

OJEE M Tech Textile Sample Paper 02

A) Mode and Time: The exam is a Computer Based Test (CBT) lasting 120 minutes.

B) Total Questions: The exam contains 90 questions.

C) Marking Scheme & Rules:

- +4 for correct answers and -1 for incorrect responses.

Q1. Which of the following polymerization methods is typically used for the commercial production of Polyethylene Terephthalate (PET)?

- A. Addition polymerization
- B. Condensation polymerization
- C. Ring-opening polymerization
- D. Free-radical polymerization

Q2. The parameter that primarily determines the limiting draw ratio of a synthetic filament during the drawing process is:

- A. Polymer molecular weight
- B. As-spun crystallinity and orientation
- C. Extrusion temperature
- D. Quenching air velocity

Q3. In a rotor spinning machine, the device responsible for separating the fed sliver into individual fibers is the:

- A. Navel
- B. Rotor groove
- C. Opening roller
- D. Take-off tube

Q4. The 'wrapper fibers' characteristic of air-jet spun yarns are formed primarily due to:

- A. False twist inserted by the first nozzle
- B. True twist from the second nozzle
- C. Edge fibers escaping the main draft zone

D. Adhesive bonding of surface fibers

Q5. A drafting system has a back draft of 1.2 and a main draft of 10. The total draft of the system is:

- A. 11.2
- B. 8.8
- C. 12.0
- D. 10.2

Q6. Which test is used to measure the uniformity and frequency of thick and thin places in a yarn over a large length?

- A. Uster Evenness Tester
- B. Shirley Yarn Hairiness Tester
- C. Classimat fault analysis
- D. Tensomat

Q7. The "sizing index" is defined as the:

- A. Ratio of size paste viscosity to concentration
- B. Percentage increase in tensile strength of warp yarn after sizing
- C. Ratio of warp tension to weft tension
- D. Amount of size removed during desizing

Q8. In modern projectile weaving machines, the torsion bar is used to:

- A. Pick the projectile
- B. Beat up the weft
- C. Shed the warp
- D. Control warp let-off

Q9. The timing of primary motions in a loom is synchronized with respect to the:

- A. Bottom shaft rotation
- B. Crank shaft rotation
- C. Tappet shaft rotation
- D. Take-up roller rotation

Q10. Which combination of weave and sett provides the maximum fabric firmness (cover factor)?

- A. Plain weave
- B. 2/1 Twill
- C. 3/1 Twill
- D. 5-end Satin

Q11. Acrylic fibers are most commonly dyed using which class of dyes?

- A. Reactive dyes
- B. Acid dyes
- C. Basic (Cationic) dyes
- D. Vat dyes

Q12. The chemical formula for the repeating unit of Nylon 6 is:

- A. $[-\text{NH}-(\text{CH}_2)_5-\text{CO}-]_n$
- B. $[-\text{NH}-(\text{CH}_2)_6-\text{NH}-\text{CO}-(\text{CH}_2)_4-\text{CO}-]_n$
- C. $[-\text{CH}_2-\text{CH}(\text{CN})-]_n$
- D. $[-\text{O}-\text{CH}_2-\text{CH}_2-\text{O}-\text{CO}-\text{C}_6\text{H}_4-\text{CO}-]_n$

Q13. During the singeing of polyester/cotton blended fabrics, care must be taken to avoid:

- A. Complete removal of cotton hairs
- B. Thermal degradation and melting of polyester forming hard beads
- C. Excessive desizing
- D. Shrinkage of the warp yarns

Q14. Scouring of raw wool is primarily done to remove:

- A. Natural coloring matter
- B. Lignin and pectin
- C. Wool grease (lanolin) and suint
- D. Seed coat fragments

Q15. In colorimetry, the $L^*a^*b^*$ color space represents the 'a*' axis as:

- A. Lightness to darkness
- B. Redness to greenness
- C. Yellowness to blueness
- D. Chroma to hue

Q16. Which printing method uses a squeegee to force print paste through a mesh?

- A. Roller printing
- B. Rotary screen printing
- C. Transfer printing
- D. Block printing

Q17. The functional finish applied to textiles to reduce static electricity buildup is known as:

- A. Soil release finish
- B. Antistatic finish
- C. Water repellent finish
- D. Flame retardant finish

Q18. The moisture regain of standard cotton under standard atmospheric conditions is approximately:

- A. 4.5%
- B. 8.5%
- C. 13.7%
- D. 0.4%

Q19. Which technique is best suited to determine the functional chemical groups present in a textile fiber?

- A. Scanning Electron Microscopy (SEM)
- B. X-ray Diffraction (XRD)
- C. Fourier Transform Infrared Spectroscopy (FTIR)
- D. Differential Thermal Analysis (DTA)

Q20. Bending length of a fabric (c) is related to its flexural rigidity (G) and fabric weight per unit area (w) by the equation:

- A. $G = w \times c^3$
- B. $G = w \times c^2$
- C. $G = c / w^3$
- D. $G = \sqrt{w \times c}$

Q21. Meltblown nonwovens differ from spunbond nonwovens primarily in having:

- A. Continuous filaments
- B. Much finer (micro to nano) fiber diameters
- C. Higher mechanical strength
- D. Cross-lapped web structure

Q22. The principle of hydroentanglement (spunlacing) involves:

- A. Chemical binders
- B. High-pressure water jets
- C. Heated calendar rollers
- D. Barbed needles

Q23. Which high-performance fiber is characterized by a highly oriented extended chain polyethylene structure?

- A. Nomex
- B. Spectra / Dyneema
- C. Carbon fiber
- D. Glass fiber

Q24. In weft knitting, a "tuck loop" is formed when the needle:

- A. Receives a new yarn and knocks over the old loop
- B. Receives a new yarn but does not knock over the old loop
- C. Does not receive a new yarn but holds the old loop
- D. Drops the old loop completely

Q25. The theoretical maximum weft insertion rate (WIR) is a product of:

- A. Loom speed and reed width

- B. Warp tension and let-off speed
- C. Shuttle mass and picking force
- D. Shed opening angle and beat-up force

Q26. Which sizing ingredient is a synthetic polymer offering excellent adhesion to polyester/cotton blends and is easily desized by washing?

- A. Corn starch
- B. Polyvinyl alcohol (PVA)
- C. Tallow
- D. Carboxymethyl cellulose (CMC)

Q27. In a carding machine, the primary function of the "licker-in" is to:

- A. Form the sliver
- B. Remove short fibers
- C. Open the fiber tufts and remove heavy trash
- D. Draft the web

Q28. The "ring and traveler" system imparts twist. The twist per inch (TPI) is calculated as:

- A. Spindle speed / Winding speed
- B. Traveler speed / Delivery roller speed
- C. Spindle speed / Delivery roller surface speed
- D. Spindle speed $\times$ Delivery rollers speed

Q29. Which parameter determines the "count" of a reed in the Stockport system?

- A. Number of dents per inch
- B. Number of dents per 2 inches
- C. Number of dents per 10 centimeters
- D. Number of warp ends per inch

Q30. The "dwell" in a shedding cam profile is required to:

- A. Change the shed rapidly
- B. Keep the shed fully open during weft insertion

- C. Ensure uniform warp tension
- D. Reduce beat-up force

Q31. Continuous filament texturing by the false-twist method primarily improves yarn:

- A. Tenacity
- B. Bulk and stretch (elasticity)
- C. Color fastness
- D. Luster

Q32. Acid dyes bond with protein fibers (like wool and silk) primarily through:

- A. Covalent bonds
- B. Ionic (salt) linkages
- C. Hydrogen bonds
- D. Solid solution

Q33. The pH of the dye bath in reactive dyeing of cotton is generally maintained in which range?

- A. Strongly acidic (pH 2-3)
- B. Mildly acidic (pH 4-5)
- C. Neutral (pH 7)
- D. Alkaline (pH 10-11)

Q34. The standard test method for determining the pilling resistance of fabrics is:

- A. Martindale abrasion tester
- B. Elmendorf tester
- C. Shirley stiffness tester
- D. Kawabata evaluation system

Q35. In the Tex system, if the length of a yarn is 10,000 meters and its mass is 200 grams, what is the count in Tex?

- A. 20 Tex
- B. 50 Tex
- C. 200 Tex

D. 10 Tex

Q36. Air permeability of a fabric is defined as the volume of air passing through:

- A. A unit area per unit time under a specified pressure difference
- B. A unit thickness per unit time
- C. A fabric at standard temperature
- D. A unit area at maximum burst pressure

Q37. If a fabric has a warp crimp of 10% and the woven fabric length is 100 meters, what is the straight length of the warp yarn?

- A. 90 meters
- B. 100 meters
- C. 110 meters
- D. 111.1 meters

Q38. The primary mechanism for flame retardancy imparted by phosphorus-based compounds on cotton is:

- A. Formation of a cooling water layer
- B. Promotion of char formation and reduction of flammable volatiles
- C. Release of radical scavengers in the gas phase
- D. Melting and dripping away from the flame

Q39. In raw cotton, the presence of "honeydew" causes which major problem during spinning?

- A. Excessive short fibers
- B. Roller lapping due to stickiness
- C. Poor dye uptake
- D. Nep formation

Q40. The drafting zone in a speed frame (roving frame) typically consists of:

- A. 4 over 4 roller drafting
- B. 3 over 3 double apron drafting
- C. 2 over 2 roller drafting

D. Slip drafting system

Q41. Stelometer is used to measure which property of a fiber bundle?

- A. Fineness and maturity
- B. Strength and elongation at break
- C. Length and uniformity
- D. Trash content

Q42. The limiting oxygen index (LOI) of a highly flammable fiber like cotton is approximately:

- A. 18 - 20
- B. 25 - 28
- C. 30 - 32
- D. 40 - 45

Q43. The process of "heat setting" synthetic fabrics is done to provide:

- A. Dimensional stability
- B. Water repellency
- C. Color fastness
- D. Increased thickness

Q44. A jig dyeing machine processes fabric in:

- A. Rope form
- B. Open-width form
- C. Tubular form
- D. Garment form

Q45. Which weave is characterized by diagonal lines on the face of the fabric?

- A. Plain
- B. Satin
- C. Twill
- D. Crepe

- Q46.** The term "gauge" in a knitting machine refers to:
- A. The thickness of the needle
 - B. The length of the needle bed
 - C. The number of needles per unit length (e.g., per inch)
 - D. The speed of the machine
- Q47.** Warp knitting machines typically produce fabrics that are:
- A. Highly stretchable in all directions
 - B. Prone to running and laddering
 - C. Dimensionally more stable and run-resistant than weft knits
 - D. Used exclusively for heavy carpets
- Q48.** A "slub" in a yarn is considered a:
- A. Desirable feature for all yarns
 - B. Yarn fault characterized by a thick place with little twist
 - C. Thin place caused by drafting wave
 - D. Foreign matter contamination
- Q49.** Waterproof breathable fabrics (like Gore-Tex) function based on the principle of:
- A. Hydrophilic solid films
 - B. Microporous membranes
 - C. Thick elastomeric coatings
 - D. Tightly woven multifilaments
- Q50.** The unit of Thermal Resistance (Clo) is equivalent to:
- A. $0.155 \text{ m}^2\text{K}/\text{W}$
 - B. $1.0 \text{ m}^2\text{K}/\text{W}$
 - C. $0.5 \text{ W}/\text{mK}$
 - D. $10 \text{ J}/\text{kgK}$
- Q51.** In the conversion of English Count (Ne) to Tex, the constant used is:
- A. 1000

B. 531.5

C. 590.5

D. 9000

Q52. Cots used on drafting rollers are typically made of:

A. Steel

B. Wood

C. Synthetic rubber (polyurethane or nitrile)

D. Ceramic

Q53. The shed formed in an air-jet loom is typically:

A. Much larger than a shuttle loom shed

B. Smaller than a shuttle loom shed

C. Exactly the same as a rapier loom shed

D. Asymmetrical

Q54. Which spinning method is capable of producing core-spun yarns directly?

A. Rotor spinning

B. Ring spinning

C. Friction spinning

D. Both B and C

Q55. The substantive force holding vat dyes inside cotton fibers after oxidation is:

A. Covalent bond

B. Mechanical entrapment of insoluble pigment

C. Ionic bond

D. Metallic complex

Q56. Discharge printing involves:

A. Printing a dye onto a white fabric

B. Printing a chemical that destroys the background dye in patterned areas

C. Using wax as a resist

D. Printing with a pigment binder

Q57. The term "denier" refers to the mass in grams of a fiber/yarn of length:

- A. 1,000 meters
- B. 10,000 meters
- C. 9,000 meters
- D. 100 meters

Q58. If the Coefficient of Variation (CV%) of a yarn is 10%, and the mean strength is 200 cN, the standard deviation is:

- A. 10 cN
- B. 20 cN
- C. 30 cN
- D. 200 cN

Q59. A "geogrid" is a type of geotextile primarily used for:

- A. Filtration
- B. Drainage
- C. Soil reinforcement
- D. Moisture barrier

Q60. In testing, "Class 1" flammability rating indicates:

- A. Normal flammability (acceptable for apparel)
- B. Intermediate flammability
- C. Rapid and intense burning (dangerously flammable)
- D. Completely fireproof

Q61. The inverse of the matrix $A = \begin{bmatrix} 2 & 1 \\ 5 & 3 \end{bmatrix}$ is:

- A. $\begin{bmatrix} 3 & -1 \\ -5 & 2 \end{bmatrix}$
- B. $\begin{bmatrix} 3 & 1 \\ 5 & 2 \end{bmatrix}$

C. $\begin{bmatrix} -2 & -1 \\ -5 & -3 \end{bmatrix}$

D. $\begin{bmatrix} 1 & -0.5 \\ -2.5 & 1 \end{bmatrix}$

Q62. The value of the limit $\lim_{x \rightarrow 0} \frac{1 - \cos(2x)}{x^2}$ is:

A. 1

B. 2

C. 0

D. 1/2

Q63. If $f(x, y) = x^3y^2$, then the mixed partial derivative $\frac{\partial^2 f}{\partial x \partial y}$ is:

A. $6x^2y$ B. $3x^2y^2$ C. $2x^3y$ D. $6xy$

Q64. The integral $\int \frac{1}{x \ln x} dx$ evaluates to:

A. $\ln(\ln x) + C$ B. $\ln x + C$ C. $(\ln x)^2 + C$ D. $e^x + C$

Q65. A fair coin is tossed 3 times. The probability of getting exactly 2 heads is:

A. 1/8

B. 3/8

C. 1/2

D. 5/8

Q66. The directional derivative of $\phi(x, y, z) = xy + yz + zx$ at the point $(1, 1, 1)$ in the direction of the vector $\mathbf{i} + \mathbf{j} + \mathbf{k}$ is:

A. $\sqrt{3}$

B. $2\sqrt{3}$

C. 3

D. 6

Q67. The solution of the differential equation $\frac{dy}{dx} = \frac{y}{x}$ is:

A. $y = c e^x$

B. $y = c x$

C. $y = c / x$

D. $y^2 = cx^2$

Q68. Using the Trapezoidal rule with $n = 1$, the integral $\int_0^2 x^3 dx$ is approximated as:

A. 4

B. 8

C. 6

D. 2

Q69. If $z = e^{i\theta}$, then $z + \frac{1}{z}$ is equal to:

A. $2\sin \theta$

B. $2\cos \theta$

C. $i\sin \theta$

D. $2e^{i\theta}$

Q70. The sum of the infinite geometric series $1 + \frac{1}{3} + \frac{1}{9} + \frac{1}{27} + \dots$ is:

A. $3/2$

B. 2

C. $4/3$

D. $5/3$

Q71. The curl of the gradient of any scalar field ϕ (i.e., $\nabla \times (\nabla\phi)$) is always:

A. $\nabla^2\phi$

B. 0

C. 1

D. $\nabla\phi$

Q72. A matrix A is called skew symmetric if:

A. $A = A^T$

B. $A = -A^T$

C. $A = A^{-1}$

D. $A = I$

Q73. The Laplace transform of the unit step function $u(t)$ is:

A. 1

B. $1/s$

C. s

D. $1/s^2$

Q74. The maximum value of the function $f(x) = -x^2 + 6x - 5$ is:

A. 4

B. 5

C. 9

D. -5

Q75. If $P(A) = 0.3$, $P(B) = 0.4$, and A and B are mutually exclusive, then $P(A \cap B)$ is:

A. 0.12

B. 0.7

C. 0

D. 1

Q76. The Taylor series expansion of e^x around $x = 0$ is:

A. $1 - x + x^2 \frac{1}{2! - \dots}$

B. $1 + x + x^2 \frac{1}{2! + \dots}$

C. $x - x^3 \frac{1}{3! + \dots}$

D. $1 - x^2 \frac{1}{2! + \dots}$

Q77. The integrating factor for the differential equation $x \frac{dy}{dx} - y = x^2$ is:

A. x

B. $1/x$

C. e^{-x}

D. $-x$

Q78. If X follows a normal distribution with mean μ and standard deviation σ , the area under the curve between $\mu - \sigma$ and $\mu + \sigma$ is approximately:

A. 50%

B. 68%

C. 95%

D. 99.7%

Q79. The characteristic equation of a 2×2 matrix A is $\lambda^2 - 5\lambda + 6 = 0$. The determinant of A is:

A. 5

B. -5

C. 6

D. -6

Q80. The residue of the complex function $f(z) = \frac{1}{z-2}$ at its pole $z = 2$ is:

A. 0

B. 1

C. 2

D. πi

Q81. If ALL cats are dogs, and SOME dogs are birds, which of the following must be true?

- A. Some cats are birds
- B. All dogs are cats
- C. Some dogs are cats
- D. All birds are dogs

Q82. A clock shows 3:15. What is the angle between the hour hand and the minute hand?

- A. 0°
- B. 7.5°
- C. 15°
- D. 22.5°

Q83. In a certain code, "WATER" is written as "XCUJW". How is "FIRE" written in that code?

- A. GLUI
- B. GKVH
- C. GMWJ
- D. HKWH

Q84. Ravi is 7 ranks ahead of Sumit in a class of 39. If Sumit's rank is 17th from the last, what is Ravi's rank from the start?

- A. 14th
- B. 15th
- C. 16th
- D. 17th

Q85. Find the missing number in the sequence: 4, 9, 25, 49, ?, 169.

- A. 81
- B. 100
- C. 121
- D. 144

Q86. A man walks 5 km South, then turns Right and walks 3 km, then turns Right and walks 5 km. In which direction is he from the starting point?

- A. North
- B. South
- C. East
- D. West

Q87. Pointing to a girl, a man says, "She is the daughter of my grandmother's only child." How is the man related to the girl?

- A. Father
- B. Brother
- C. Cousin
- D. Uncle

Q88. Select the odd one out:

- A. Square
- B. Rectangle
- C. Triangle
- D. Cube

Q89. If 5 machines take 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?

- A. 100 minutes
- B. 5 minutes
- C. 1 minute
- D. 50 minutes

Q90. P, Q, R, S, and T are sitting in a line facing North. P is sitting next to Q. R is sitting next to S. S is not sitting with T who is on the left end of the bench. R is on the second position from the right. Who is sitting in the center?

- A. P
- B. Q
- C. R
- D. P or Q

Solutions

1. B

Explanation: PET is produced via step-growth condensation polymerization of ethylene glycol and terephthalic acid (or dimethyl terephthalate), releasing water (or methanol) as a byproduct.

2. B

Explanation: The limiting draw ratio (how much a fiber can be stretched before breaking) is inversely related to the degree of molecular orientation and crystallinity already present in the as-spun yarn.

3. C

Explanation: In rotor spinning, the pinned or wire-covered opening roller rotates at high speed, combing and separating the fed sliver into individual fibers before they are transported to the rotor.

4. C

Explanation: In air-jet spinning (like Murata Jet Spinning), edge fibers escape the twisting action of the main nozzle but are caught by the second nozzle, wrapping around the parallel core fibers to provide strength.

5. C

Explanation: The total mechanical draft in a drafting system is the product of all intermediate drafts. $\text{Total Draft} = \text{Back Draft} \times \text{Main Draft} = 1.2 \times 10 = 12.0$.

6. C

Explanation: The Classimat system classifies yarn faults (thick places, thin places, and neps) based on their length and cross-sectional size over a large length of yarn, represented in a matrix.

7. B

Explanation: The sizing index is a measure of the effectiveness of the sizing process. It is generally calculated as the percentage increase in the tensile strength of the sized yarn compared to the unsized yarn.

8. A

Explanation: In a projectile loom (like Sulzer), the immense kinetic energy required to fire the heavy steel projectile across the shed is stored and rapidly released by twisting a heavy steel torsion bar.

9. B

Explanation: The crank shaft is the main driving shaft of a loom. The timing of all primary motions (shedding, picking, and beat-up) is synchronized based on the angular position (0 to 360 degrees) of the crank shaft.

10. A

Explanation: Plain weave has the highest number of interlacements (every end crosses every pick). This restricts yarn movement and allows for the tightest packing, providing maximum fabric firmness.

11. C

Explanation: Acrylic fibers contain anionic (acidic) comonomer groups (like sulfonates or carboxylates). These negatively charged sites form strong ionic bonds with positively charged basic (cationic) dyes.

12. B

Explanation: Nylon 6 is polymerized from caprolactam, giving the repeating unit $[-NH-(CH_2)_5-CO-]_n$. The option given in B is Nylon 6,6, so the correct choice text corresponds to caprolactam's structure. (Wait, option A is Nylon 6. My apologies, adjusting explanation: Option A is Nylon 6). *Correction:* Option A is $[-NH-(CH_2)_5-CO-]_n$.

13. B

Explanation: Polyester is thermoplastic. Excessive heat during singeing can melt the polyester fibers, causing them to form hard, glassy beads on the fabric surface which cause dyeing defects and harsh handle.

14. C

Explanation: Raw wool contains large amounts of impurities. Scouring (washing with detergent and alkali) is performed primarily to emulsify and remove the natural wool grease (lanolin) and dried sweat (suint).

15. B

Explanation: In the CIE $L^*a^*b^*$ color space, L^* is lightness, the a^* axis represents the green-red opponent colors (negative is green, positive is red), and the b^* axis represents blue-yellow.

16. B

Explanation: Rotary screen printing utilizes seamless cylindrical screens. A stationary squeegee inside the rotating cylinder forces the print paste out through the mesh onto the moving fabric.

17. B

Explanation: Synthetic fibers are hydrophobic and accumulate static charge. Antistatic finishes are applied to attract moisture from the air, increasing the surface conductivity of the fiber to dissipate the charge.

18. B

Explanation: Under standard testing conditions (65% RH and 20°C/27°C), the standard moisture regain of raw cotton is officially accepted as 8.5%.

19. C

Explanation: FTIR measures the absorption of infrared radiation by molecular bonds. Different chemical functional groups absorb at specific frequencies, providing a "chemical fingerprint" of the fiber.

20. A

Explanation: According to Peirce's cantilever test principle for fabric stiffness, flexural rigidity (G) is calculated by the equation $G = W \times c^3$, where W is fabric weight per unit area and c is bending length.

21. B

Explanation: Meltblown technology uses high-velocity hot air to rapidly attenuate the extruded polymer melt, resulting in nonwoven webs composed of extremely fine microfibers or nanofibers, unlike spunbond.

22. B

Explanation: Hydroentanglement, or spunlacing, consolidates a loose fiber web by blasting it with multiple rows of fine, high-pressure water jets, causing the fibers to knot and entangle mechanically.

23. B

Explanation: Spectra and Dyneema are trade names for Ultra-High Molecular Weight Polyethylene (UHMWPE) fibers, manufactured via gel spinning to achieve a highly oriented, extended-chain structure.

24. B

Explanation: A tuck loop is formed when a knitting needle rises just enough to receive a new yarn but does not rise high enough to clear the old loop over the latch. Both loops are held on the needle.

25. A

Explanation: Weft Insertion Rate (WIR) measures loom productivity. It is calculated by multiplying the loom speed (picks per minute) by the reed width (meters), yielding meters of weft inserted per minute.

26. B

Explanation: Polyvinyl alcohol (PVA) is a highly effective synthetic size. It provides a strong, flexible film suitable for polyester blends and is highly water-soluble, making desizing very easy.

27. C

Explanation: The licker-in is covered with robust saw-tooth wire. Its fast rotation opens the feed tufts down to tiny flocks, releasing heavy trash particles which fall through the mote knives and grid bars.

28. C

Explanation: Twist is inserted by the rotation of the traveler. The formula for mechanical twist per inch (TPI) is the spindle speed (RPM) divided by the surface delivery speed of the front rollers (inches/min).

29. B

Explanation: Different systems define reed count differently. In the Stockport system, the count of the reed is specifically defined as the number of dents contained in a width of exactly 2 inches.

30. B

Explanation: Dwell is the period where the cam follower does not move, holding the heald frames stationary. This keeps the shed fully open, providing a clear path for the shuttle/weft to pass through.

31. B

Explanation: False-twist texturing heats, twists, sets, and untwists thermoplastic continuous filaments. This creates permanent helical crimps in the filaments, drastically increasing yarn bulk, stretch, and softness.

32. B

Explanation: Acid dyes contain sulfonic acid groups that are negatively charged in water. They form electrostatic (ionic or salt) bonds with the positively charged protonated amino groups ($-\text{NH}_3^+$) of protein fibers.

33. D

Explanation: Reactive dyeing of cotton requires an alkaline medium. Alkali (like sodium carbonate) is added to ionize the cellulose hydroxyl groups to cellulosate anions (Cell-O^-), which then nucleophilically attack the dye.

34. A

Explanation: The Martindale abrasion tester is the internationally recognized standard apparatus used to determine both the abrasion resistance and the pilling propensity of textile fabrics under controlled rubbing.

35. A

Explanation: Tex is a direct counting system defined as the mass in grams of 1,000 meters of yarn. Since 10,000 m weighs 200 g, 1,000 m weighs $200 / 10 = 20$ g. Therefore, the count is 20 Tex.

36. A

Explanation: Standard air permeability is defined as the rate of air flow (volume per unit area per unit time, e.g., $\text{cm}^3/\text{cm}^2/\text{s}$) passing perpendicularly through a fabric under a prescribed air pressure differential.

37. C

Explanation: $\text{Crimp}\% = [(StraightLength - WovenLength) / WovenLength] \times 100$. So,
 $10 = [(L - 100) / 100] \times 100 \implies L - 100 = 10 \implies L = 110$ meters.

38. B

Explanation: Phosphorus-based flame retardants act in the condensed phase. They alter the thermal degradation pathway of cellulose, promoting the formation of solid carbonaceous char rather than flammable volatile gases.

39. B

Explanation: Honeydew is a sticky, sugary substance secreted by whiteflies on cotton plants. During spinning, this stickiness causes severe roller lapping (fibers wrapping around drafting rollers) and machine blockages.

40. B

Explanation: Modern speed frames (roving frames) almost universally use a 3-over-3 double apron drafting system to effectively control fiber movement during the high drafts required to reduce sliver to roving.

41. B

Explanation: The Stelometer is a pendulum-type testing instrument used in textile laboratories to accurately determine both the tensile breaking strength (tenacity) and the elongation at break of a flat bundle of cotton fibers.

42. A

Explanation: LOI is the minimum percentage of oxygen required to sustain burning. Normal air has 21% oxygen. Cotton has an LOI of around 18-20, meaning it burns easily in normal atmospheric air.

43. A

Explanation: Heat setting involves heating a thermoplastic fabric (like polyester) under tension to above its T_g but below its melting point. This relieves internal stresses and provides permanent dimensional stability against shrinkage.

44. B

Explanation: In a jig dyeing machine, the fabric is wound back and forth between two rollers through a stationary dye bath. The fabric is kept flat and under tension, so it is processed entirely in open-width form.

45. C

Explanation: Twill weave is structurally characterized by stepping the interlacement points by one pick on successive warp yarns. This creates prominent diagonal lines (wales) across the face of the fabric.

46. C

Explanation: In knitting, "gauge" specifies the fineness of the machine. It is universally defined as the number of needles per unit length of the needle bed (typically needles per inch).

47. C

Explanation: Warp knitted structures (like tricot) have yarns interlocking lengthwise, providing fabrics that are significantly more dimensionally stable, less stretchy, and highly resistant to laddering compared to weft knits.

48. B

Explanation: While slubs can be introduced intentionally for design (slub yarn), in standard spinning, a slub is a severe yarn fault. It is a thick, bulky place lacking adequate twist, representing a weak point in the yarn.

49. B

Explanation: Gore-Tex utilizes a thin membrane of expanded PTFE that is microporous. The pores are much smaller than liquid water droplets (preventing rain entry) but much larger than water vapor molecules (allowing sweat to escape).

50. A

Explanation: The 'Clo' is a standard unit of thermal insulation used for clothing. 1 Clo represents the insulation required to keep a resting person comfortable in a normal indoor environment, mathematically equal to $0.155 \text{ m}^2\text{K}/\text{W}$.

51. C

Explanation: Ne is an indirect system (length/weight) and Tex is direct (weight/length). The conversion constant relates their base units (840 yards/lb and g/1000m). The relationship is: $\text{Tex} \times \text{Ne} = 590.5$.

52. C

Explanation: Drafting cots (the covering on top rollers) require specific frictional properties, wear resistance, and elasticity to grip fibers firmly. They are made from vulcanized synthetic rubbers like nitrile or polyurethane.

53. B

Explanation: Because the air-jet insertion medium (air and a very light yarn tip) has very small mass and dimensions compared to a solid wooden shuttle, the loom can operate with a much smaller shed opening, reducing warp strain.

54. D

Explanation: Core-spun yarns (where a filament core is wrapped by staple fibers) can be produced directly by modifying the feeding mechanisms on both conventional ring spinning and friction (DREF) spinning machines.

55. B

Explanation: Soluble leuco vat dyes penetrate the cotton fiber. Upon oxidation, they instantly convert back into large, insoluble pigment molecules that are physically trapped (mechanically entrapped) within the polymer network.

56. B

Explanation: In discharge printing, the fabric is first dyed a solid ground color. A print paste containing a reducing agent (discharge chemical) is then printed on, which destroys the ground dye in the patterned areas, revealing a white or colored pattern.

57. C

Explanation: Denier is a direct yarn numbering system heavily used for synthetic filaments and silk. It is strictly defined as the mass in grams of exactly 9,000 meters of the fiber or yarn.

58. B

Explanation: Coefficient of Variation (CV%) is defined as $(StandardDeviation/Mean) \times 100$. So, $10 = (\sigma/200) \times 100 \implies \sigma = (10 \times 200)/100 = 20$ cN.

59. C

Explanation: Geogrids are specialized technical textiles featuring an open grid-like structure with high tensile strength. They are embedded into soil primarily to provide mechanical soil reinforcement and stabilization.

60. A

Explanation: In flammability testing (e.g., 16 CFR 1610), Class 1 designates textiles that exhibit normal flammability. These fabrics have a relatively slow burn rate and are legally acceptable for use in consumer apparel.

61. A

Explanation: For a 2×2 matrix $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$, $A^{-1} = \frac{1}{ad-bc} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$. $\det(A) = (2)(3) - (1)(5) = 1$. Swapping diagonal and negating off-diagonal gives $\begin{bmatrix} 3 & -1 \\ -5 & 2 \end{bmatrix}$.

62. B

Explanation: Using L'Hopital's rule twice or Taylor expansion. $\cos(2x) \approx 1 - \frac{(2x)^2}{2} = 1 - 2x^2$. Limit becomes $\frac{1-(1-2x^2)}{x^2} = \frac{2x^2}{x^2} = 2$.

63. A

Explanation: First derive with respect to x : $\frac{\partial f}{\partial x} = 3x^2y^2$. Then derive that result with respect to y : $\frac{\partial}{\partial y}(3x^2y^2) = 6x^2y$.

64. A

Explanation: Use substitution $u = \ln x \implies du = \frac{1}{x}dx$. The integral becomes $\int \frac{1}{u}du = \ln|u| + C$. Substituting back gives $\ln|\ln x| + C$.

65. B

Explanation: Total outcomes $= 2^3 = 8$. Outcomes with exactly 2 heads: HHT, HTH, THH (3 outcomes). Probability $= 3/8$.

66. B

Explanation: Gradient $\nabla\phi = (y+z)\mathbf{i} + (x+z)\mathbf{j} + (x+y)\mathbf{k}$. At $(1,1,1)$, $\nabla\phi = 2\mathbf{i} + 2\mathbf{j} + 2\mathbf{k}$. Unit vector of direction $= \frac{\mathbf{i}+\mathbf{j}+\mathbf{k}}{\sqrt{3}}$. Dot product $= \frac{2(1)+2(1)+2(1)}{\sqrt{3}} = \frac{6}{\sqrt{3}} = 2\sqrt{3}$.

67. B

Explanation: Separate variables: $\frac{dy}{y} = \frac{dx}{x}$. Integrate both sides: $\ln y = \ln x + C_1 \implies \ln y = \ln(cx) \implies y = cx$.

68. A

Explanation: Trapezoidal rule for 1 interval: $\int_a^b f(x)dx \approx \frac{b-a}{2}[f(a) + f(b)]$. Here, $\frac{2-0}{2}[f(0) + f(2)] = 1 \cdot (0^3 + 2^3) = 8/2 = 4$. (Wait: $1 \cdot (0 + 8) = 8$. Let me re-calculate: $\frac{h}{2}(y_0 + y_1) = \frac{2}{2}(0 + 8) = 8$. Ah, if the options are A=4, B=8, let me check. The question options have B=8. *Correction*: The answer is B).

69. B

Explanation: $z = e^{i\theta} = \cos\theta + i\sin\theta$. $1/z = e^{-i\theta} = \cos\theta - i\sin\theta$. Summing them gives $2\cos\theta$.

70. A

Explanation: Infinite geometric series sum $S = \frac{a}{1-r}$. Here $a = 1$, $r = 1/3$. $S = \frac{1}{1-1/3} = \frac{1}{2/3} = \frac{3}{2}$.

71. B

Explanation: A fundamental vector identity states that the curl of the gradient of any twice-differentiable scalar field is identically zero vector ($\nabla \times \nabla\phi = \mathbf{0}$).

72. B

Explanation: By definition, a matrix A is skew-symmetric (or antisymmetric) if its transpose is equal to its negative, i.e., $A^T = -A$.

73. B

Explanation: The unit step function $u(t) = 1$ for $t \geq 0$. The Laplace transform is $\int_0^\infty e^{-st}(1)dt = \left[\frac{e^{-st}}{-s} \right]_0^\infty = 0 - \left(-\frac{1}{s} \right) = \frac{1}{s}$.

74. A

Explanation: Derivative $f'(x) = -2x + 6 = 0 \implies x = 3$. Second derivative is -2 .

(concave down, so it's a maximum). Max value $f(3) = -(3^2) + 6(3) - 5 = -9 + 18 - 5 = 4$.

75. C

Explanation: Mutually exclusive events cannot happen at the same time. Therefore, the probability of their intersection (both occurring simultaneously) is zero.

76. B

Explanation: The standard Maclaurin series (Taylor series at $x = 0$) for the exponential function e^x is $1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \dots$

77. B

Explanation: Standard form: $\frac{dy}{dx} - \frac{1}{x}y = x$. IF = $e^{\int (-1/x)dx} = e^{-\ln x} = x^{-1} = 1/x$.

78. B

Explanation: By the empirical rule (68-95-99.7 rule) for normal distributions, approximately 68.27% of the data falls within one standard deviation ($\pm 1\sigma$) of the mean.

79. C

Explanation: The characteristic equation is $\lambda^2 - (\text{Trace})\lambda + \text{Det} = 0$. Comparing this to $\lambda^2 - 5\lambda + 6 = 0$, the determinant is exactly the constant term, which is 6.

80. B

Explanation: For a simple pole at $z = a$, $\text{Res} = \lim_{z \rightarrow a} (z - a)f(z)$. Here, $\lim_{z \rightarrow 2} (z - 2)\frac{1}{z-2} = 1$.

81. C

Explanation: If all cats are dogs, then the set of cats is fully inside the set of dogs. Thus, there are some dogs (the ones that are cats) that are indeed cats.

82. B

Explanation: At 3:00, the hour hand is exactly on 3. In 15 minutes, it moves $(15/60) \times 30^\circ = 7.5^\circ$. The minute hand is exactly on 3 (15 min). The angle between them is 7.5° .

83. A

Explanation: The code follows +1, +2, +3, +4, +5. W(+1)=X; A(+2)=C; T(+3)=W (wait, W is 23, T is 20, +3=23=W. Code has U? No, T(+1)U, W(+1)X... W(+1)=X, A(+2)=C, T(+1)U? T(20)+1=21=U. Let's re-verify: W(23)+1=X(24), A(1)+2=C(3), T(20)+1=U(21)? No, U is 21. Wait, WATER -> X(24) C(3) U(21) J(10)? W(23). Let me fix the logic pattern. W->X (+1), A->C (+2), T->U (+1), E->J (+5)? Let's use simple +1, +2, +3, +4, +5. F(+1)=G, I(+2)=K, R(+3)=U, E(+4)=I. Corrected code logic mapping is applied). *Correction:* Assuming standard +1, +2, +3 pattern, FIRE -> GLUI.

84. C

Explanation: Sumit's rank from top = $39 - 17 + 1 = 23$ rd. Ravi is 7 ranks ahead of Sumit (meaning a better rank, numerically smaller). Ravi's rank = $23 - 7 = 16$ th.

85. C

Explanation: The sequence represents squares of prime numbers: $2^2 = 4$, $3^2 = 9$, $5^2 = 25$, $7^2 = 49$. The next prime is 11, so $11^2 = 121$. (169 is 13^2).

86. D

Explanation: Walks South (5). Turns Right (faces West, walks 3). Turns Right (faces North, walks 5). He is now exactly 3 km West of his starting point.

87. A

Explanation: The man's grandmother's only child is the man's parent (either father or mother). The girl is the daughter of his parent, making her the man's sister. Wait. "She is the daughter...". Option A was Father, let me re-evaluate. If he is the father? No. The man is the brother. (Option B). Let me correct the answer. The answer is B.

88. D

Explanation: Square, Rectangle, and Triangle are 2-dimensional (flat) geometrical figures. A Cube is a 3-dimensional solid figure.

89. B

Explanation: It takes 1 machine exactly 5 minutes to make 1 widget. Therefore, if 100 machines work simultaneously, they will produce 100 widgets in the same 5 minutes.

90. D

Explanation: T is at the left end. S is not next to T. R is 2nd from right. Positions: T R Since R and S are together, S must be at the right end. Positions: T R S. P and Q are left, taking spots 2 and 3. So center (spot 3) is either P or Q.