OJEE M Tech Textile Sample Paper 03

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. The primary objective of the combing process in cotton spinning is to:

A. Impart twist to the sliver

B. Remove short fibers, neps, and impurities

C. Blend different varieties of cotton

D. Increase the moisture content of the fiber

Q2. In the context of cotton fiber testing, the Micronaire value is an indirect measure of:

A. Fiber length and uniformity

B. Fiber strength and elongation

C. Fiber fineness and maturity

D. Fiber friction and crimp

Q3. Which spinning technology is best suited for producing yarns with a high degree of bulk and low twist, often used for denim or towels?

A. Compact spinning

B. Rotor spinning

C. Air-jet spinning

D. Friction (DREF) spinning

Q4. The "winding tension" in a ring spinning frame is primarily generated by:

A. The spindle motor torque

B. The friction between the traveler and the ring

C. The balloon control ring

D. The drafting rollers

Q5. Compact spinning differs from conventional ring spinning primarily by:

A. Using air to impart twist

B. Eliminating the spinning triangle

C. Using a heavier traveler

D. Drafting in a single zone

Q6. The twist contraction in a spun yarn causes:

A. An increase in the actual yarn length

B. A decrease in yarn linear density (count)

C. An increase in yarn linear density (tex)

D. No change in yarn dimensions

Q7. In warp sizing, the use of a "split rod" (or lease rod) is essential for:

A. Drying the sized yarn

B. Applying the size paste uniformly

C. Separating the individual sized yarns that have stuck together

D. Winding the yarn onto the weaver's beam

Q8. The theoretical shape of the yarn balloon in ring spinning is approximated by a curve known as the:

A. Catenary

B. Parabola

C. Elastica

D. Hyperbola

Q9. A fabric defect known as "reed marks" is typically caused by:

A. Broken warp ends

B. Incorrect weft tension

C. Bent or distorted wires in the reed

D. Missing heald wires

Q10. In a rapier weaving machine, the transfer of the weft yarn from the giver rapier to the taker rapier occurs:

A. At the fabric fell

B. Outside the shed

C. In the center of the shed

D. At the take-up roller

Q11. The basic structural repeating unit of the silk fibroin protein is rich in which amino acids?

A. Glycine and Alanine

B. Tyrosine and Tryptophan

C. Cysteine and Methionine

D. Lysine and Arginine

Q12. Which natural fiber has the highest natural moisture regain?

A. Cotton

B. Flax

C. Wool

D. Silk

Q13. In dyeing, the term "exhaustion" refers to:

A. The amount of dye wasted in the effluent

B. The migration of dye within the fiber

C. The proportion of dye transferred from the bath to the fiber

D. The fading of dye under sunlight

Q14. Optical brightening agents (OBAs) function by:

A. Absorbing UV light and emitting visible blue light

B. Bleaching the natural pigments chemically

C. Reflecting all visible light equally

D. Absorbing blue light and emitting yellow light

Q15. The presence of "dead cotton" (highly immature fibers) in a fabric typically results in:

A. Higher tensile strength

B. Brilliant, deep shades upon dyeing

C. White specks after dyeing due to poor dye uptake

D. Increased fabric stiffness

Q16. A spectrophotometer measures color by analyzing the fabric's:

A. Thermal conductivity

B. Reflectance or transmittance curve across visible wavelengths

C. Moisture content

D. Surface friction

Q17. The "Kawabata Evaluation System" (KES) is primarily used to measure the:

A. Tensile strength of geotextiles

B. Flammability of protective clothing

C. Low-stress mechanical properties related to fabric hand

D. Color fastness to rubbing

Q18. The bursting strength test is most appropriate for which type of fabrics?

A. Heavy canvas woven fabrics

B. Nonwoven geotextiles

C. Knitted fabrics

D. Laminated composites

Q19. If the moisture regain of a textile sample is 10%, its moisture content will be:

A. 9.09%

B. 11.11%

C. 10.0%

D. 8.5%

Q20. In drawing synthetic filaments, the draw ratio is mathematically defined as the ratio of:

A. Take-up speed to extrusion speed

B. Draw roll speed to feed roll speed

C. Final denier to initial denier

D. Crystalline region to amorphous region

Q21. Which parameter is critical in determining the "melt flow index" (MFI) of a polymer used in melt spinning?

A. Solvent concentration

B. Polymer viscosity at a specific temperature and load

C. Crystallinity percentage

D. Moisture regain

Q22. Carbon fibers are commercially produced primarily by the controlled thermal degradation of which precursor fiber?

A. Polypropylene

B. Polyethylene

C. Polyacrylonitrile (PAN)

D. Nylon 6,6

Q23. The "wet spinning" process requires:

A. A high-temperature melting zone

B. A chemical coagulation bath to precipitate the polymer

C. A high-velocity air jet

D. A strong electrostatic field

Q24. In a warp knitted fabric, the technical back is characterized by the presence of:

A. Clear vertical V-shaped wales

B. Horizontal courses

C. Underlaps

D. Floating weft yarns

Q25. A "courses per inch" (CPI) and "wales per inch" (WPI) measurement is used to determine the stitch density of:

A. Woven fabrics

B. Knitted fabrics

C. Braided ropes

D. Spunlaid nonwovens

Q26. Which enzymatic treatment is used in the textile industry to achieve a "bio-polishing" effect on cotton fabrics?

A. Amylase

B. Pectinase

C. Cellulase

D. Protease

Q27. The "limit of spinability" is reached when:

A. The traveler burns out

B. The yarn breaks due to insufficient fibers in the cross-section

C. The spindle vibrates excessively

D. The balloon collapses

Q28. In the Shirley Analyzer, the separation of lint from trash is based on the difference in their:

A. Color

B. Electrical conductivity

C. Aerodynamic behavior and specific volume

D. Melting point

Q29. A "mock leno" weave is characterized by:

A. Crossing warp yarns

B. Open, perforated, mesh-like fabric structure

C. A velvet-like pile surface

D. Diagonal twill lines

Q30. To produce a terry towel, a loom must be equipped with:

A. A Jacquard shedding mechanism

B. A double beat-up mechanism and two warp beams

C. A rotary dobby

D. Multiple shuttles

Q31. In texturing, the "crimp rigidity" test measures the yarn's:

A. Breaking strength

B. Resistance to abrasion

C. Ability to recover from stretch after crimping

D. Thermal shrinkage

Q32. Which dye class is typically applied to cellulosic fibers using a pad-batch dyeing process?

A. Disperse dyes

B. Acid dyes

C. Reactive dyes

D. Basic dyes

Q33. The fastness to rubbing (crocking) of a dyed fabric is evaluated using a:

A. Launder-Ometer

B. Crockmeter

C. Xenotest machine

D. Tensile tester

Q34. The "drop penetration test" is used to evaluate a fabric's:

A. Air permeability

B. Crease recovery

C. Water repellency

D. Flammability

Q35. In the indirect English count system, a higher number indicates:

A. A coarser yarn

B. A finer yarn

C. A stronger yarn

D. A more twisted yarn

Q36. Thermal bonding of nonwovens is only possible if the fiber web contains:

A. A high percentage of natural fibers

B. A chemical binder

C. Thermoplastic fibers

D. Water-soluble fibers

Q37. If a fabric has a fractional cover of 0.6 in the warp direction and 0.5 in the weft direction, the total fractional cover is:

A. 1.10

B. 0.30

C. 0.80

D. 1.00

Q38. Flame retardant finishes for synthetic fibers often incorporate compounds containing:

A. Sodium and Potassium

B. Halogens (like Bromine) and Phosphorus

C. Calcium and Magnesium

D. Sulfur and Iron

Q39. In spinning, a "drafting wave" usually results in yarn defects classified as:

A. Neps

B. Slubs

C. Periodic mass variations

D. Hairiness

Q40. The "apron" in a ring frame drafting system prevents:

A. Traveler wear

B. Yarn hairiness

C. Uncontrolled movement of short floating fibers

D. Roller lapping

Q41. Which instrument uses the capacitance principle to measure yarn evenness?

A. Uster Tester

B. Shirley Hairiness Tester

C. Instron

D. Lea Strength Tester

Q42. The "glass transition temperature" (T_g) of Polyethylene Terephthalate (PET) is approximately:

A. 20°C

B. 70-80°C

C. 150°C

D. 250-260°C

Q43. The process of "crabbing" is a finishing treatment primarily applied to fabrics made of:

A. Cotton

B. Polyester

C. Wool

D. Silk

Q44. A stenter machine is widely used in textile processing for:

A. Drying and heat setting fabrics at a controlled width

B. Washing printed fabrics

C. Dyeing yarns

D. Spinning synthetic filaments

Q45. In a dobby loom, the maximum number of heald shafts that can typically be controlled is:

A. 2 to 4

B. 8 to 24

C. 100 to 200

D. Over 1000

Q46. Which of the following is a "secondary motion" in a weaving machine?

A. Shedding

B. Picking

C. Beat-up

D. Warp Let-off

Q47. A single jersey fabric has a tendency to curl at the edges. It typically curls:

A. Towards the face at the top and bottom, and towards the back at the sides

B. Towards the back at the top and bottom, and towards the face at the sides

C. Inwards on all four sides

D. Outwards on all four sides

Q48. The "nep count" in a cotton web is generally evaluated manually or using an AFIS. Neps are predominantly composed of:

A. Tangled mature fibers

B. Tangled immature or dead cotton fibers

C. Seed coat fragments

D. Foreign synthetic fibers

Q49. Which coating polymer is famous for producing highly durable, waterproof, and chemically resistant protective clothing?

A. Starch

B. Polyurethane (PU)

C. Polyvinyl Acetate (PVA)

D. Gelatin

Q50. The unit of intrinsic thermal insulation of a fabric is measured in:

A. Joules

B. Watts per meter

C. Clo

D. Pascals

Q51. Convert a yarn count of 40 Ne to Tex. (Given: $Tex \times Ne = 590.5$)

A. 14.76 Tex

B. 24.2 Tex

C. 10.5 Tex

D. 59 Tex

Q52. The distance between the nip of the front rollers and the thread guide (lappet) in ring spinning is known as the:

A. Spinning triangle

B. Balloon height

C. Drafting zone

D. Winding zone

Q53. Which shedding mechanism uses a patterned chain of pegs or a punched paper roll to control harness lifting?

A. Tappet

B. Jacquard

C. Dobby

D. Cam

Q54. Friction spun yarns (DREF) are structurally characterized by:

A. A highly parallel core wrapped by surface fibers

B. A true twist running uniformly through the entire cross-section

C. A false twisted core with no surface fibers

D. A braided structure

Q55. Sulfur dyes are extensively used for dyeing cellulosic fibers in deep shades of:

A. Brilliant Red

B. Yellow and Orange

C. Black, Navy, and Brown

D. Fluorescent Green

Q56. Resist printing involves:

A. Printing a dye over a previously dyed fabric

B. Printing a chemical paste that prevents the subsequent uptake of dye

C. Destroying the background dye with a reducing agent

D. Using heat to transfer a pattern from paper to fabric

Q57. The term "tenacity" of a fiber is defined as its:

A. Breaking load divided by its linear density

B. Breaking load divided by its cross-sectional area

C. Extension at break divided by initial length

D. Work of rupture

Q58. If the mean length of a cotton sample is 25 mm and the upper half mean length is 30 mm, the Uniformity Index is:

A. 83.3%

B. 120%

C. 55%

D. 90%

Q59. Geotextiles used in road construction to prevent the intermixing of subgrade soil and aggregate base perform the function of:

A. Drainage

B. Filtration

C. Separation

D. Reinforcement

Q60. According to standard flammability tests, fabrics that are entirely made of which fiber will not burn but may melt?

A. Cotton

B. Viscose Rayon

C. Glass

D. Acetate

Q61. For the matrix $A = \begin{bmatrix} 3 & -1 \\ -1 & 3 \end{bmatrix}$, the eigenvalues are:

A. 2 and 4

B. 1 and 5

C. 3 and -1

D. 0 and 6

Q62. The limit $\lim_{x\to 0} \frac{\tan x - x}{x^3}$ is equal to:

A. 1

B. 1/3

C. 1/2

D. 0

Q63. The partial differential equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ is known as:

A. Heat equation

B. Wave equation

C. Laplace's equation

D. Poisson's equation

Q64. The integral $\int_0^{\pi/2} \sin^3 x \cos x \, dx$ evaluates to:

A. 1/4

B. 1/2

C. 1

D. 1/3

Q65. A box contains 5 defectives and 15 good items. Two items are drawn at random without replacement. The probability that both are good is:

A. 21/38

B. 15/38

C. 9/19

D. 7/19

Q66. The gradient of the scalar field $f(x, y, z) = x^2yz^3$ at the point (1, 1, 1) is:

A. 2i + j + 3k

B. 2i - j + 3k

C. i + j + k

D. 2i + 2j + 2k

Q67. The solution to the ordinary differential equation $\frac{d^2y}{dx^2} + 9y = 0$ is of the form:

A. $y = c_1 e^{3x} + c_2 e^{-3x}$

B. $y = c_1 \cos 3x + c_2 \sin 3x$

C. $y = c_1 e^{9x} + c_2 x e^{9x}$

D. $y = c_1 \cos 9x + c_2 \sin 9x$

Q68. Using Simpson's 1/3 rule with two intervals, the value of $\int_0^2 x^2 dx$ is approximated as:

A. 8/3

B. 2

C. 3

D. 10/3

Q69. The value of the complex integral $\oint_C \frac{1}{z} dz$, where C is the unit circle $|z| = 1$ traversed counter-clockwise, is:

A. 0

B. $2\pi i$

C. πi

D. 1

Q70. The sum of the series $\sum_{n=1}^{\infty} \frac{1}{n(n+1)}$ is:

A. 1

B. 2

C. $\ln 2$

D. $\pi^2/6$

Q71. If $\mathbf{F} = \nabla\phi$, then the line integral $\int_A^B \mathbf{F} \cdot d\mathbf{r}$ is equal to:

A. 0

B. $\phi(A) - \phi(B)$

C. $\phi(B) - \phi(A)$

D. $\nabla \times \mathbf{F}$

Q72. The inverse of an orthogonal matrix Q is given by:

A. Q

B. Q^T

C. -Q

D. I

Q73. The Laplace transform of t^n (where n is a positive integer) is:

A. $\frac{n!}{s^{n+1}}$

B. $\frac{n}{s^n}$

C. $\frac{1}{s^n}$

D. $\frac{n!}{s^n}$

Q74. The point of inflection for the curve $y = x^3 - 3x^2 + 2x$ occurs at $x =$:

A. 0

B. 1

C. 2

D. -1

Q75. If a random variable X has a Poisson distribution such that $P(X = 1) = P(X = 2)$, then the mean of X is:

A. 1

B. 2

C. 3

D. 4

Q76. The Maclaurin series expansion of $\sin x$ is:

A. $\frac{1 - x^2}{2! + \frac{x^4}{4!} - \ldots}$

B. $\frac{x + x^3}{3! + \frac{x^5}{5!} + \ldots}$

C. $\frac{x - x^3}{3! + \frac{x^5}{5!} - \ldots}$

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

Q77. The integrating factor for the exact differential equation $M(x, y)dx + N(x, y)dy = 0$ is required when:

A. $\partial M \overline{\partial y = \frac{\partial N}{\partial x}}$

B. $\partial M \overline{\partial y \neq \frac{\partial N}{\partial x}}$

C. $\partial M \overline{\partial x = \frac{\partial N}{\partial y}}$

D. M = N

Q78. If Z is a standard normal random variable, then the variance of Z is:

A. 0

B. 1

C. μ

D. σ^2

Q79. The determinant of the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 0 & 4 & 5 \\ 0 & 0 & 6 \end{bmatrix}$ is:

A. 0

B. 10

C. 24

D. 12

Q80. According to Cauchy's Integral Theorem, if $f(z)$ is analytic inside and on a simple closed contour C, then $\oint_C f(z)dz$ is:

A. $2\pi i$

B. 1

C. 0

D. $2\pi i \times$ Residue

Q81. If "some birds are planes" and "all planes are fast", which conclusion necessarily follows?

A. All birds are fast

B. Some birds are fast

C. All planes are birds

D. No birds are fast

Q82. A clock strikes once at 1 o'clock, twice at 2 o'clock, and so on. How many times will it strike in 24 hours?

A. 156

B. 300

C. 78

D. 24

Q83. If 'A' is the brother of 'B', 'B' is the sister of 'C', and 'C' is the father of 'D', how is 'D' related to 'A'?

A. Nephew or Niece

B. Uncle

C. Cousin

D. Brother

Q84. Complete the series: 3, 8, 15, 24, 35, ?

A. 44

B. 46

C. 48

D. 50

Q85. If in a certain language, PROSE is coded as PPOQE, how will LIGHT be coded?

A. LGGFT

B. LIGFT

C. LGJHT

D. LJGFT

Q86. A girl cycles 4 km towards East, turns Right and cycles 3 km. How far is she from her starting point?

A. 7 km

B. 5 km

C. 1 km

D. 12 km

Q87. In a class, Rohan ranks 7th from the top and 26th from the bottom. How many students are there in the class?

A. 31

B. 32

C. 33

D. 34

Q88. Select the option that is related to the third word in the same way as the second word is related to the first. Book : Author :: Statue : ?

A. Mason

B. Painter

C. Sculptor

D. Architect

Q89. If 8 men can build a wall in 10 days, how many days will it take 4 men to build the same wall?

A. 5 days

B. 15 days

C. 20 days

D. 25 days

Q90. Five books are placed on a table. Economics is above Math, Sanskrit is below Hindi, Math is above Hindi, and Science is below Sanskrit. Which book is at the bottom?

A. Hindi

B. Science

C. Sanskrit

D. Math

Solutions

1. B
Explanation: The combing process physically combs the fibers to extract short fibers (noil), neps, and fine impurities, resulting in a highly parallelized, fine, and strong combed sliver.

2. C
Explanation: Micronaire measures the air permeability of a standard plug of cotton. It provides an indirect but highly reliable combined measure of both fiber fineness and fiber maturity.

3. D
Explanation: Friction spinning (DREF) twists fibers using aerodynamic and mechanical friction forces. It is highly suitable for spinning very coarse, bulky, and soft yarns (like for mops, towels, and denim).

4. B
Explanation: The traveler is dragged around the ring by the yarn. The physical friction between the traveler and the ring creates the winding tension required to wind the yarn tightly onto the bobbin.

5. B
Explanation: Compact spinning uses aerodynamic forces (suction) in the drafting zone to condense the fiber bundle just before twist insertion, effectively eliminating the weak "spinning triangle."

6. C
Explanation: When twist is applied, the fibers take a helical path, which shortens the overall length of the yarn (twist contraction). This increases the mass per unit length (tex) of the yarn.

7. C
Explanation: After passing through the size box and drying cylinders, warp yarns are glued together in a sheet. Split rods (lease rods) are used to physically break this sheet into individual yarns before winding.

8. A
Explanation: The shape of the yarn balloon rotating around the bobbin under the influence of centrifugal force and air drag is mathematically modeled and approximated as a catenary curve.

9. C
Explanation: The reed controls the spacing of warp yarns. If the metal wires (dents) of the reed are bent or distorted, the warp yarns are grouped unevenly, leaving visible

lengthwise streaks called reed marks.

10. C
Explanation: In most modern rigid and flexible rapier weaving machines, the giver rapier carries the weft to the center of the shed, where it is transferred to the taker rapier which pulls it to the other side.

11. A
Explanation: Silk fibroin is characterized by a high proportion of simple, small amino acids. The primary repeating sequence is (-Gly-Ser-Gly-Ala-Gly-Ala-), heavily enriched in Glycine and Alanine.

12. C
Explanation: Wool has the highest moisture regain among common natural fibers. Under standard conditions (65% RH, 20°C), its official moisture regain is approximately 13.6% to 16%.

13. C
Explanation: Exhaustion is a measure of dyeing efficiency. It represents the percentage of dye molecules that have migrated from the dye liquor (bath) and bonded securely into the textile fibers.

14. A
Explanation: OBAs (or fluorescent brightening agents) absorb invisible ultraviolet (UV) radiation and re-emit it in the visible blue spectrum. This blue light counteracts the natural yellowness of the fabric, making it appear whiter.

15. C
Explanation: Dead cotton fibers lack a developed secondary cellulose wall. Therefore, they cannot absorb dyes properly, resulting in white, undyed specks appearing on the surface of the finished fabric.

16. B
Explanation: Spectrophotometers measure the exact amount of light reflected or transmitted by a sample at individual wavelengths across the visible spectrum (400-700 nm) to quantify its exact color.

17. C
Explanation: The Kawabata Evaluation System (KES) uses highly sensitive instruments to measure the low-stress mechanical properties of fabrics (tensile, shear, bending, compression, surface friction) to objectively evaluate "fabric hand" or feel.

18. C
Explanation: Knitted fabrics are highly stretchable in multiple directions. Standard

tensile testing is difficult; therefore, bursting strength (applying multidirectional pressure via a diaphragm or steel ball) is the preferred method.

19. A
Explanation: Moisture Regain (R) = $(W/D) \times 100 = 10 \implies W = 0.1D$. Moisture Content (M) = $(W/(W + D)) \times 100$. Substituting W: $(0.1D/1.1D) \times 100 = (0.1/1.1) \times 100 = 9.09\%$.

20. B
Explanation: The mechanical draw ratio is strictly the ratio of the surface speed of the faster drawing rollers to the surface speed of the slower feeding rollers.

21. B
Explanation: MFI is an indirect measure of molecular weight and viscosity. It measures the mass of polymer (in grams) that flows through a standard capillary die in 10 minutes under a specific load and temperature.

22. C
Explanation: Polyacrylonitrile (PAN) is the most common precursor for high-performance carbon fibers. The PAN fibers are stabilized (oxidized) and then carbonized at extremely high temperatures in an inert atmosphere.

23. B
Explanation: In wet spinning (used for viscose rayon and acrylic), the polymer is dissolved in a solvent. The solution is extruded through a spinneret directly into a chemical bath that coagulates (precipitates) the solid fiber.

24. C
Explanation: In warp knits, the face shows the vertical V-shaped loops (wales), while the technical back displays the underlaps—the yarns connecting the loops in one course to the loops in the next course diagonally.

25. B
Explanation: Stitch density is a key parameter for knitted fabrics. It is calculated by multiplying the number of courses per inch (horizontal rows) by the number of wales per inch (vertical columns).

26. C
Explanation: Cellulase enzymes specifically attack and hydrolyze the microscopic protruding cellulose fibers on the surface of cotton fabrics. This removes hairiness, reduces pilling, and imparts a smooth, soft handle (bio-polishing).

27. B
Explanation: The limit of spinability determines the finest yarn count possible. It is

reached when the number of fibers in the yarn cross-section is too low to maintain the cohesion and strength needed to withstand spinning tension.

28. C
Explanation: The Shirley Analyzer mechanically opens the cotton and utilizes an air stream. The lighter, high-surface-area lint fibers are carried by the air to a cage, while the heavier, denser trash particles fall due to gravity.

29. B
Explanation: A mock leno is a woven fabric structure that uses specific interlacing patterns to group warp and weft yarns tightly together, leaving visible open spaces or perforations, mimicking a true leno mesh.

30. B
Explanation: Terry weaving requires two warp beams (ground warp and pile warp). A special double beat-up mechanism allows a "loose pick" followed by a "fast pick" to force the pile warp into loops on the fabric surface.

31. C
Explanation: Crimp rigidity measures the bulkiness and stretchability of a textured yarn. It determines the yarn's ability to contract back to its crimped state after being subjected to a standard stretching load.

32. C
Explanation: Pad-batch is a highly efficient, semi-continuous method for dyeing cotton with reactive dyes. The fabric is padded with dye and alkali, batched onto a roll, wrapped in plastic, and rotated slowly to allow dye fixation at room temperature.

33. B
Explanation: The Crockmeter is a standardized testing instrument that rubs a white test cloth against the dyed fabric sample under a specific load to determine the amount of color transferred (crocking fastness).

34. C
Explanation: The drop penetration test evaluates the water repellency of heavy fabrics (like canvas or tent material) by measuring the time and volume of water required to penetrate the fabric under a continuous dripping load.

35. B
Explanation: In an indirect counting system (like English count, Ne), the count represents length per unit weight (e.g., 840-yard hanks per pound). Therefore, a higher number means more length per pound, indicating a finer yarn.

36. C

Explanation: Thermal bonding requires the application of heat and pressure. The web must contain at least a percentage of thermoplastic (meltable) fibers or binder fibers to fuse the structure together.

37. C
Explanation: The formula for total fractional cover (C) is $C = C_1 + C_2 - (C_1 \times C_2)$, where C_1 and C_2 are the warp and weft fractional covers. $C = 0.6 + 0.5 - (0.6 \times 0.5) = 1.1 - 0.3 = 0.80$.

38. B
Explanation: Flame retardants for synthetics are largely based on Halogens (Bromine, Chlorine) and Phosphorus. Halogens interrupt the radical gas-phase combustion mechanism, while Phosphorus promotes solid char formation.

39. C
Explanation: A drafting wave is an uncontrolled variation in fiber density occurring in the drafting zone due to floating short fibers. This manifests as repeating thick and thin places (periodic mass variations) in the yarn.

40. C
Explanation: The aprons in a double-apron drafting system extend close to the nip of the front rollers. They provide flexible guidance and friction to control short "floating" fibers, ensuring they draft evenly without creating a drafting wave.

41. A
Explanation: The Uster Tester measures mass variation (evenness/CV%) continuously by passing the yarn between two parallel capacitor plates. The change in mass of the yarn alters the dielectric constant and capacitance.

42. B
Explanation: The glass transition temperature (T_g) is the point where the amorphous regions of the polymer become flexible. For PET, this typically occurs between 70°C and 80°C, essential for processes like drawing and dyeing.

43. C
Explanation: Crabbing is a scouring and setting process specific to wool fabrics. It involves passing the fabric through boiling water under tension to release internal stresses and prevent distortions (like listing or cockling) during subsequent wet processing.

44. A
Explanation: A stenter is a long, heated chamber machine. The fabric edges are held by pins or clips on continuous chains, allowing the fabric to be dried and heat-set to precise dimensions (width and length).

45. B
Explanation: A dobby mechanism provides greater patterning capability than cams. It can mechanically control up to about 24 to 28 heald shafts independently, allowing for intricate geometric weaves.

46. D
Explanation: Primary motions form the fabric (Shedding, Picking, Beat-up). Secondary motions make weaving continuous by advancing the warp (Warp Let-off) and winding the woven cloth (Fabric Take-up).

47. B
Explanation: Due to the imbalanced structural loops in a plain single jersey fabric, the top and bottom edges (courses) curl towards the technical back, while the side edges (wales) curl towards the technical face.

48. B
Explanation: While neps can contain seed fragments, standard fiber neps are predominantly small, tightly tangled knots composed of highly immature or dead cotton fibers, which lack the stiffness of mature fibers.

49. B
Explanation: Polyurethane (PU) is widely used in textile coating. It forms a flexible, extremely tough, waterproof film that is highly resistant to abrasion and chemicals, ideal for rainwear and protective gear.

50. C
Explanation: The "Clo" is a unit used to measure the thermal insulation provided by clothing. 1 Clo is the insulation needed to keep a resting person warm in a room at 21°C. It equals 0.155 $m^2 \cdot K/W$.

51. A
Explanation: The conversion between English cotton count (Ne) and Tex is given by the constant 590.5. $Tex = 590.5/Ne$. Therefore, $Tex = 590.5/40 = 14.7625 \approx 14.76$ Tex.

52. B
Explanation: The balloon height is the vertical distance between the drafting front roller nip (or specifically the thread guide/lappet) and the traveler on the ring. It dictates the size and shape of the yarn balloon.

53. C
Explanation: A dobby mechanism uses mechanical pegs, punched paper, or electronic solenoids to read a pattern and dictate which specific heald shafts are lifted for each pick.

54. A

Explanation: DREF (friction) spinning creates a highly structured yarn where a core of parallel, untwisted (or false-twisted) fibers is held together by wrapper fibers that are tightly spun around the outside.

55. C
Explanation: Sulfur dyes are cheap, have good wash fastness, and are used almost exclusively to produce deep, heavy, dark shades like black, navy blue, and dark brown on cotton fabrics.

56. B
Explanation: In resist printing, a paste containing a resisting agent (chemical or mechanical like wax) is printed first. When the fabric is subsequently dyed, the dye is repelled or destroyed in the printed areas, leaving a pattern.

57. A
Explanation: Tenacity standardizes fiber strength relative to its thickness. It is calculated by dividing the absolute breaking load (in centinewtons or grams-force) by the linear density (in tex or denier).

58. A
Explanation: Uniformity Index (UI) = (Mean Length / Upper Half Mean Length) $\times$ 100. UI = (25 / 30) $\times$ 100 = 83.33%.

59. C
Explanation: When placed between the soft subgrade soil and the coarse aggregate base, the geotextile performs the "separation" function, preventing the aggregate from sinking into the mud and maintaining road integrity.

60. C
Explanation: Glass fibers are completely inorganic and non-combustible. Under standard apparel flammability tests, glass textiles will not ignite or burn, although they will melt at extreme temperatures.

61. A
Explanation: Characteristic equation: $\det(A - \lambda I) = (3-\lambda)(3-\lambda) - (-1)(-1) = \lambda^2 - 6\lambda + 9 - 1 = \lambda^2 - 6\lambda + 8 = 0$. Roots are $\lambda = 2$ and $\lambda = 4$.

62. B
Explanation: Maclaurin series for $\tan x \approx x + \frac{x^3}{3}$. So, $\frac{\tan x - x}{x^3} \approx \frac{(x + x^3/3) - x}{x^3} = \frac{x^3/3}{x^3} = 1/3$.

63. C
Explanation: The equation $\nabla^2 u = \frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ is the classic 2D Laplace's equation, representing steady-state heat conduction or potential flow.

64. A
Explanation: Let $u = \sin x$, $du = \cos x\, dx$. Limits change from $u(0) = 0$ to $u(\pi/2) = 1$. Integral becomes $\int_0^1 u^3 du = [u^4/4]_0^1 = 1/4$.

65. A
Explanation: Total items = 20. Probability of first good = 15/20. Probability of second good (without replacement) = 14/19. Total probability = $(15/20) \times (14/19) = (3/4) \times (14/19) = 42/76 = 21/38$.

66. A
Explanation: $\nabla f = \frac{\partial f}{\partial x}\mathbf{i} + \frac{\partial f}{\partial y}\mathbf{j} + \frac{\partial f}{\partial z}\mathbf{k} = 2xyz^3\mathbf{i} + x^2z^3\mathbf{j} + 3x^2yz^2\mathbf{k}$. At (1,1,1), this becomes $2\mathbf{i} + 1\mathbf{j} + 3\mathbf{k}$.

67. B
Explanation: The characteristic equation is $m^2 + 9 = 0 \implies m = \pm 3i$. The roots are purely imaginary, so the general solution is $y = c_1 \cos 3x + c_2 \sin 3x$.

68. A
Explanation: Two intervals $n = 2$, step size $h = (2 - 0)/2 = 1$. Points are $x_0 = 0, x_1 = 1, x_2 = 2$. Values $y_0 = 0, y_1 = 1, y_2 = 4$. Simpson's rule: $\frac{h}{3}[y_0 + 4y_1 + y_2] = \frac{1}{3}[0 + 4(1) + 4] = \frac{8}{3}$.

69. B
Explanation: The function $1/z$ has a simple pole at $z = 0$ with a residue of 1. By Cauchy's Residue Theorem, the integral is $2\pi i \times$ (Sum of residues) $= 2\pi i \times 1 = 2\pi i$.

70. A
Explanation: This is a telescoping series. $\frac{1}{n(n+1)} = \frac{1}{n} - \frac{1}{n+1}$. Summing from 1 to N: $(1 - 1/2) + (1/2 - 1/3) + \cdots + (\frac{1}{N} - \frac{1}{N+1}) = 1 - \frac{1}{N+1}$. As $N \to \infty$, sum = 1.

71. C
Explanation: This is the Fundamental Theorem of Line Integrals. If a vector field is conservative ($\mathbf{F} = \nabla\phi$), the line integral is path-independent and equals the potential ϕ at the endpoint minus the start point: $\phi(B) - \phi(A)$.

72. B
Explanation: By definition, an orthogonal matrix Q is a square matrix whose columns and rows are orthogonal unit vectors, meaning $Q^TQ = I$. Therefore, $Q^{-1} = Q^T$.

73. A
Explanation: By definition and standard tables, the Laplace transform of t^n is given by $\mathcal{L}\{t^n\} = \frac{n!}{s^{n+1}}$.

74. B

Explanation: First derivative: $y' = 3x^2 - 6x + 2$. Second derivative: $y'' = 6x - 6$. Inflection point occurs where $y'' = 0$. $6x - 6 = 0 \implies x = 1$.

75. B
Explanation: Poisson PMF: $P(X = k) = \frac{\lambda^k e^{-\lambda}}{k!}$. $P(X = 1) = \lambda e^{-\lambda}$. $P(X = 2) = \frac{\lambda^2 e^{-\lambda}}{2}$. Equating them: $\lambda = \lambda^2/2 \implies \lambda = 2$. Mean is $\lambda = 2$.

76. C
Explanation: The standard Maclaurin series for $\sin x$ is an alternating series containing only odd powers of x: $x - \frac{x^3}{3!} + \frac{x^5}{5!} - \ldots$

77. B
Explanation: An equation is exact if $\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$. If they are not equal ($\neq$), the equation is inexact, and an integrating factor is required to multiply through and make it exact.

78. B
Explanation: By definition, a standard normal distribution has a mean (μ) of 0 and a variance (σ^2) of 1.

79. C
Explanation: The matrix is an upper triangular matrix. The determinant of any triangular matrix is simply the product of its main diagonal entries: $1 \times 4 \times 6 = 24$.

80. C
Explanation: Cauchy's Integral Theorem states that if a function $f(z)$ is analytic everywhere inside and on a simple closed contour C, the loop integral around C is exactly 0.

81. B
Explanation: If some birds are planes, and every single plane is fast, then those specific birds that are planes must also be fast. Therefore, some birds are fast.

82. A
Explanation: In 12 hours, strikes $= 1 + 2 + 3 + ... + 12 = \frac{12 \times 13}{2} = 78$. Since a day has 24 hours, the clock completes this 12-hour cycle twice. $78 \times 2 = 156$ times.

83. A
Explanation: A is a male (brother). B is a female (sister of C). C is a male (father of D). A, B, and C are siblings. Since C is the father of D, D is the child of C. A is the brother of D's father, making A the uncle of D. Thus, D is the nephew or niece of A.

84. C
Explanation: The series follows the pattern $n^2 - 1$. $2^2 - 1 = 3$, $3^2 - 1 = 8$, $4^2 - 1 = 15$, $5^2 - 1 = 24$, $6^2 - 1 = 35$. The next term is $7^2 - 1 = 49 - 1 = 48$.

85. B

Explanation: Pattern: letters at odd positions remain the same, letters at even positions are shifted by -3. P(same), R(-3)=O, O(same), S(-3)=P, E(same)? No, PROSE to PPOQE: P(same), R-¿P (-2), O(same), S-¿Q (-2), E(same). Let's apply this to LIGHT: L(same), I-¿G (-2), G(same), H-¿F (-2), T(same) = LGGFT.

86. B

Explanation: The girl travels 4 km East, then turns right (South) and travels 3 km. This forms a right-angled triangle with legs of 4 and 3. The hypotenuse (distance from start) is $\sqrt{4^2 + 3^2} = \sqrt{16 + 9} = \sqrt{25} = 5$ km.

87. B

Explanation: Total students = (Rank from top + Rank from bottom) - 1. Total = (7 + 26) - 1 = 33 - 1 = 32.

88. C

Explanation: An Author writes/creates a Book. Similarly, a Sculptor carves/creates a Statue.

89. C

Explanation: This is an inverse proportion problem ($M_1 \times D_1 = M_2 \times D_2$). $8 \times 10 = 4 \times D_2$. $80 = 4 \times D_2 \implies D_2 = 20$ days.

90. B

Explanation: Order from top to bottom based on clues: Eco is above Math (E ¿ M). Math is above Hindi (M ¿ H). Sanskrit is below Hindi (H ¿ Sa). Science is below Sanskrit (Sa ¿ Sc). Chain: Eco ¿ Math ¿ Hindi ¿ Sanskrit ¿ Science. Science is at the bottom.