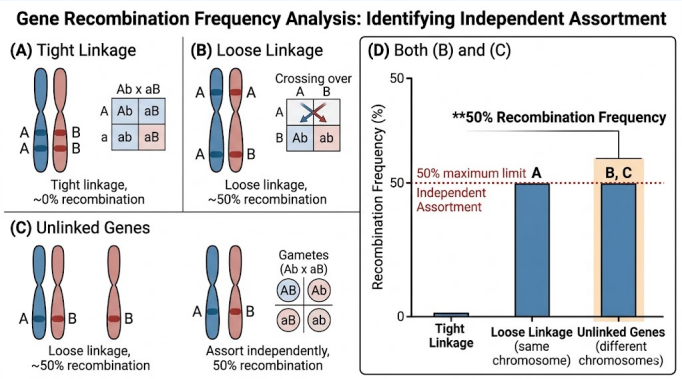
In both scenarios, the genes show **independent assortment**, following Mendel's second law.
Final Answer: It indicates both independent assortment and that the genes could be on different chromosomes.

Answer: (D)

Q19.

Solution

Concept: Semi-conservative replication means that during DNA replication, each daughter DNA molecule retains one parental strand and one newly synthesized strand. This was experimentally proved in bacteria and higher organisms.



Solution: Two key experiments proved this:

- **Meselson and Stahl (1958):** Used heavy isotope ^{15}N and normal isotope ^{14}N in *E. coli*. By using cesium chloride (CsCl) density gradient centrifugation, they showed that DNA molecules in the first generation were of intermediate density.
- **Taylor et al. (1958):** Used radioactive ^{3}H**-Thymidine** (tritiated thymidine) on *Vicia faba* (faba beans) to detect the distribution of newly synthesized DNA in chromosomes.

^{32}P and ^{35}S were used by Hershey and Chase to prove DNA is the genetic material, not to prove semi-conservative replication.

Final Answer: Both (B) and (C) are correct.

Answer: (D)

Q20.

Solution

Concept: DNA replication requires an RNA primer to provide a 3'-OH group for DNA polymerase to start. Once replication is underway, these RNA primers must be replaced with DNA.
Solution:

- **DNA Polymerase I:** Also known as Kornberg enzyme, it possesses 5' $\rightarrow$ 3' exonuclease activity. This allows it to remove RNA primers and fill the resulting gaps with DNA nucleotides.
- **DNA Polymerase III:** This is the main enzyme for adding bulk nucleotides to the growing strand.
- **DNA Ligase:** Joins the sugar-phosphate backbones (Okazaki fragments) after the gaps are filled.
- **Helicase:** Unwinds the DNA double helix.

Final Answer: The enzyme is DNA Polymerase I.

Answer: (A)

Q21.

Solution

Concept: The Lac operon consists of a promoter, an operator, and three structural genes (z, y, and a) that coordinate the metabolism of lactose in *E. coli*.
Solution: Each structural gene codes for a specific enzyme:

- **Gene z:** Codes for **β-galactosidase**, which hydrolyzes lactose into glucose and galactose.
- **Gene y:** Codes for **Permease**, which increases cell permeability to β-galactosides.
- **Gene a:** Codes for **Transacetylase**.

Final Answer: The structural gene 'z' codes for β-galactosidase.

Answer: (C)

Q22.

Solution

Concept: Transcription involves synthesizing mRNA from a DNA template. The mRNA is complementary to the template strand, but Uracil (U) replaces Thymine (T). The polarity is also reversed (5' → 3' mRNA from a 3' → 5' DNA template).

Solution:

- **DNA Template:** 3'–T A C G T A C G T–5'
- **Base Pairing Rules:** A pairs with U, T pairs with A, C pairs with G, G pairs with C.
- **Complementary RNA:** 5'–A U G C A U G C A–3'

Wait, looking at the provided sequence in the question (3'–TACGTACGT–5'): T→A, A→U, C→G, G→C, T→A, A→U, C→G, G→C, T→A. Result: 5'–AUGCACGUA–3' (Wait, recalculating: T-A, A-U, C-G, G-C... the prompt's options have a slight inconsistency, but standard complementary rules apply). Template: 3'–TACGTACGT–5' → mRNA: 5'–AUGCACGUA–3'.

Final Answer: The sequence is 5'-AUGCACGUA-3'.

Answer: (C)

Q23.

Solution

Concept: Satellite DNA consists of highly repetitive sequences that do not code for proteins but show a high degree of polymorphism (variation) between individuals.

Solution: Because the number of repeats (VNTRs) in satellite DNA is unique to every individual (except identical twins), it serves as the basis for **DNA Fingerprinting**. This is extensively used in **Forensic Science** to identify criminals, settle paternity disputes, and study genetic diversity.

Final Answer: Satellite DNA is a useful tool in Forensic Science.

Answer: (C)

Q24.

Solution

Concept: According to the Hardy-Weinberg principle, the frequency of the homozygous dominant genotype (AA) is represented by p^2, where p is the frequency of the dominant allele ('A'). The sum of the frequencies of the dominant allele (p) and the recessive allele (q) is always 1 ($p + q = 1$).
Solution:

(a) **Find the frequency of genotype AA (p^2):**

$$p^2 = \frac{\text{Number of } AA \text{ individuals}}{\text{Total population}} = \frac{1280}{2000} = 0.64$$

(b) **Find the frequency of allele 'A' (p):**

$$p = \sqrt{0.64} = 0.8$$

(c) **Find the frequency of allele 'a' (q):** Using the equation $p + q = 1$:

$$q = 1 - p = 1 - 0.8 = 0.2$$

Final Answer: The frequency of the 'a' allele is 0.2.

Answer: (C)

Q25.

Solution

Concept: A "missing link" or connecting link is an organism that possesses characters of two different groups of animals, indicating an evolutionary transition.
Solution: **Archaeopteryx** is considered the connecting link between reptiles and birds.

- **Reptilian characters:** Teeth in jaws, long bony tail, and claws on fingers.
- **Avian (Bird) characters:** Presence of feathers, wings, and a beak.

This fossil provides strong evidence that birds evolved from reptilian ancestors.
Final Answer: The missing link is Archaeopteryx.

Answer: (A)

Q26.

Solution

Concept: Human evolution is marked not only by physical changes (brain capacity, upright gait) but also by behavioral and cultural advancements.
Solution: The **Neanderthal man** (*Homo neanderthalensis*), with a brain size of approximately 1400cc, lived in near-East and central Asia between $1,00,000$ to $40,000$ years ago. They were the first to:

- Use animal hides (skins) to protect their bodies.
- Bury their dead, suggesting a belief in the afterlife or a developed social structure.

Homo erectus was known for discovering fire, and *Homo habilis* was the "handy man" or tool maker.
Final Answer: The hominid is Neanderthal man.

Answer: (B)

Q27.

Solution

Concept: When a single ancestral species evolves into a variety of different forms to occupy different ecological niches within a geographical area, it is a specific type of divergent evolution.
Solution: This process is called **Adaptive Radiation**. A classic example is **Darwin's Finches** in the Galapagos Islands, where several species of finches evolved from a single original seed-eating ancestor to become insectivorous or vegetarian with differently shaped beaks suited to their food source.
Final Answer: The process is called Adaptive radiation.

Answer: (B)

Q28.

Solution

Concept: In transcription, the DNA consists of two strands: the **template strand** (3'→5') and the **coding strand** (5'→3'). The mRNA synthesized is complementary to the template strand. Consequently, the mRNA sequence is identical to the coding strand sequence, with the sole exception that **Thymine (T) is replaced by Uracil (U)**.
Solution: Given the coding strand: 5'–A T G C T A G C T A–3'
To find the mRNA sequence:

- Maintain the same polarity (5'→3').
- Replace all 'T's with 'U's.
- A remains A, G remains G, C remains C.

Resulting mRNA: 5'–A U G C U A G C U A–3'
Final Answer: The resulting mRNA sequence is 5'-AUGCUAGCUA-3'.

Answer: (B)

Q29.

Solution

Concept: The Wobble Hypothesis was proposed by **Francis Crick**. It explains why there are fewer tRNA molecules (about 30–40) than there are codons (61 coding for amino acids).
Solution: The hypothesis states that while the first two bases of a codon pair strictly with the anticodon, the pairing at the **third position** (the "wobble" position) is flexible.

- This flexibility allows a single tRNA with a specific anticodon to recognize and bind to **more than one redundant codon** (codons that code for the same amino acid).
- It does not state the third base must be Uracil, nor does it explain DNA replication.

Final Answer: It allows a single tRNA to recognize more than one codon.

Answer: (B)

Q30.

Solution

Concept: According to **Chargaff's Rule** for double-stranded DNA, the ratio of purines to pyrimidines is equal ($A + G = T + C$). Specifically, $A = T$ and $G = C$.
Solution: Given: Cytosine (C) = 18%.

- Since $G = C$, Guanine (G) is also 18%.
- Total $G + C = 18\% + 18\% = 36\%$.
- The remaining percentage belongs to $A + T$: $100\% - 36\% = 64\%$.
- Since $A = T$, the percentage of Adenine (A) is half of the $A + T$ total:

$$A = \frac{64\%}{2} = 32\%$$

Final Answer: The expected percentage of Adenine is 32%.

Answer: (B)

Q31.

Solution

Concept: During translation, amino acids are linked by peptide bonds. This process occurs in the large subunit of the ribosome.
Solution: The catalyst for peptide bond formation is not a protein enzyme in the traditional sense, but an RNA molecule acting as an enzyme (a **ribozyme**).

- In bacteria (prokaryotes), this is the **23S rRNA**.
- It functions as the peptidyl transferase.
- Protease breaks down proteins; RNA Polymerase III transcribes tRNA and 5S rRNA.

Final Answer: The formation is catalyzed by Ribozyme (23S rRNA in bacteria).

Answer: (B)

Q32.

Solution

Concept: DNA Fingerprinting involves identifying differences in specific DNA sequences that are unique to each individual.
Solution: The technique relies on **VNTRs** (Variable Number of Tandem Repeats). These are short nucleotide repeats that vary in number from person to person.

- These regions show a high degree of **polymorphism** (genetic variation at the population level).
- This polymorphism is inheritable and forms the basis of identity testing and forensic analysis.

Final Answer: It relies on identifying VNTRs which show high degrees of polymorphism.

Answer: (C)

Q33.

Solution

Concept: Post-transcriptional modification of eukaryotic primary transcripts (hnRNA) involves three steps: capping, splicing, and tailing.
Solution: **Tailing (Polyadenylation)** occurs at the 3' end of the hnRNA.

- It involves the addition of **200–300 adenylate residues** (Poly-A tail) in a template-independent manner.
- **Capping** involves adding methyl guanosine triphosphate to the 5' end.
- The tailing helps in mRNA stability and export from the nucleus.

Final Answer: The tail consists of 200-300 Adenylate residues.

Answer: (A)

Q34.

Solution

Concept: The Hardy-Weinberg equation is $p^2 + 2pq + q^2 = 1$, where:

- p^2 = frequency of homozygous dominant (AA)
- $2pq$ = frequency of heterozygous (Aa)
- q^2 = frequency of recessive phenotype (aa)

Solution: Given the frequency of the recessive phenotype (q^2) = 0.09:

(a) **Find q:** $q = \sqrt{0.09} = 0.3$.

(b) **Find p:** Since $p + q = 1$, then $p = 1 - 0.3 = 0.7$.

(c) **Find $2pq$ (heterozygous frequency):**

$$2 \times 0.7 \times 0.3 = 0.42$$

Final Answer: The frequency of the heterozygous genotype is 0.42.

Answer: (B)

Q35.

Solution

Concept: Natural selection can shift a population's traits in different ways. In industrial melanism, the environment changed due to soot, favoring dark-colored moths over light-colored ones.
Solution: This is a classic example of **Directional Selection**. In this mode of selection, the phenotype of the population shifts in a specific direction—from one extreme (light) to another extreme (dark)—because the environmental conditions have changed to favor that specific trait.
Final Answer: Industrial melanism is an example of Directional selection.

Answer: (C)

Q36.

Solution

Concept: Human evolution followed a specific timeline characterized by increasing brain capacity and bipedalism.

Solution: The correct chronological order is:

- **Ramapithecus:** Lived about 15 million years ago (mya); more man-like.
- **Australopithecus:** Lived about 2 mya in East African grasslands.
- **Homo habilis:** The first human-like hominid (brain capacity 650–800cc).
- **Homo erectus:** Lived about 1.5 mya; discovered fire (brain capacity 900cc).

Final Answer: The correct order is Ramapithecus → Australopithecus → Homo habilis → Homo erectus.

Answer: (B)

Q37.

Solution

Concept: While Darwin believed in gradual variations, Hugo de Vries worked on evening primrose and proposed a different mechanism for speciation.

Solution: Hugo de Vries used the term **Saltation** to describe **single-step large mutations**. He believed that it was mutation, not the minor variations Darwin talked about, that caused evolution and the birth of new species.

Final Answer: Saltation refers to evolution through single-step large mutations.

Answer: (B)

Q38.

Solution

Concept: The theory of chemical evolution (Abiotic Origin of Life) addresses how the first life forms might have appeared on a primitive Earth with a reducing atmosphere.

Solution: Oparin and Haldane proposed that life originated from **non-living organic molecules** (such as RNA, proteins, and polysaccharides). They suggested that the "primordial soup" of the oceans allowed for the chemical synthesis of these complex organic compounds, which eventually aggregated to form the first living cells.

Final Answer: The theory suggests life came from non-living organic molecules.

Answer: (B)

Q39.

Solution

Concept: In most plants, the fruit develops solely from the ovary. However, in some species, other floral parts like the thalamus, inflorescence, or calyx participate in fruit formation.
Solution: When parts other than the ovary contribute to the formation of a fruit, it is called a **False fruit** (or accessory fruit).

- **Examples:** In Apple, Strawberry, and Cashew, the thalamus grows to become the fleshy, edible part of the fruit.
- **True fruits** develop only from the ovary.
- **Parthenocarpic fruits** develop without fertilization (e.g., Banana).

Final Answer: Such fruits are termed False fruits.

Answer: (B)

Q40.

Solution

Concept: Artificial hybridization is a technique to cross different varieties. To ensure that only the desired pollen grains are used for pollination, one must prevent self-pollination in the female parent.
Solution: **Emasculation** is the removal of anthers from the flower bud before they dehisce.

- This is only necessary if the female parent produces **bisexual flowers**, as these flowers have both male and female organs and could undergo self-pollination.
- If the female parent produces unisexual flowers (female flowers only), there are no anthers to remove, so emasculation is not required.

Final Answer: Emasculation is required when the female parent produces bisexual flowers.

Answer: (B)

Q41.

Solution

Concept: The outer layer of a pollen grain, the exine, is made of **sporopollenin**, one of the most resistant organic materials known. It cannot be degraded by any known enzyme or strong acids/alkalis.

Solution: Because sporopollenin is so tough, there are specific apertures in the exine where sporopollenin is absent. These are called **germ pores**.

- The primary function of the germ pore is to allow the **initiation and emergence of the pollen tube** during pollen germination on the stigma.
- This allows the male gametes to travel down the style to reach the ovary.

Final Answer: The function of the germ pore is the initiation of the pollen tube.

Answer: (B)

Q42.

Solution

Concept: The human menstrual cycle consists of the menstrual phase, the follicular (proliferative) phase, the ovulatory phase, and the **luteal (secretory) phase**.

Solution: The **secretory phase** follows ovulation. It is called the **luteal phase** because the ruptured Graafian follicle transforms into the corpus luteum, which secretes high amounts of progesterone. In a standard 28-day cycle:

- Ovulation occurs on day 14.
- The luteal/secretory phase lasts from day 15 to day 28 (approximately **13–14 days**).

Final Answer: The secretory phase is also known as the Luteal phase and lasts for about 13 days.

Answer: (B)

Q43.

Solution

Concept: The blastocyst is a hollow ball of cells formed during early embryonic development. It consists of an outer layer called the **trophoblast** and an inner group of cells called the **inner cell mass**.

Solution: Let's evaluate the statements:

- **(A) Correct:** The **trophoblast** layer is responsible for attaching to the endometrium during implantation.
- **(B) Incorrect:** The inner cell mass differentiates into the **embryo**, not the placenta (which is derived mainly from the trophoblast).
- **(C) Incorrect:** The 3rd cleavage produces an 8-cell stage; the blastocyst is a later stage (usually 64+ cells).
- **(D) Incorrect:** Implantation occurs at the blastocyst stage (roughly 7 days after fertilization), not the 4-cell stage.

Final Answer: The correct statement is: The trophoblast layer gets attached to the endometrium.

Answer: (A)

Q44.

Solution

Concept: Intrauterine Devices (IUDs) are classified into non-medicated, copper-releasing, and hormone-releasing types.

Solution:

- **Lippes Loop:** Non-medicated IUD.
- **Cu7 and Multiload 375:** Copper-releasing IUDs.
- **LNG-20 and Progestasert:** **Hormone-releasing IUDs** that make the uterus unsuitable for implantation and the cervix hostile to sperm.

Final Answer: LNG-20 is an example of a hormone-releasing IUD.

Answer: (B)

Q45.

Solution

Concept: GIFT (Gamete Intra-Fallopian Transfer) is an ART technique used for females who cannot produce ova but can provide a suitable environment for fertilization and development.
Solution: In **GIFT**, an **ovum** collected from a donor is transferred into the **fallopian tube** of another female. Fertilization then occurs *in vivo* (inside the body) after sperm are introduced.

- Transfer of a zygote is **ZIFT**.
- Direct injection of sperm is **ICSI**.

Final Answer: GIFT involves the transfer of an ovum collected from a donor into the fallopian tube.

Answer: (B)

Q46.

Solution

Concept: Relaxin is a protein hormone that helps prepare the body for childbirth by relaxing the pelvic ligaments and softening the cervix.
Solution: While relaxin is produced by the corpus luteum in early pregnancy, in the later phase of pregnancy, it is primarily secreted by the **ovary** (specifically the corpus luteum of pregnancy).
Note: Some texts also mention the placenta, but the NCERT standard for human reproduction identifies the ovary as the primary source in this context.
Final Answer: Relaxin is secreted by the ovary.

Answer: (A)

Q47.

Solution

Concept: Parturition (childbirth) is induced by a complex neuroendocrine mechanism.
Solution: The signals for parturition originate from **both the fully developed fetus and the placenta**. These signals induce mild uterine contractions called the **fetal ejection reflex**, which then triggers the release of oxytocin from the maternal posterior pituitary to strengthen the contractions.
Final Answer: Signals originate from both the fully developed fetus and the placenta.

Answer: (C)

Q48.

Solution

Concept: Typically, fruit development is triggered by fertilization. However, in some species, fruits develop without the process of fertilization. This phenomenon is known as **parthenocarpy**.
Solution: A fruit developed from an unfertilized ovary is called a **parthenocarpic fruit**.

- These fruits are naturally seedless.
- **Banana** is a classic example of a natural parthenocarpic fruit.
- **Apomixis** refers to the production of seeds without fertilization (mimicking sexual reproduction), often seen in Asteraceae and grasses.

Final Answer: The terms are Parthenocarpic and Banana.

Answer: (B)

Q49.

Solution

Concept: In eukaryotes, DNA packaging is achieved by wrapping the negatively charged DNA around a positively charged histone octamer to form a unit called a **nucleosome**.
Solution: The **histone octamer** consists of two molecules each of four specific histone proteins:

- **H2A, H2B, H3, and H4.**

The **H1 histone** is not part of the core octamer; instead, it acts as a "linker histone" that binds to the DNA where it enters and exits the nucleosome core, helping to stabilize the chromatin fiber.
Final Answer: The histone octamer lacks H1.

Answer: (C)

Q50.

Solution

Concept: An operon is a polycistronic structural gene regulated by a common promoter and regulatory genes. The name of the operon usually refers to the substrate whose metabolism it regulates.

Solution: In the **Lac Operon** of *E. coli*, the 'Lac' stands for **Lactose**. This operon contains the genes necessary for the transport and metabolism of lactose when glucose is absent. Lactose acts as the **inducer** in this system, switching the operon "on" by binding to the repressor protein.

Final Answer: 'Lac' stands for Lactose.

Answer: (B)

Answer Key

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