

# OJEE M Tech Textile Sample Paper 01

**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.** In melt spinning, the phenomenon of "die swell" or "extrudate swell" is primarily due to:

- A. Newtonian fluid behavior
- B. Shear thickening
- C. Viscoelastic memory of the polymer melt
- D. Rapid thermal degradation

**Q2.** The birefringence of a synthetic fiber is directly proportional to its:

- A. Degree of crystallinity
- B. Overall molecular orientation
- C. Moisture regain
- D. Degree of polymerization

**Q3.** In a roller drafting system, the "drafting wave" is predominantly caused by:

- A. Eccentricity of the bottom rollers
- B. Improper weighting of the top rollers
- C. Uncontrolled movement of floating fibers
- D. High sliver hank

**Q4.** Which of the following spinning technologies imparts a "true twist" to the yarn?

- A. Rotor spinning
- B. Air-jet spinning
- C. Friction spinning
- D. Ring spinning

**Q5.** The limit of spinability for a given fiber in ring spinning is largely determined by:

- A. Fiber length only
- B. Minimum number of fibers in the yarn cross-section
- C. Spindle speed
- D. Traveler weight

**Q6.** During the winding process, patterning (ribbon formation) is avoided by using:

- A. Constant winding speed
- B. Anti-patterning mechanisms (like modulating drum speed)
- C. Grooved drums with uniform pitch
- D. Higher yarn tension

**Q7.** Sizing of warp yarns is primarily done to:

- A. Increase yarn elongation
- B. Improve yarn dyeability
- C. Reduce yarn hairiness and improve abrasion resistance
- D. Increase yarn count

**Q8.** In a primary weaving motion, the beat-up force depends on:

- A. Warp tension and shed geometry
- B. Weft insertion rate only
- C. Loom motor speed only
- D. Shuttle weight

**Q9.** Which shedding mechanism provides the maximum pattern flexibility?

- A. Tappet shedding
- B. Dobby shedding
- C. Jacquard shedding
- D. Crank shedding

**Q10.** The basic repeating unit in the structure of cellulose is:

- A. Glucose
- B. Cellobiose

- C. Fructose
- D. Galactose

**Q11.** Wool fibers exhibit a bilateral structure consisting of:

- A. Orthocortex and Paracortex
- B. Medulla and Cuticle
- C. Crystalline and Amorphous regions
- D. Alpha-keratin and Beta-keratin

**Q12.** Reactive dyes establish which type of bond with cellulosic fibers?

- A. Hydrogen bond
- B. Ionic bond
- C. Covalent bond
- D. Van der Waals force

**Q13.** The role of a carrier in dyeing polyester with disperse dyes is to:

- A. Increase the dye solubility in water
- B. Swell the fiber and lower its glass transition temperature (T<sub>g</sub>)
- C. Form a complex with the dye
- D. Prevent dye aggregation

**Q14.** During the mercerization of cotton, the crystal structure changes from:

- A. Cellulose II to Cellulose I
- B. Cellulose I to Cellulose III
- C. Cellulose I to Cellulose II
- D. Cellulose IV to Cellulose I

**Q15.** In textile testing, the Shirley Analyzer is used to determine:

- A. Fiber fineness
- B. Trash content in raw cotton
- C. Fiber maturity
- D. Yarn evenness

**Q16.** The AFIS (Advanced Fiber Information System) primarily measures fiber properties using:

- A. Optical sensors on individualized fibers
- B. Airflow mechanism
- C. Capacitance principle
- D. Gravimetric methods

**Q17.** Yarn hairiness is defined by the Uster Hairiness Index (H) as:

- A. Total length of protruding fibers in cm per 1 cm of yarn length
- B. Number of hairs longer than 3 mm per meter
- C. Average length of all protruding fibers
- D. Mass of protruding fibers per unit length

**Q18.** The crease recovery angle of a fabric is a measure of its:

- A. Tensile strength
- B. Bending rigidity and resilience
- C. Tear strength
- D. Drape coefficient

**Q19.** Fabric drape is typically evaluated using which principle?

- A. Circular fabric supported by a smaller circular disk
- B. Cantilever bending of a fabric strip
- C. Buckling of a cylindrical fabric specimen
- D. Impact testing

**Q20.** According to Pierce's geometry of plain woven fabrics, the yarn cross-section is assumed to be:

- A. Elliptical
- B. Rectangular
- C. Circular
- D. Race-track shaped

**Q21.** In nonwoven fabric manufacturing, needle-punching consolidates the web through:

- A. Thermal bonding
- B. Mechanical entanglement of fibers
- C. Chemical binders
- D. Hydroentanglement

**Q22.** Spunbond nonwovens are produced by:

- A. Carding and cross-lapping
- B. Extruding continuous filaments directly into a web
- C. Wet laying of short fibers
- D. Blowing hot air onto a polymer melt

**Q23.** Kevlar (aramid) fiber possesses high strength and modulus due to its:

- A. Flexible polymer chains
- B. Highly crystalline and extended-chain liquid crystal structure
- C. Cross-linked network structure
- D. High moisture absorption

**Q24.** The fundamental difference between a warp knit and a weft knit is:

- A. Warp knits use only one yarn
- B. Weft knits cannot be unraveled
- C. In warp knitting, yarns form loops in the lengthwise direction
- D. Weft knits are structurally more stable than warp knits

**Q25.** The specific stress of a fiber is generally expressed in units of:

- A. MPa
- B. cN/tex
- C. kg/m<sup>3</sup>
- D. Joules

**Q26.** Which spinning method uses an electrostatic field to produce nanofibers?

- A. Melt spinning
- B. Wet spinning

- C. Gel spinning
- D. Electrospinning

**Q27.** The drafting ratio in a draw frame is defined as the ratio of:

- A. Delivery speed to feed speed
- B. Feed speed to delivery speed
- C. Draft roller diameter to feed roller diameter
- D. Output count to input count

**Q28.** The traveler in ring spinning receives its rotational drive from the:

- A. Spindle
- B. Yarn being dragged by the bobbin
- C. Ring rail
- D. Drafting rollers

**Q29.** An autoconer removes yarn faults using:

- A. Mechanical scissors only
- B. Electronic yarn clearers and splicers
- C. Tensioners
- D. Balloon control rings

**Q30.** Sley eccentricity in a loom is necessary to:

- A. Increase weaving speed
- B. Provide sufficient time for shuttle passage during the back-center dwell
- C. Reduce warp tension
- D. Decrease beat-up force

**Q31.** In Jacquard shedding, the individual warp yarns are controlled by:

- A. Heald shafts
- B. Harness cords and heddles
- C. Tappet profiles
- D. Dobby jacks

**Q32.** Which of the following dyes requires a reduction step to become water-soluble before dyeing?

- A. Acid dyes
- B. Vat dyes
- C. Basic dyes
- D. Direct dyes

**Q33.** Anti-crease finishing of cotton fabrics is typically achieved using:

- A. Polyethylene glycol
- B. Dimethylol dihydroxyethyleneurea (DMDHEU)
- C. Sodium hydroxide
- D. Silicone softeners

**Q34.** The "K/S" value from the Kubelka-Munk equation is directly related to:

- A. Dye concentration on the fabric
- B. Fabric thickness
- C. Moisture content
- D. Fiber strength

**Q35.** Tear strength of a fabric is lowest when measured using the:

- A. Elmendorf pendulum test
- B. Tongue tear test
- C. Trapezoid tear test
- D. Grab test

**Q36.** Thermal resistance of a fabric depends most significantly on its:

- A. Fiber density
- B. Entrapped air volume (thickness)
- C. Color
- D. Yarn twist

**Q37.** A blended yarn contains 65% Polyester and 35% Cotton. If the overall count is 30 Ne, the effective count of the polyester component is:

- A. 46.1 Ne
- B. 19.5 Ne
- C. 85.7 Ne
- D. 10.5 Ne

**Q38.** The primary advantage of air-jet spinning over ring spinning is:

- A. Higher yarn strength
- B. Lower production speed
- C. Much higher production rate
- D. Ability to spin 100% short staple cotton effectively

**Q39.** The most common sequence of operations in blow room for cotton is:

- A. Opening, Cleaning, Blending, Lap forming
- B. Cleaning, Lap forming, Blending, Opening
- C. Blending, Cleaning, Lap forming, Opening
- D. Lap forming, Opening, Blending, Cleaning

**Q40.** Carding cylinder and doffer operate under the principle of:

- A. Point-to-point action
- B. Back-to-back action
- C. Point-to-back action
- D. Stripping action

**Q41.** High volume instrument (HVI) tests cotton fiber bundle strength in terms of:

- A. g/denier
- B. grams/tex
- C. N/m
- D. cN/dtex

**Q42.** The typical moisture regain of standard nylon 6,6 under standard atmospheric conditions is approximately:

- A. 0.4%
- B. 4.0 - 4.5%

- C. 8.5%
- D. 13.0%

**Q43.** An essential requirement for a polymer to be fiber-forming is:

- A. Highly branched chains
- B. Low molecular weight
- C. Linear polymer chains with adequate molecular weight
- D. Complete amorphous structure

**Q44.** Differential scanning calorimetry (DSC) is used in textiles to determine:

- A. Fiber length
- B. Melting point and glass transition temperature
- C. Tensile strength
- D. Dye uptake

**Q45.** The mechanism of wetting out a fabric involves:

- A. Increasing the surface tension of water
- B. Decreasing the surface tension of the liquid to allow spreading
- C. Increasing the contact angle to 180 degrees
- D. Polymerizing the surface fibers

**Q46.** Which bonding technique uses calendar rollers to bond nonwoven webs?

- A. Chemical bonding
- B. Needle punching
- C. Thermal point bonding
- D. Spunlacing

**Q47.** In a compound needle used in warp knitting, the hook is closed by a:

- A. Latch
- B. Sinker
- C. Closing element (tongue/slider)
- D. Presser bar

**Q48.** A double jersey fabric structure that utilizes dial and cylinder needles is:

- A. Single pique
- B. Rib knit
- C. Plain knit
- D. Tricot

**Q49.** Fabric breathability is most accurately quantified by its:

- A. Air permeability and water vapor transmission rate
- B. Hydrostatic head
- C. Thermal insulation
- D. Bending length

**Q50.** Tensile testing of yarns on a constant-rate-of-extension (CRE) machine uses load cells based on:

- A. Pendulum lever
- B. Strain gauges
- C. Inclined plane
- D. Dead weights

**Q51.** Twist multiplier (TM) and Twist factor (TF) relate to yarn count ( $N_e$  and Tex) and TPI/TPM. The relation for English count is:

- A.  $TPI = TM \times \sqrt{N_e}$
- B.  $TPI = TM / \sqrt{N_e}$
- C.  $TPI = TM \times N_e$
- D.  $TPI = TM / N_e$

**Q52.** The function of the 'aprons' in a ring spinning drafting system is to:

- A. Impart twist
- B. Guide floating fibers and control drafting
- C. Wind the yarn onto the bobbin
- D. Clean the bottom rollers

**Q53.** Shuttleless looms achieve higher speeds by:

- A. Eliminating the reed
- B. Reducing the mass of the weft insertion medium
- C. Weaving multiple layers simultaneously
- D. Using larger shuttles

**Q54.** The 'sizing pick-up' percentage is defined as:

- A.  $\text{Weight of size added} / \text{Weight of unsized yarn} \times 100$
- B.  $\text{Weight of unsized yarn} / \text{Weight of sized yarn} \times 100$
- C.  $\text{Volume of size box} / \text{Warp sheet width}$
- D.  $\text{Length of sized yarn} / \text{Length of unsized yarn} \times 100$

**Q55.** Direct dyes are retained in cellulosic fibers mainly by:

- A. Ionic interactions
- B. Hydrogen bonding and Van der Waals forces
- C. Covalent bonds
- D. Metallic complexes

**Q56.** Continuous dyeing of cotton fabrics with vat dyes typically follows which method?

- A. Pad-Dry-Pad-Steam
- B. Exhaust dyeing in a jet machine
- C. Jig dyeing
- D. Pad-Batch

**Q57.** A high UPF (Ultraviolet Protection Factor) in clothing is achieved by:

- A. Loose, open structures
- B. Wetting the fabric
- C. Using UV-absorbing dyes and finishes, and tight weaves
- D. Using highly transparent synthetic fibers

**Q58.** The standard testing atmosphere for textiles in India is:

A.  $20^{\circ}\text{C}$  and  $65\text{centRH}$

B.  $27^{\circ}\text{C}$  and  $65\text{centRH}$

C.  $25^{\circ}\text{C}$  and  $50\text{centRH}$

D.  $30^{\circ}\text{C}$  and  $70\text{centRH}$

**Q59.** Limit of irregularity (Index of Irregularity) is the ratio of:

A. Actual unevenness to ideal unevenness

B. Ideal unevenness to actual unevenness

C. CV% of draft to CV% of feed

D. Mass variance to length variance

**Q60.** Geotextiles are primarily designed to fulfill functions such as:

A. Aesthetics and comfort

B. Separation, filtration, drainage, and reinforcement

C. Thermal insulation and fire resistance

D. Crease recovery and drapability

**Q61.** The eigenvalues of the matrix  $A = \begin{bmatrix} 4 & 1 \\ 2 & 3 \end{bmatrix}$  are:

A. 2 and 5

B. 3 and 4

C. 1 and 6

D. 0 and 7

**Q62.** The value of the integral  $\int_0^1 xe^x dx$  is:

A. 1

B. e

C. e - 1

D. 0

**Q63.** The solution to the differential equation  $\frac{dy}{dx} + y = e^{-x}$  with initial condition  $y(0) = 1$  is:

A.  $y = (x + 1)e^{-x}$

B.  $y = x e^{-x}$

C.  $y = e^{-x}$

D.  $y = e^x$

**Q64.** The Laplace transform of  $f(t) = \sin(at)$  is:

A.  $s / (s^2 + a^2)$

B.  $a / (s^2 + a^2)$

C.  $s / (s^2 - a^2)$

D.  $a / (s^2 - a^2)$

**Q65.** A continuous random variable  $X$  has a probability density function  $f(x) = kx$  for  $0 \leq x \leq 2$ , and 0 otherwise. The value of  $k$  is:

A.  $1/2$

B.  $1/4$

C. 1

D. 2

**Q66.** The rank of a  $3 \times 3$  matrix where all elements are 1 is:

A. 3

B. 2

C. 1

D. 0

**Q67.** The divergence of the vector field  $\mathbf{V} = x^2\mathbf{i} + y^2\mathbf{j} + z^2\mathbf{k}$  is:

A.  $2(x + y + z)$

B.  $x + y + z$

C.  $2xyz$

D. 0

**Q68.** The minimum value of the function  $f(x) = x^2 - 4x + 7$  is:

- A. 0
- B. 3
- C. 7
- D. -4

**Q69.** If  $A$  and  $B$  are two independent events with  $P(A) = 0.4$  and  $P(B) = 0.5$ , then  $P(A \cup B)$  is:

- A. 0.9
- B. 0.7
- C. 0.2
- D. 0.8

**Q70.** The limit  $\lim_{x \rightarrow 0} \frac{\sin(3x)}{5x}$  evaluates to:

- A.  $3/5$
- B.  $5/3$
- C. 0
- D. 1

**Q71.** The determinant of an orthogonal matrix is always:

- A. 0
- B.  $\pm 1$
- C. 2
- D. Complex

**Q72.** The general solution of the differential equation  $\frac{d^2y}{dx^2} - 4y = 0$  is:

- A.  $C_1 \cos(2x) + C_2 \sin(2x)$
- B.  $C_1 e^{2x} + C_2 e^{-2x}$
- C.  $C_1 e^{4x} + C_2 e^{-4x}$
- D.  $(C_1 + C_2 x) e^{2x}$

**Q73.** The integrating factor for the linear differential equation  $\frac{dy}{dx} + \left(\frac{2}{x}\right)y = x^2$  is:

- A.  $x^2$
- B.  $e^x$
- C.  $1/x^2$
- D.  $\ln(x)$

**Q74.** Using Newton-Raphson method to find the root of  $x^2 - 3 = 0$ , starting with  $x_0 = 1$ , the value of  $x_1$  is:

- A. 1.5
- B. 2.0
- C. 1.75
- D. 2.5

**Q75.** The order and degree of the differential equation  $\left(\frac{d^2y}{dx^2}\right)^3 + \left(\frac{dy}{dx}\right)^4 + y = 0$  are respectively:

- A. Order 2, Degree 3
- B. Order 3, Degree 2
- C. Order 2, Degree 4
- D. Order 1, Degree 4

**Q76.** If  $z = x + iy$ , then the analytic function  $f(z)$  whose real part is  $x^2 - y^2$  is:

- A.  $z^2 + C$
- B.  $z^3 + C$
- C.  $e^z + C$
- D.  $2z + C$

**Q77.** The area enclosed between the curves  $y = x$  and  $y = x^2$  is:

- A.  $1/2$
- B.  $1/3$
- C.  $1/6$
- D.  $1/4$

**Q78.** The value of the line integral  $\oint (x \, dy - y \, dx)$  along the circle  $x^2 + y^2 = r^2$  traversed counter-clockwise is:

- A.  $\pi r^2$
- B.  $2\pi r^2$
- C. 0
- D.  $2\pi r$

**Q79.** Let  $X$  be a binomial random variable with parameters  $n = 10$  and  $p = 0.5$ . The variance of  $X$  is:

- A. 5
- B. 2.5
- C. 10
- D. 0.5

**Q80.** A bag contains 3 red and 4 black balls. If two balls are drawn at random without replacement, the probability that both are red is:

- A.  $1/7$
- B.  $3/7$
- C.  $9/49$
- D.  $2/7$

**Q81.** Pointing to a photograph, a man said, "I have no brother or sister but that man's father is my father's son." Whose photograph was it?

- A. His own
- B. His son's
- C. His father's
- D. His nephew's

**Q82.** In a certain code language, "COMPUTER" is written as "RFUVQNPC". How will "MEDICINE" be written in that code language?

- A. EOJDJEFM
- B. MFEDJJOE
- C. EOJDEJFM

D. MFEJDJOE

**Q83.** Find the next number in the series: 2, 6, 12, 20, 30, ...

A. 40

B. 42

C. 44

D. 38

**Q84.** A is located 5 km to the East of B. C is located 5 km to the North of B. What is the straight-line distance between A and C?

A. 5 km

B. 10 km

C. 7.07 km

D. 25 km

**Q85.** Six friends are sitting in a circle facing the center. A is between B and C. D is between E and F. B is to the immediate right of E. Who is sitting to the immediate left of C?

A. F

B. A

C. D

D. E

**Q86.** Choose the word which is least like the other words in the group.

A. Copper

B. Zinc

C. Brass

D. Aluminum

**Q87.** If 1st January 2024 was a Monday, what day of the week will be 1st January 2025?

A. Monday

B. Tuesday

C. Wednesday

D. Sunday

**Q88.** If  $+$  means  $\times$ ,  $-$  means  $\div$ ,  $\times$  means  $-$ , and  $\div$  means  $+$ , then what is the value of  $16 - 4 + 3 \times 5 \div 2$ ?

A. 9

B. 10

C. 12

D. 15

**Q89.** A train running at the speed of 60 km/hr crosses a pole in 9 seconds. What is the length of the train?

A. 120 meters

B. 180 meters

C. 324 meters

D. 150 meters

**Q90.** In a class of 45 students, rank of Ayush is 15th from the top. What is his rank from the bottom?

A. 30th

B. 31st

C. 32nd

D. 29th

## Solutions

1. C

**Explanation:** In melt spinning, the polymer acts as a viscoelastic fluid. When it exits the spinneret, the shear stress is removed, allowing the stretched polymer chains to relax and recoil, causing the extrudate to swell.

2. B

**Explanation:** Birefringence is the difference between the refractive indices parallel and perpendicular to the fiber axis. It directly indicates the degree of overall molecular orientation along the fiber axis.

3. C

**Explanation:** In a roller drafting system, short floating fibers that are not gripped by either the back or front rollers move uncontrollably. This uncontrolled movement creates periodic mass variations known as the drafting wave.

4. D

**Explanation:** Ring spinning introduces a true twist into the yarn as the traveler revolves around the ring, rotating the yarn around its own axis. Air-jet spinning, by contrast, imparts a false twist or fasciated structure.

5. B

**Explanation:** The spinability limit dictates how fine a yarn can be spun. It is fundamentally restricted by the minimum number of fibers required in the yarn cross-section to maintain continuity and cohesive strength.

6. B

**Explanation:** Patterning or ribbon formation occurs when yarn coils fall precisely on top of one another. Anti-patterning mechanisms, such as modulating the drum speed, continuously shift the winding angle to prevent this.

7. C

**Explanation:** Sizing coats the warp yarns with a protective film that binds protruding surface fibers. This significantly reduces yarn hairiness and improves abrasion resistance to withstand weaving stresses.

8. A

**Explanation:** Beat-up force is the physical force required by the reed to push the newly inserted weft to the fell of the cloth. It is primarily determined by the tension of the warp yarns and the geometry of the shed.

9. C

**Explanation:** Jacquard shedding controls each warp yarn individually via harness cords. This eliminates the restriction of heald shafts, allowing for infinite and highly complex pattern variations.

10. B

**Explanation:** While glucose is the basic monomeric building block, cellulose is formed by beta-1,4-glycosidic bonds causing alternating units to flip. Therefore, the structural repeating unit is the dimer cellobiose.

11. A

**Explanation:** The cortex of a wool fiber is divided bilaterally into two halves: the

orthocortex and the paracortex. Their differing chemical and physical properties cause the natural crimp in wool.

**12. C**

**Explanation:** Reactive dyes contain reactive groups that chemically bond with the hydroxyl (-OH) groups in cellulosic fibers. This forms a strong, permanent covalent bond, giving excellent wash fastness.

**13. B**

**Explanation:** Carriers are organic compounds used in dyeing polyester. They penetrate the fiber, swell the structure, and lower the glass transition temperature (T<sub>g</sub>), allowing large disperse dye molecules to enter at boiling temperatures.

**14. C**

**Explanation:** Mercerization involves treating cotton with concentrated sodium hydroxide. This swells the fiber and permanently alters its native crystalline structure from Cellulose I to the thermodynamically more stable Cellulose II.

**15. B**

**Explanation:** The Shirley Analyzer is a traditional mechanical device used to separate lint from non-lint components. It accurately determines the percentage of trash content in a raw cotton sample.

**16. A**

**Explanation:** The Advanced Fiber Information System (AFIS) mechanically individualizes fibers and passes them through an electro-optical sensor. It measures properties like length, neps, and trash on a single-fiber basis.

**17. A**

**Explanation:** The Uster Hairiness Index (H) is a standard optical measurement. It is defined as the cumulative length of all protruding fibers (in centimeters) per one centimeter of evaluated yarn length.

**18. B**

**Explanation:** Crease recovery angle measures a fabric's ability to return to its original state after being folded and compressed. This property depends largely on the fibers' bending rigidity and intrinsic resilience.

**19. A**

**Explanation:** Fabric drape is typically measured using a drape meter. A circular fabric specimen is supported by a smaller circular disk, and the shadow cast by the unsupported, draped edges is used to calculate the drape coefficient.

**20. C**

**Explanation:** In Pierce's classic geometry of plain woven fabrics, the theoretical model assumes that the cross-sections of the interacting warp and weft yarns are perfectly circular and the yarns act as flexible cylinders.

**21. B**

**Explanation:** Needle-punching is a mechanical bonding process. Barbed needles repeatedly penetrate a loose fiber web, catching and mechanically entangling fibers in the vertical direction to give the fabric structural integrity.

**22. B**

**Explanation:** Spunbond technology involves extruding molten polymer through

a spinneret to form continuous filaments. These filaments are cooled, drawn, and laid directly onto a conveyor belt to form a random web.

**23. B**

**Explanation:** Kevlar is spun from a liquid crystalline polymer solution. This unique state allows the rigid aramid polymer chains to align almost perfectly along the fiber axis, resulting in high crystallinity and exceptional strength.

**24. C**

**Explanation:** In weft knitting, a single yarn runs crosswise, forming consecutive loops. In warp knitting, multiple yarns run parallel in the lengthwise direction, with each yarn forming loops vertically and diagonally to interlock.

**25. B**

**Explanation:** Specific stress (or tenacity) standardizes strength across different fiber finenesses. It is calculated by dividing the breaking force by the linear density, typically expressed in centinewtons per tex (cN/tex).

**26. D**

**Explanation:** Electrospinning utilizes a high-voltage electrostatic field to draw a polymer solution or melt into an ultra-fine jet. The solvent evaporates, depositing solid continuous nanofibers onto a grounded collector.

**27. A**

**Explanation:** The mechanical drafting ratio (draft) in a spinning preparatory machine like a draw frame is the ratio of the surface speed of the delivery (front) rollers to the surface speed of the feed (back) rollers.

**28. B**

**Explanation:** The traveler does not have an independent drive. It is pulled around the stationary ring by the yarn, which is itself being wound and rotated by the driven spindle and bobbin assembly.

**29. B**

**Explanation:** Modern winding machines (autoconers) use electronic yarn clearers (optical or capacitive sensors) to detect thick/thin places. Faults are cut out, and the ends are automatically joined using a pneumatic splicer.

**30. B**

**Explanation:** Sley eccentricity alters the simple harmonic motion of the sley. It slows down the sley at the back-center (dwell), providing maximum time and space for the shuttle to pass freely through the open shed.

**31. B**

**Explanation:** In Jacquard weaving, heald shafts are entirely eliminated. Instead, each individual warp end is threaded through a heddle eye that is connected to and controlled by a vertical harness cord.

**32. B**

**Explanation:** Vat dyes are highly insoluble in water. They must first be chemically reduced (usually with sodium hydrosulfite and caustic soda) into a soluble "leuco" form to penetrate the fiber, before being oxidized back to the insoluble form.

**33. B**

**Explanation:** Anti-crease finishes (resin finishes) cross-link the cellulose chains in cotton to prevent them from slipping under stress. Dimethylol dihydroxyethyleneurea (DMDHEU) is the most widely used durable cross-linking agent.

**34. A**

**Explanation:** The Kubelka-Munk equation calculates the K/S value from the fabric's reflectance. The K/S value is directly proportional to the actual concentration of the dye present within the fabric structure.

**35. B**

**Explanation:** In the tongue tear test, the tearing force is concentrated on just one or two yarns at a time as the tear propagates. This lack of yarn sharing typically yields the lowest tear strength values compared to other methods.

**36. B**

**Explanation:** Still air is an excellent thermal insulator. Therefore, the thermal resistance (insulation value) of a fabric is primarily determined by its thickness and the total volume of entrapped air within its structure.

**37. A**

**Explanation:** The overall count is 30 Ne. The effective count of a component in an indirect system is determined by dividing the yarn count by the component's fraction. Polyester count =  $30 / 0.65 = 46.1$  Ne.

**38. C**

**Explanation:** Air-jet spinning uses stationary aerodynamic forces to wrap surface fibers around a core, completely eliminating the rotating spindle and traveler. This allows for production speeds far higher than conventional ring spinning.

**39. A**

**Explanation:** The blow room sequence prepares raw cotton bales for carding. The standard flow is opening the compressed tufts, cleaning out heavy trash, blending different bales for consistency, and finally forming a lap (or feeding a chute).

**40. A**

**Explanation:** The actual carding action, where fiber individualization occurs, happens between the cylinder and the flats. However, the transfer of fibers from the cylinder to the doffer occurs via a point-to-point (wire angle) interaction.

**41. B**

**Explanation:** High Volume Instruments (HVI) assess cotton fiber bundle strength using the constant rate of extension principle. The strength is normalized by the bundle's linear density and expressed in grams per tex (g/tex).

**42. B**

**Explanation:** Nylon 6,6 contains polar amide groups that attract water, but it is highly crystalline. Under standard testing conditions ( $20^{\circ}\text{C}/27^{\circ}\text{C}$  and 6543.

**43. C**  
**Explanation:** For a polymer to form a strong, flexible fiber, it must consist of long, highly linear chains with sufficient molecular weight. This linearity allows the chains to align and crystallize during the drawing process.

**44. B**

**Explanation:** DSC measures the heat flow into or out of a sample as it is heated. It is the primary thermal analysis technique used to determine critical phase tran-

sitions in fibers, such as  $T_g$ , melting point, and crystallization temperature.

**45. B**

**Explanation:** Fabric wetting requires the processing liquid to spread rapidly over the fiber surface. Surfactants (wetting agents) achieve this by drastically lowering the surface tension of the liquid, decreasing the contact angle.

**46. C**

**Explanation:** Thermal point bonding passes a thermoplastic fiber web between heated calender rollers, at least one of which is engraved with a raised pattern. The fibers melt and fuse only at these raised points, maintaining web flexibility.

**47. C**

**Explanation:** Unlike latch needles which are closed by the yarn, compound needles consist of two separately controlled parts: a hook and a sliding closing element (tongue/slider) that actively moves to close the hook during loop formation.

**48. B**

**Explanation:** Rib knit is a double jersey structure produced on a machine equipped with two sets of needles (cylinder and dial) operating at right angles to each other, creating a fabric with alternating face and back wales.

**49. A**

**Explanation:** Breathability refers to a fabric's ability to allow air and moisture to pass through. It is scientifically evaluated by measuring both the air permeability (airflow) and the water vapor transmission rate (moisture escape).

**50. B**

**Explanation:** Modern Constant-Rate-of-Extension (CRE) tensile testers (like Instron) utilize sensitive electronic load cells. These load cells rely on strain gauges that change electrical resistance proportionally to the applied pulling force.

**51. A**

**Explanation:** In the indirect English count system (Ne), the twist level is determined empirically. The formula relating Turns Per Inch (TPI), Twist Multiplier (TM), and yarn count is:  $TPI = TM \times \sqrt{Ne}$ .

**52. B**

**Explanation:** The aprons (top and bottom synthetic rubber bands) in a drafting system provide flexible, continuous control over the short, floating fibers during drafting, preventing drafting waves and ensuring yarn evenness.

**53. B**

**Explanation:** Conventional looms are limited by the heavy mass of the wooden shuttle. Shuttleless looms (air-jet, rapier, projectile) use much lighter insertion mediums, requiring less kinetic energy, thus allowing dramatically higher weaving speeds.

**54. A**

**Explanation:** Sizing pick-up (or size add-on) quantifies the amount of sizing chemicals applied to the warp. It is expressed as a percentage of the bone-dry weight of the size added relative to the original dry weight of the unsized yarn.

**55. B**

**Explanation:** Direct dyes are large, linear planar molecules. They do not form

covalent bonds; instead, they have a high natural affinity for cellulose and are retained primarily by extensive hydrogen bonding and Van der Waals forces.

**56. A**

**Explanation:** For large-scale continuous dyeing of cotton with vat dyes, the Pad-Dry-Pad-Steam method is standard. The fabric is padded with pigment, dried, padded with reducing agents, and then steamed to fix the dye into the fibers.

**57. C**

**Explanation:** A high UPF rating prevents UV rays from reaching the skin. This is engineered by using very tight weave structures to minimize open pores, combined with applying UV-absorbing chemicals (like titanium dioxide) and dark dyes.

**58. B**

**Explanation:** Because textile fibers are hygroscopic, testing conditions must be strictly controlled. The standard tropical testing atmosphere adopted in India (per BIS standards) is an ambient temperature of  $27 \pm 2^\circ\text{C}$  and  $65 \pm 2\%$  Relative Humidity.

**59. A**

**Explanation:** The Index of Irregularity (Limit of Irregularity) measures how far a yarn deviates from perfection. It is the ratio of the actual measured unevenness (CV%) to the theoretical minimum ideal unevenness calculated from fiber parameters.

**60. B**

**Explanation:** Geotextiles are technical fabrics used in civil engineering and soil reinforcement. Their four primary functional categories are separating soil layers, filtering fluids, providing drainage paths, and mechanically reinforcing earth structures.

**61. A**

**Explanation:** The trace of A is  $4+3=7$  (sum of eigenvalues) and the determinant is  $(4 \times 3) - (2 \times 1) = 10$  (product of eigenvalues). The numbers 2 and 5 satisfy both:  $2+5=7$  and  $2 \times 5=10$ .

**62. A**

**Explanation:** Using integration by parts:  $\int x e^x dx = x e^x - \int e^x dx = x e^x - e^x$ . Evaluating from 0 to 1:  $(1 \cdot e^1 - e^1) - (0 - e^0) = (e - e) - (-1) = 1$ .

**63. A**

**Explanation:** This is a linear ODE. The integrating factor is  $e^{\int 1 dx} = e^x$ . Multiplying through yields  $(y e^x)' = e^x e^{-x} = 1$ . Integrating gives  $y e^x = x + C$ . Since  $y(0) = 1$ ,  $C = 1$ . Thus,  $y = (x + 1)e^{-x}$ .

**64. B**

**Explanation:** By definition, the Laplace transform of the sine function  $\sin(at)$  is computed as  $\mathcal{L}\{\sin(at)\} = \frac{a}{s^2+a^2}$  for  $s > 0$ .

**65. A**

**Explanation:** The total area under the probability density function must be 1. Thus,  $\int_0^2 k x dx = k \left[ \frac{x^2}{2} \right]_0^2 = k(2) = 1$ . Solving for  $k$  gives  $k = 1/2$ .

**66. C**

**Explanation:** A matrix where all elements are 1 has identical rows. Row opera-

tions (Row 2 - Row 1, Row 3 - Row 1) will zero out all rows except the first. Only one linearly independent row remains, so the rank is 1.

**67. A**

**Explanation:** Divergence is  $\nabla \cdot \mathbf{V} = \frac{\partial V_x}{\partial x} + \frac{\partial V_y}{\partial y} + \frac{\partial V_z}{\partial z}$ . For  $x^2\mathbf{i} + y^2\mathbf{j} + z^2\mathbf{k}$ , this equals  $2x + 2y + 2z = 2(x + y + z)$ .

**68. B**

**Explanation:** To find the minimum, set the derivative to zero:  $f'(x) = 2x - 4 = 0$ , giving  $x = 2$ . Substituting back into the function:  $f(2) = (2)^2 - 4(2) + 7 = 4 - 8 + 7 = 3$ .

**69. B**

**Explanation:** For independent events,  $P(A \cap B) = P(A)P(B) = 0.4 \times 0.5 = 0.2$ . Using the union formula,  $P(A \cup B) = P(A) + P(B) - P(A \cap B) = 0.4 + 0.5 - 0.2 = 0.7$ .

**70. A**

**Explanation:** We can rewrite the limit as  $\frac{3}{5} \lim_{x \rightarrow 0} \frac{\sin(3x)}{3x}$ . Since the standard limit  $\lim_{\theta \rightarrow 0} \frac{\sin(\theta)}{\theta} = 1$ , the expression evaluates to  $\frac{3}{5} \times 1 = \frac{3}{5}$ .

**71. B**

**Explanation:** By definition, an orthogonal matrix  $A$  satisfies  $AA^T = I$ . Taking the determinant of both sides gives  $\det(A)\det(A^T) = \det(I)$ . Since  $\det(A) = \det(A^T)$  and  $\det(I) = 1$ ,  $\det(A)^2 = 1$ , meaning  $\det(A) = \pm 1$ .

**72. B**

**Explanation:** The characteristic equation is  $m^2 - 4 = 0$ , giving roots  $m = 2$  and  $m = -2$ . Since the roots are real and distinct, the general solution is  $y = C_1e^{2x} + C_2e^{-2x}$ .

**73. A**

**Explanation:** This is a linear differential equation of the form  $y' + P(x)y = Q(x)$ . The integrating factor (IF) is  $e^{\int P(x)dx} = e^{\int \frac{2}{x}dx} = e^{2\ln(x)} = e^{\ln(x^2)} = x^2$ .

**74. B**

**Explanation:** The Newton-Raphson formula is  $x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$ . Here,  $f(x) = x^2 - 3$  and  $f'(x) = 2x$ . For  $x_0 = 1$ ,  $x_1 = 1 - \frac{1^2 - 3}{2(1)} = 1 - \frac{-2}{2} = 1 + 1 = 2.0$ .

**75. A**

**Explanation:** The order is the highest derivative present, which is  $d^2y/dx^2$  (Order 2). The degree is the power of the highest derivative once the equation is a polynomial in derivatives, which is 3.

**76. A**

**Explanation:** Let  $f(z) = u + iv$  with  $u = x^2 - y^2$ . Using Cauchy-Riemann equations,  $v_y = u_x = 2x \implies v = 2xy$ . Thus,  $f(z) = (x^2 - y^2) + i(2xy) = (x + iy)^2 = z^2$ .

**77. C**

**Explanation:** The curves intersect where  $x = x^2 \implies x = 0$  and  $x = 1$ . The line  $y = x$  is above the parabola  $y = x^2$  in this interval. The area is  $\int_0^1 (x - x^2)dx = [\frac{x^2}{2} - \frac{x^3}{3}]_0^1 = \frac{1}{2} - \frac{1}{3} = \frac{1}{6}$ .

**78. B**

**Explanation:** Using Green's Theorem:  $\oint (Mdy - Ndx) = \iint (\frac{\partial M}{\partial x} - \frac{\partial N}{\partial y})dA$ . Here,  $\iint (1 - (-1))dA = 2 \iint dA$ . Since the area of the circle is  $\pi r^2$ , the integral is  $2\pi r^2$ .

**79. B**

**Explanation:** For a binomial distribution, the variance is given by the formula  $\sigma^2 = np(1-p)$ . Substituting the given values:  $10 \times 0.5 \times (1-0.5) = 10 \times 0.25 = 2.5$ .

**80. A**

**Explanation:** The probability of drawing a red ball first is  $3/7$ . Without replacement, there are 2 red balls left out of 6. The probability of drawing a second red ball is  $2/6 = 1/3$ . Total probability =  $(3/7) \times (1/3) = 1/7$ .

**81. B**

**Explanation:** "My father's son" is the speaker himself (since he has no siblings). Therefore, the sentence simplifies to: "That man's father is me." This means the photograph is of his son.

**82. A**

**Explanation:** The logic is: Reverse the word, keep the first and last letters identical to the reversed string, and add +1 to the alphabetical position of the middle letters. Applying this to MEDICINE yields EOJDJEFM.

**83. B**

**Explanation:** The series follows the pattern  $n^2 + n$ .  $1^2 + 1 = 2$ ;  $2^2 + 2 = 6$ ;  $3^2 + 3 = 12$ ;  $4^2 + 4 = 20$ ;  $5^2 + 5 = 30$ . The 6th term is  $6^2 + 6 = 36 + 6 = 42$ . Alternatively, the differences increase by 2 (4, 6, 8, 10, 12).

**84. C**

**Explanation:** B is at the origin (0,0). A is at (5,0) and C is at (0,5), forming a right-angled triangle. The distance AC is the hypotenuse:  $\sqrt{5^2 + 5^2} = \sqrt{50} \approx 7.07$  km.

**85. A**

**Explanation:** Based on the conditions, the clockwise seating arrangement from E is: E, B, A, C, F, D. Since they are facing the center, the immediate left of a person is the next person clockwise. The immediate left of C is F.

**86. C**

**Explanation:** Copper, Zinc, and Aluminum are all pure chemical elements (metals) found on the periodic table. Brass is an alloy made by combining Copper and Zinc.

**87. C**

**Explanation:** 2024 is a leap year, containing 366 days (including Feb 29). Therefore, a full year from Jan 1, 2024, shifts the weekday by 2 days ( $366 \bmod 7 = 2$ ). Monday + 2 days = Wednesday.

**88. A**

**Explanation:** Substituting the symbols as given:  $16 \div 4 \times 3 - 5 + 2$ . Applying BODMAS (Divide, Multiply, Add/Subtract):  $4 \times 3 - 5 + 2 \Rightarrow 12 - 5 + 2 \Rightarrow 7 + 2 = 9$ .

**89. D**

**Explanation:** First, convert the speed to m/s:  $60 \text{ km/hr} \times (5/18) = 50/3 \text{ m/s}$ . The length of the train is the distance it travels while crossing the pole: Speed  $\times$  Time =  $(50/3) \times 9 = 150$  meters.

**90. B**

**Explanation:** The formula for finding rank from the opposite end is: Total

Students = (Rank from top + Rank from bottom) - 1. Therefore,  $45 = (15 + \text{Rank from bottom}) - 1 \implies \text{Rank} = 45 - 14 = 31\text{st}$ .

