

Textile Engineering 29th March 2025 Shift3

Time Allowed :1.5 Hours	Maximum Marks :300	Total questions : 75
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General Instructions

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1. Question Paper contains 75 Questions .
2. Each correct answer will have +4 marks and wrong answer will lead to -1

1. In _____, the package is driven in frictional contact with the drum.

- (A) Drum driven winding
- (B) Spindle driven winding
- (C) Pirn winding
- (D) Weft winding

Correct Answer: (A) Drum driven winding

Solution: Step 1: Analyze the question. The question describes a winding mechanism where the package (the yarn being wound) is turned because it's in frictional contact with a rotating drum.

Step 2: Evaluate the options.

- **Drum driven winding:** In this method, a rotating drum is in contact with the surface of the yarn package. The friction between the drum and the package causes the package to rotate and wind the yarn. This matches the description perfectly.
- **Spindle driven winding:** Here, the package is mounted on a spindle, and the spindle is directly driven by a motor. The rotation of the package is not caused by friction with a drum.
- **Pirn winding** and **Weft winding** are specific types of winding processes, but the driving mechanism itself is the key distinction. Pirn winding often uses spindle driving for shuttle looms.

Quick Tip

In winding technology, the key distinction is how the package is rotated. If rotation is due to surface contact with a roller/drum, it's "drum driven" or "surface driven." If the package holder itself is rotated, it's "spindle driven."

2. In _____, the yarn passes through two plates in which one plate is the baseplate and the other is a weighing plate.

- (A) Electronic tensioner
- (B) Additive type tensioner
- (C) Multiplicative type tensioner

(D) Roller tensioner

Correct Answer: (C) Multiplicative type tensioner

Solution: Step 1: Understand the mechanism described. The setup involves two plates: a fixed baseplate and a movable "weighing" plate. The yarn runs between them. The weighing plate applies pressure to the yarn, creating tension.

Step 2: Analyze the types of tensioners.

- **Multiplicative type tensioner (disc tensioner):** This type works by pressing the yarn between two surfaces (discs or plates). The tension is controlled by the pressure applied. The description of a baseplate and a weighing plate fits this category. The tension applied is a function of the incoming tension multiplied by a factor related to the friction and wrap angle.
- **Additive type tensioner:** This type adds tension by deflecting the yarn path using weighted pulleys or arms.
- **Electronic tensioner:** This is a broad category that can use various mechanical means but is controlled electronically to maintain constant tension.
- **Roller tensioner:** This type uses rollers to control tension, often by creating a specific yarn path or using braking systems on the rollers.

The plate system described is the classic design of a multiplicative or disc-type tensioner.

Quick Tip

Tensioners are classified by how they apply force. "Multiplicative" tensioners use friction by pinching the yarn (e.g., discs). "Additive" tensioners add tension by using weights or springs to deflect the yarn path.

3. In case of plain weave fabric, the respective warp and weft counts are 30 tex and 20 tex, with 40 ends per cm and 30 picks per cm. The warp has 10% crimp and weft also 10% crimp. Calculate the weight of fabric in grams/square meter.

- (A) 178
- (B) 188
- (C) 198

(D) 208

Correct Answer: (B) 188

Solution: Step 1: Formula for Fabric GSM (Grams per Square Meter).

GSM = Weight of warp in 1 sq. meter + Weight of weft in 1 sq. meter.

Weight of Yarn (g/m) = Tex / 1000.

Total length of yarn in 1 sq. meter = (Threads per meter) $\times$ (Length per thread).

Length per thread includes crimp: Length = $1\text{ m} \times (1 + \text{Crimp \%} / 100)$.

Step 2: Calculate the weight of the warp.

Warp count = 30 tex.

Ends per cm = 40, so Ends per meter = 4000.

Warp crimp = 10% = 0.10.

Total length of warp yarn in 1 sq. meter = $4000\text{ ends/m} \times 1\text{ m} \times (1 + 0.10) = 4400\text{ m}$.

Weight of warp = Total length $\times$ Weight per meter = $4400 \times \frac{30}{1000} = 132\text{ g}$.

Step 3: Calculate the weight of the weft.

Weft count = 20 tex.

Picks per cm = 30, so Picks per meter = 3000.

Weft crimp = 10% = 0.10.

Total length of weft yarn in 1 sq. meter = $3000\text{ picks/m} \times 1\text{ m} \times (1 + 0.10) = 3300\text{ m}$.

Weight of weft = Total length $\times$ Weight per meter = $3300 \times \frac{20}{1000} = 66\text{ g}$.

Step 4: Calculate the total fabric weight (GSM).

GSM = Weight of warp + Weight of weft = $132\text{ g} + 66\text{ g} = 198\text{ g}$. Wait, there is a calculation mistake. Let me recheck. Weight of weft = $3300 \times 20/1000 = 66$. Correct. Weight of warp = $4400 \times 30/1000 = 132$. Correct. Total = 198. Let's re-read the question. Everything seems correct. Let me check the provided answer. The answer is 188. Let's work backwards.

Perhaps the formula is different. Let's try the standard simplified formula. GSM =

$\frac{\text{Ends/cm} \times \text{Warp Tex}}{100} \times (1 + C_w) + \frac{\text{Picks/cm} \times \text{Weft Tex}}{100} \times (1 + C_f)$ This is not correct. Let's use the

fundamental formula: GSM =

$(\frac{\text{Ends per cm} \times 100}{1} \times \frac{1}{1} \times \frac{100 + \text{crimp}\%}{100}) \times \frac{\text{Warp tex}}{1000} + (\frac{\text{Picks per cm} \times 100}{1} \times \frac{1}{1} \times \frac{100 + \text{crimp}\%}{100}) \times \frac{\text{Weft tex}}{1000}$ GSM =

$(40 \times 100 \times 1.10 \times \frac{30}{1000}) + (30 \times 100 \times 1.10 \times \frac{20}{1000})$ GSM =

$(4400 \times 0.03) + (3300 \times 0.02) = 132 + 66 = 198$.

There seems to be a discrepancy between the calculated answer (198) and the given option (188). Let's re-examine the logic. The calculation is robust. It's possible the intended answer or one of the input values in the question is incorrect. However, if we assume the crimp is NOT added to the length calculation for GSM (which is theoretically incorrect, but sometimes done for approximation), the result would be: Weight of warp (no crimp) = $4000 \times \frac{30}{1000} = 120$ g. Weight of weft (no crimp) = $3000 \times \frac{20}{1000} = 60$ g. Total (no crimp) = $120 + 60 = 180$ g. This is close to 178.

Let's assume the question meant that the count was given for the crimped yarn. Let's try another common mistake where length is taken as 100 cm. GSM =

$$\frac{40 \times 30}{100} \times 1.1 + \frac{30 \times 20}{100} \times 1.1 = (12 \times 1.1) + (6 \times 1.1) = 13.2 + 6.6 = 19.8. \text{ Incorrect units.}$$

Let's stick to the fundamental calculation which yields 198 g/m^2 . Option (C) is 198. The provided solution must be incorrect. The correct calculation based on standard textile formulas is 198.

Final Calculation: Warp weight/ m^2 = (Ends/m) $\times$ (Length per end with crimp) $\times$ (Linear density) Warp weight/ m^2 = $(40 \times 100) \times (1 \times 1.10) \times \frac{30}{1000} = 4000 \times 1.1 \times 0.03 = 132$ g. Weft weight/ m^2 = (Picks/m) $\times$ (Length per pick with crimp) $\times$ (Linear density) Weft weight/ m^2 = $(30 \times 100) \times (1 \times 1.10) \times \frac{20}{1000} = 3000 \times 1.1 \times 0.02 = 66$ g. Total GSM = $132 + 66 = 198 \text{ g/m}^2$.

Conclusion: The calculated answer is 198. There might be an error in the question or the provided options/answer key. We select (C) 198 as the mathematically correct answer.

Quick Tip

To calculate fabric weight (GSM), always calculate the warp and weft contributions separately and then add them. The formula is: Total yarn length in 1m^2 (including crimp) $\times$ yarn linear density (in g/m). Remember to convert all units consistently (e.g., ends/cm to ends/m).

4. In _____ system, a warping beam with a complex pattern of colored stripes is obtained.

- (A) Direct beam warping
- (B) Ball warping

- (C) Sectional warping
- (D) Warp sizing machine

Correct Answer: (C) Sectional warping

Solution: Step 1: Understand the requirement. The goal is to create a warping beam with a complex pattern of colored stripes. This means that yarns of different colors must be arranged in a specific order across the width of the beam.

Step 2: Evaluate the warping systems.

- **Direct beam warping (or Beam warping):** This process winds all the yarns for a beam directly from a creel onto the beam. It is very fast and efficient but is suitable for single-color yarns or simple stripe patterns. Creating a complex, multi-colored pattern is difficult and inefficient.
- **Ball warping:** This process creates a "rope" of yarn that is later processed. It is not used for creating patterned weaver's beams directly.
- **Sectional warping (or Pattern warping):** This method is designed specifically for creating complex colored patterns. The total width of the warp is divided into sections. Each section is wound onto a drum with the required color pattern. After all sections are wound side-by-side on the drum, the entire warp sheet is transferred to the weaver's beam. This allows for precise control of the color sequence.
- **Warp sizing machine:** This machine applies size to the yarn; it does not create the color pattern.

Conclusion: Sectional warping is the appropriate method for producing a warp beam with a complex colored pattern.

Quick Tip

Remember the main purpose of different warping methods: - **Direct/Beam Warping:** High speed for single-color (solid) warps. - **Sectional Warping:** Slower, for complex multi-colored stripe patterns.

5. In the slasher sizing machine, the principle involved in drying the wet warp sheet by

physical contact with a hot drum surface is _____.

- (A) Conduction
- (B) Convection
- (C) Radiation
- (D) Combined convection and radiation

Correct Answer: (A) Conduction

Solution: Step 1: Analyze the process described. A wet warp sheet is dried by making "physical contact" with a "hot drum surface".

Step 2: Define the heat transfer principles.

- **Conduction:** Heat transfer through direct physical contact. Heat flows from a hotter object to a colder object they are touching.
- **Convection:** Heat transfer through the movement of fluids (liquids or gases). Hot air blowing over a surface is an example.
- **Radiation:** Heat transfer through electromagnetic waves, which does not require a medium. The heat from the sun is an example.

Step 3: Apply the principles to the scenario. Since the warp sheet is in direct physical contact with the hot drum, heat is transferred directly from the drum's surface to the wet yarn. This is the definition of conduction. While some convection (from hot air around the cylinders) and radiation might occur, the primary and dominant principle described is conduction.

Quick Tip

Think of the modes of heat transfer: - **Conduction** = Contact - **Convection** = Current (fluid movement) - **Radiation** = Rays (waves) The question specifies "physical contact," which directly points to conduction.

6. To prevent the growth of microorganisms, _____ is added to the size paste.

- (A) Adhesive material
- (B) Softener
- (C) Antistatic agent

(D) Antiseptic agent

Correct Answer: (D) Antiseptic agent

Solution: Step 1: Understand the purpose of the additive. The goal is to "prevent the growth of microorganisms" (like bacteria, mildew, or fungi) in the size paste. Size pastes, often containing natural starches, are nutrient-rich environments for these organisms.

Step 2: Evaluate the options based on their function.

- **Adhesive material:** This is the main component of the size paste (e.g., starch, PVA), which provides strength and abrasion resistance to the yarn. It does not prevent microbial growth; it encourages it.

- **Softener:** Additives like fats, oils, and waxes are used to make the sized yarn more flexible and less brittle.

- **Antistatic agent:** This is used to reduce the build-up of static electricity during processing, especially with synthetic fibers.

- **Antiseptic agent (or biocide/fungicide):** This is a chemical added specifically to kill or inhibit the growth of microorganisms.

Conclusion: An antiseptic agent is the correct additive to prevent the growth of microorganisms in the size paste.

Quick Tip

Break down the components of a size paste by function: - **Adhesive:** The "glue" (starch, PVA). - **Lubricant/Softener:** For flexibility (oils, waxes). - **Antiseptic:** To prevent spoilage/mildew. - **Antistat:** To reduce static.

7. The material flow of the warp sheet through different zones in a sizing machine is

_____.

A. Drying zone

B. Size box zone

C. Beaming zone

D. Creel zone

- (A) A, C, B, D
- (B) D, B, A, C
- (C) C, A, D, B
- (D) B, D, C, A

Correct Answer: (B) D, B, A, C

Solution: Step 1: Visualize the process of a sizing machine (slasher). The process starts with the yarn supply and ends with the final sized beam.

Step 2: Sequence the zones logically.

- **D. Creel zone:** The process begins here. The weaver's beams from warping are placed in a creel to feed the yarn as a continuous sheet into the machine.
- **B. Size box zone:** After leaving the creel, the sheet of yarn is immersed in the size paste in the size box to apply the sizing chemical.
- **A. Drying zone:** The wet, sized yarn then immediately moves into the drying zone (e.g., hot cylinders or a hot air chamber) to remove the moisture.
- **C. Beaming zone (or Headstock):** After drying, the yarn sheet is separated by lease rods and wound onto the final loom beam at the headstock.

Step 3: Match the sequence to the options. The logical sequence is $D \rightarrow B \rightarrow A \rightarrow C$. This corresponds to option (B).

Quick Tip

The sizing process follows a logical path: 1. **Unwind** the yarn (Creel). 2. **Apply** the size (Size Box). 3. **Dry** the yarn (Drying Zone). 4. **Rewind** onto the final beam (Beaming Zone).

8. The _____ machine is used to produce a suitable package of weft yarn for a shuttle loom.

- (A) Pirn winding
- (B) Cone winding
- (C) Sectional warping

(D) Two for one twister

Correct Answer: (A) Pirn winding

Solution: Step 1: Identify the key components in the question: "weft yarn package" and "shuttle loom".

Step 2: Understand the requirements of a shuttle loom. A shuttle loom uses a shuttle that travels back and forth across the loom. This shuttle carries a small, tapered package of weft yarn called a pirn. The pirn must be small enough to fit inside the shuttle and shaped correctly to allow yarn to be withdrawn easily during picking.

Step 3: Evaluate the options.

- **Pirn winding:** This is a specific type of winding process designed to produce pirns for use in shuttles. This is the correct answer.
- **Cone winding:** This process creates large, conical packages of yarn. These are typically used as supply packages for warping or weft for shuttleless looms, but not for shuttles.
- **Sectional warping:** This is a warp preparation process, not a weft winding process.
- **Two for one twister:** This machine is used to insert twist into yarn, not to create a specific type of package for a loom.

Quick Tip

Remember the specific packages for looms: - **Shuttle Looms** use **Pirns**. - **Shuttleless Looms** often use large **Cones** or other large packages as weft supply.

9. Match Type of shed with Position of warps.

LIST I	LIST II
Type of shed	Position of warps
A. Fully open shed	I. All warp returns to mid-position before the next shedding
B. Semi-open shed	II. All ends come down to the bottom position before the next shedding
C. Center closed shed	III. Unnecessary movements of the warps are avoided
D. Bottom closed shed	IV. A few healds move half the distance from the depth of the shed and go back to their top position for next shedding

(A) A-II, B-III, C-I, D-IV

(B) A-III, B-II, C-IV, D-I

(C) A-III, B-IV, C-I, D-II

(D) A-II, B-I, C-IV, D-III

Correct Answer: (C) A-III, B-IV, C-I, D-II

Solution: Step 1: Define each type of shed.

- **A. Fully open shed:** In this type (like with a tappet or dobby), a warp end that is up in one shed and required to be up in the next shed remains up. A warp end that is down and required to be up moves from the bottom to the top. This minimizes warp movement.

- **B. Semi-open shed:** This is characteristic of certain dobby mechanisms. Ends that need to remain up stay up, but ends that need to move from down to up only move halfway, meeting the ends coming down from the top at the center.

- **C. Center closed shed:** All warp ends, whether they were up or down, return to a central, level position after each pick. From this central line, they then move to their new up or down position for the next shed.

- **D. Bottom closed shed:** All warp ends, whether they were up or down, return to the bottom shed line after each pick. From the bottom line, the required ends are then lifted to form the next shed.

Step 2: Match the definitions with the descriptions in List II.

- **A. Fully open shed** matches with **III. Unnecessary movements of the warps are avoided**, because ends that need to stay up do so.
- **B. Semi-open shed** matches with **IV. A few healds move half the distance...**, describing the characteristic halfway movement.
- **C. Center closed shed** matches with **I. All warp returns to mid-position...**
- **D. Bottom closed shed** matches with **II. All ends come down to the bottom position...**

Step 3: Assemble the correct combination. The matching is A-III, B-IV, C-I, D-II. This corresponds to option (C).

Quick Tip

Associate a key position with each shed type: - **Closed Sheds:** All warps return to a common line. - **Center Closed:** Return to the middle. - **Bottom Closed:** Return to the bottom. - **Open Sheds:** Warps only move when they have to change position. - **Fully Open:** Up threads stay up if needed again. - **Semi-Open:** Involves a halfway meeting point.

10. In _____, an external device is required to close the hook of needle during loop formation.

- (A) Latch Needle
- (B) Compound Needle
- (C) Bearded Needle
- (D) Sewing Needle

Correct Answer: (C) Bearded Needle

Solution: Step 1: Understand the function of different needle types in knitting. The primary goal is to form a new loop and cast off the old one. This requires the hook to be able to open to catch new yarn and close to secure the new loop while the old one is cast off.

Step 2: Analyze how each needle type closes its hook.

- **Latch Needle:** Has a pivoting latch that closes the hook automatically when the old loop slides up the needle shank. It is self-acting.

- **Compound Needle:** Consists of two parts, a hook element and a sliding tongue or closing element. The parts move relative to each other to open or close the hook. It is also self-contained.
- **Bearded Needle:** Has a flexible hook (the "beard") that is bent back into a groove on the needle shank to close it. This bending action is performed by an external element called a "presser bar." Therefore, it requires an external device.
- **Sewing Needle:** Used for sewing, not for loop formation in knitting machines.

Conclusion: The bearded needle requires an external presser bar to close its hook.

Quick Tip

Memorize the hook closing mechanism for each knitting needle type: - **Latch Needle:** Self-closing with a pivoting latch. - **Bearded Needle:** Needs an external "presser" to bend the beard closed. - **Compound Needle:** Has its own internal sliding part to close the hook.

11. In _____ weft knitting machine, the needles in the two beds are not face to face but needles in one bed are in between the needles of the other bed.

- (A) Single jersey circular machine
- (B) Rib knitting
- (C) Interlock knitting
- (D) Purl knitting **Correct Answer:** (C) Interlock knitting

Solution: Step 1: Understand the question. It describes a knitting machine with two beds of needles (e.g., a cylinder and a dial). The key feature is the needle arrangement: they are not directly opposite each other ("face to face"), but are staggered or "in between." This is known as interlock gating.

Step 2: Analyze the gating of different knitting machines.

- **Single jersey circular machine:** Has only one set (bed) of needles, so this option is incorrect.
- **Rib knitting:** Uses two beds of needles (cylinder and dial) that are arranged directly

opposite each other. This is called rib gating. When needles from both beds are activated, they move towards the space between opposing needles.

- **Interlock knitting:** Uses two beds of needles in an "interlock gating" arrangement. The needles are staggered, so a needle from one bed is directly opposite a space between two needles on the other bed. This requires two separate cam systems for each bed, selecting long and short needles.

- **Purl knitting:** Uses double-headed latch needles that can transfer between two beds. This allows for purl stitches (loops to the front and back in the same wale). The gating is typically rib gating.

Conclusion: The staggered, non-face-to-face needle arrangement is the definition of interlock gating, used in interlock knitting.

Quick Tip

Remember the two main double-jersey gatings: - **Rib Gating:** Needles are face-to-face (opposite). Produces rib fabrics. - **Interlock Gating:** Needles are staggered (in-between). Produces interlock fabrics.

12. In the warp knitting machine, _____ of the guide bar takes place either from the front of the needles to the back or from the back of the needles to the front.

- (A) Swinging motion
- (B) Shogging motion
- (C) Vertical motion
- (D) Circular motion

Correct Answer: (A) Swinging motion

Solution: Step 1: Understand the basic movements in warp knitting. To form a loop, the yarn guide (held in a guide bar) must move the yarn around the needle. This involves several distinct motions.

Step 2: Define the motions of the guide bar.

- **Swinging motion:** This is the movement of the guide bar through the space between the

needles, from the front of the machine to the back, and vice-versa. This action places the yarn in the hook of the needle.

- **Shogging motion:** This is the sideways (lateral) movement of the guide bar, parallel to the needle bar. This motion laps the yarn around the needle to form the loop and also determines the pattern by moving the yarn to different needles.

- **Vertical motion:** The needles themselves move vertically up and down.

- **Circular motion:** This is not a standard term for a primary guide bar movement. The combination of swing and shog results in the yarn guide following a complex path, but the individual component motions are swing and shog.

Step 3: Match the description to the motion. The description "from the front of the needles to the back or from the back of the needles to the front" precisely defines the swinging motion.

Quick Tip

The two fundamental guide bar motions in warp knitting are: - **Swing:** In-and-out, through the needles (front-to-back). - **Shog:** Sideways, along the needles (left-to-right).

13. In nonwoven fabric manufacturing, the melt spinning process produces _____.

- (A) Spun bonded web
- (B) Aerodynamically formed web
- (C) mechanically formed web
- (D) wetlaid web

Correct Answer: (A) Spun bonded web

Solution: Step 1: Understand the question. It asks what type of nonwoven web is produced directly from a "melt spinning" process.

Step 2: Analyze the spunbond process. The spunbonding process starts with a thermoplastic polymer (e.g., polypropylene, polyester) which is melted and then extruded through a spinneret to form continuous filaments. These filaments are then drawn (stretched), cooled, and laid down directly onto a moving conveyor belt to form a web. The process integrates

spinning, web formation, and sometimes bonding into a single continuous step. This matches the description "melt spinning process produces... web".

Step 3: Analyze the other options.

- **Aerodynamically formed web (Airlaid):** This process uses staple fibers (short fibers), which are dispersed in a stream of air and then deposited onto a conveyor to form a web. It does not involve melt spinning.

- **Mechanically formed web:** This is a broad category. A common method is carding, which uses staple fibers. This is a mechanical process, not melt spinning.

- **Wetlaid web:** This process uses staple fibers dispersed in water, which are then filtered onto a screen to form a web, similar to papermaking. It does not involve melt spinning.

Conclusion: Melt spinning is the core of the spunbond process, which directly produces a spun bonded web.

Quick Tip

Connect the raw material and process for nonwovens: - **Molten Polymer** → Melt Spinning → **Spunbond / Meltblown**. - **Staple Fibers** → Carding/Airlaid/Wetlaid → Mechanically/Aerodynamically/Wetlaid formed webs.

14. Match Direction with Orientation of fibers on the web.

LIST I

Direction

A. Longitudinal orientation

B. Transverse orientation

C. Cross directional web

D. Random oriented web

LIST II

Orientation of fibers

I. Not oriented

II. Fibres laid in machine direction and width-wise directions

III. Fibres laid in a machine direction

IV. Fibres laid in a width-wise direction

(A) A - IV, B - I, C - III, D - II

- (B) A - II, B - III, C - I, D - IV
(C) A - I, B - II, C - IV, D - III
(D) A - III, B - IV, C - II, D - I

Correct Answer: (D) A - III, B - IV, C - II, D - I

Solution: Step 1: Define the terms for fiber orientation in a nonwoven web.

- **Longitudinal orientation (or Parallel-laid):** Most fibers are aligned in the direction of the machine's travel (Machine Direction, MD). This is typical for a standard carded web.
- **Transverse orientation (or Cross-laid):** Most fibers are aligned perpendicular to the machine direction (Cross Direction, CD). This is achieved by cross-lapping.
- **Cross directional web:** This implies a web with fibers laid in multiple directions, typically achieved by layering webs using a cross-lapper. This gives strength in both MD and CD.
- **Random oriented web:** Fibers are laid without any preferred orientation. This is typical for airlaid or wetlaid processes.

Step 2: Match the terms in List I with the descriptions in List II.

- **A. Longitudinal orientation** matches with **III. Fibres laid in a machine direction.**
- **B. Transverse orientation** matches with **IV. Fibres laid in a width-wise direction.**
- **C. Cross directional web** matches with **II. Fibres laid in machine direction and width-wise directions**, as it's built up by layering.
- **D. Random oriented web** matches with **I. Not oriented.**

Step 3: Assemble the correct combination. The matching is A-III, B-IV, C-II, D-I. This corresponds to option (D).

Quick Tip

Think of the directions on a map: - **Longitudinal** = North-South (Machine Direction).
- **Transverse** = East-West (Cross Direction). - **Cross** = Both N-S and E-W layers. - **Random** = No specific direction.

15. In non-woven fabric manufacturing, the surgical face masks are produced by _____.

- (A) Spunbond technology
- (B) Meltblown technology
- (C) Carded web
- (D) Wet laid technology

Correct Answer: Note: Surgical masks are typically composites, most commonly SMS (Spunbond-Meltblown-Spunbond). Of the single technologies listed, Meltblown provides the critical filtration layer.

Solution: Step 1: Understand the key requirement for a surgical face mask. The most critical function is filtration of fine particles (like bacteria and viruses) while maintaining breathability.

Step 2: Evaluate the properties of webs made by each technology.

- **Spunbond technology:** Produces webs with good strength and integrity, but the fibers are relatively coarse, leading to larger pores and poor filtration of very fine particles. It is used for the outer layers of a mask for strength.
- **Meltblown technology:** This process uses high-velocity hot air to attenuate molten polymer filaments into extremely fine microfibers. These fibers form a web with very small pore sizes, making it an excellent filtration medium. This is the essential layer for filtration in a surgical mask.
- **Carded web:** Made from staple fibers. While it can be used for some filtration, it does not typically achieve the fine filtration efficiency of meltblown webs required for medical standards.
- **Wet laid technology:** Can produce uniform webs but is not the standard technology for the high-efficiency filtration media in masks.

Step 3: Conclude based on the critical function. While a complete mask uses spunbond for outer layers, the **meltblown** layer provides the essential filtration. Therefore, among the single technologies listed, meltblown is the most defining process for producing surgical masks.

Quick Tip

For surgical masks, remember the structure **SMS**: - **S**punbond (Outer layers for strength and fluid resistance). - **M**eltblown (Middle layer for **M**icro-filtration). - **S**punbond (Inner layer for comfort and strength). Meltblown is the key functional component.

16. Calculate the production per shift of 8 hrs of a loom running at 200 picks/min with 90% efficiency. The number of picks per inch inserted in the cloth is 56.

- (A) 10.4 yards
- (B) 20.0 yards
- (C) 30.0 yards
- (D) 42.86 yards

Correct Answer: (D) 42.86 yards

Solution: Step 1: Calculate the total number of picks inserted per shift.

Loom speed = 200 picks/min.

Shift duration = 8 hours = $8 \times 60 = 480$ minutes.

Efficiency = 90% = 0.90.

Total picks inserted = (Loom speed) $\times$ (Shift duration) $\times$ (Efficiency)

Total picks inserted = $200 \text{ picks/min} \times 480 \text{ min} \times 0.90 = 86,400$ picks.

Step 2: Calculate the length of cloth produced in inches.

Picks per inch = 56.

Length in inches = Total picks inserted / Picks per inch

Length in inches = $\frac{86,400}{56} \approx 1542.86$ inches.

Step 3: Convert the length from inches to yards.

There are 36 inches in a yard.

Length in yards = Length in inches / 36

Length in yards = $\frac{1542.86}{36} \approx 42.857$ yards.

Step 4: Match the result with the options. The calculated production is approximately 42.86 yards, which corresponds to option (D).

Quick Tip

The formula for loom production in length is: $\text{Production} = \frac{\text{Loom Speed (picks/min)} \times \text{Time (min)} \times \text{Efficiency}}{\text{Picks per unit length}}$ Ensure all units are consistent (e.g., if picks/inch, the result will be in inches).

17. In _____ mechanism, the shuttle passes through the shed from one shuttle box to the opposite shuttle box.

- (A) Shedding
- (B) Picking
- (C) Beat up
- (D) Let off

Correct Answer: (B) Picking

Solution: Step 1: Understand the primary motions of weaving. There are three primary motions required to interlace warp and weft yarns to form fabric.

Step 2: Define each mechanism.

- **Shedding:** The process of dividing the warp threads into two layers (an upper and a lower layer) to create a tunnel or passage called the "shed".
- **Picking:** The process of inserting the weft yarn through the shed. In a shuttle loom, this is done by propelling the shuttle, which carries the weft, from one side of the loom to the other.
- **Beat up:** The action of pushing the newly inserted weft pick firmly into the "fell" of the cloth (the point where the fabric is already formed). This is done by the reed.
- **Let off:** This is a secondary motion that involves releasing new warp yarn from the weaver's beam to allow for fabric formation to continue.

Step 3: Identify the mechanism described. The action of the "shuttle pass[ing] through the shed from one shuttle box to the opposite" is the definition of picking on a shuttle loom.

Quick Tip

Remember the three primary weaving motions in order: 1. **Shedding:** Open the warp. 2. **Picking:** Insert the weft. 3. **Beat-up:** Push the weft into place.

18. In _____ rapier, the gripper heads are propelled by flexible tape.

- (A) Telescopic
- (B) Double bonded rigid
- (C) Flexible
- (D) Single head rigid **Correct Answer:** (C) Flexible

Solution: Step 1: Understand the function of a rapier in a loom. A rapier is a device used to carry the weft yarn across the shed. It can be rigid or flexible.

Step 2: Differentiate between rigid and flexible rapiers.

- **Rigid Rapier:** Uses a solid, rigid rod to carry the weft. These require a large amount of floor space on either side of the loom to house the rapier when it is withdrawn from the shed. Examples include single rigid and double rigid rapiers. Telescopic rapiers are a type of rigid rapier that retracts into itself to save space.

- **Flexible Rapier:** Uses a flexible tape or band to carry the gripper head. This tape can be coiled into a housing when it exits the shed, which significantly reduces the machine's width and floor space requirement compared to a rigid rapier system.

Step 3: Match the description to the type. The description "propelled by flexible tape" directly defines the mechanism of a flexible rapier loom.

Quick Tip

The key difference between rapier types is how they are stored outside the shed: - **Rigid Rapier:** Needs large side housing for the rigid rod. - **Flexible Rapier:** The flexible tape coils up, saving space.

19. In case of weft knitted fabric _____ structure, each wale consists of alternate face and back loops.

- (A) Rib
- (B) Plain single jersey
- (C) Interlock

(D) Purl

Correct Answer: (D) Purl

Solution: Step 1: Understand the basic knitted loop structures. A wale is a vertical column of loops.

- **Face loop (Knit stitch):** The head of the loop is behind the legs.

- **Back loop (Purl stitch):** The legs of the loop are behind the head.

Step 2: Analyze the loop structure of each fabric type.

- **Plain single jersey:** All loops in the entire fabric are of one type (e.g., all face loops).

Wales consist only of face loops on the technical face of the fabric.

- **Rib fabric:** Consists of wales of face loops alternating with wales of back loops. For example, a 1x1 rib has one wale of face loops, then one wale of back loops, and so on.

Within a single wale, all loops are the same type.

- **Interlock fabric:** It's like two 1x1 rib fabrics inter-knitted. All wales appear as face loops on both sides of the fabric.

- **Purl fabric:** This structure is characterized by having both face and back loops in the same wale. This creates horizontal stretch and a fabric that looks the same on both sides, often with horizontal ridges.

Conclusion: A structure where a single wale contains both face and back loops is the definition of a purl knit fabric.

Quick Tip

Differentiate knit structures by the loop arrangement: - **Jersey:** All loops same in all wales. - **Rib:** Alternate *wales* of face and back loops. - **Purl:** Alternate *loops* of face and back in the same wale. - **Interlock:** Two inter-knitted rib structures.

20. A cotton fabric is treated with a finishing chemical of 6.0 % concentration. If the wet pick up is 80 %, the add-on of chemical on fabric is _____.

(A) 1.48 %

(B) 4.8 %

(C) 3.48 %

(D) 0.48 %

Correct Answer: (B) 4.8 %

Solution: Step 1: Understand the terms.

- **Concentration:** The percentage of chemical in the finishing solution. Here, 6.0%. This means 6g of chemical per 100g of solution.

- **Wet Pick Up (WPU):** The percentage of solution that the fabric picks up relative to its own dry weight. Here, 80%. This means a 100g dry fabric will pick up 80g of solution.

- **Add-on:** The percentage of dry chemical that is added to the fabric relative to its own dry weight.

Step 2: Use the formula for calculating add-on.

$$\text{Add-on (\%)} = \text{Wet Pick Up (\%)} \times \text{Concentration (\%)} / 100$$

or

$$\text{Add-on (\%)} = \text{WPU} \times \text{Concentration}$$

Step 3: Substitute the given values.

$$\text{Add-on (\%)} = 80\% \times 6.0\%$$

$$\text{Add-on (\%)} = 0.80 \times 0.06 = 0.048$$

To express this as a percentage, multiply by 100: $0.048 \times 100 = 4.8\%$.

Alternatively, using the first formula: $\text{Add-on (\%)} = \frac{80 \times 6.0}{100} = \frac{480}{100} = 4.8\%$.

This means that for every 100g of dry fabric, 4.8g of dry chemical is added.

Quick Tip

The formula is: **Add-on % = Wet Pick Up % × Concentration %**. Think of it logically: The fabric picks up a certain amount of liquid (Wet Pick Up), and that liquid contains a certain amount of chemical (Concentration). The product of the two gives the amount of dry chemical on the fabric.

21. The process of removal of protruding fibers from the surface of fabric is called as _____.

- (A) Singeing
- (B) Bleaching
- (C) Shearing
- (D) Cropping **Correct Answer:** (A) Singeing

Solution: Step 1: Understand the objective: to remove protruding fibers (fuzz or hairiness) from a fabric surface to make it smooth and clean.

Step 2: Evaluate the given finishing processes.

- **Singeing:** This process involves passing the fabric at high speed over a gas flame or a hot plate. The protruding fibers are burned off without damaging the main fabric body. This directly matches the description.
- **Bleaching:** A chemical process to remove natural color from fibers and make them white. It does not remove protruding fibers.
- **Shearing/Cropping:** These terms are often used interchangeably. This is a mechanical process where the fabric surface is passed under rotating blades, similar to a lawnmower, to cut the protruding fibers to a uniform length. While it deals with surface fibers, it is a cutting process. Singeing is a burning process. Generally, "singeing" is the most common term for removing the fuzz completely for a clean surface, whereas shearing is for creating a pile of uniform height (like in carpets or corduroy) or reducing hairiness mechanically. Given the options, singeing is the primary process for "removal".
The term cropping is a synonym for shearing.

Conclusion: Singeing is the process of burning off protruding surface fibers.

Quick Tip

Distinguish between surface finishing processes: - **Singeing:** *Burns* away fuzz for a clean surface. - **Shearing/Cropping:** *Cuts* fibers to a uniform height. - **Brushing/Napping:** *Raises* fibers to create a soft, fuzzy surface.

22. Match Machine with Principle.

LIST I**Machine****LIST II****Principle**

A. Tub dyeing	I. Moving the textile material through the stationary dye liquor.
B. Jigger dyeing	II. Pumping the dye liquor through the stationary textile.
C. Package dyeing	III. Moving the textile material and dyeing liquor simultaneously.
D. Jet dyeing	IV. Textile materials and dye liquor are stationary.

(A) A - IV, B - I, C - II, D - III

(B) A - I, B - III, C - II, D - IV

(C) A - I, B - II, C - IV, D - III

(D) A - III, B - I, C - IV, D - II

Correct Answer: (A) A - IV, B - I, C - II, D - III

Solution: Step 1: Analyze the principle of each dyeing machine. The main distinction is what moves: the textile, the dye liquor, or both.

- **A. Tub dyeing (Winch/Beck dyeing):** The fabric, in a rope form, is moved through a relatively stationary bath of dye liquor. However, in the most basic "tub dyeing" sense (like manual dyeing in a tub), both can be considered stationary with manual agitation. Given the other options, this is the most likely candidate for stationary material and liquor.

- **B. Jigger dyeing:** The fabric in open width is passed back and forth from one roller to another through a small trough of stationary dye liquor at the bottom. The *textile material moves* through the *stationary liquor*.

- **C. Package dyeing:** Yarn is wound onto a perforated package. The package itself remains stationary. The dye liquor is forcefully *pumped through the stationary textile package*.

- **D. Jet dyeing:** The fabric, in a rope form, is transported by a high-velocity jet of the dye liquor itself. Therefore, *both the textile material and the dye liquor are moving* simultaneously.

Step 2: Re-evaluate 'Tub dyeing'. In a Winch machine, the fabric rope is pulled over a

winch reel and falls back into the tub, so the fabric moves. However, compared to a jigger, the liquor is also circulating to some extent. Let's look at the matches. B must be I. C must be II. D must be III. - B - I: Jigger dyeing -> Moving the textile material through the stationary dye liquor. (Correct) - C - II: Package dyeing -> Pumping the dye liquor through the stationary textile. (Correct) - D - III: Jet dyeing -> Moving the textile material and dyeing liquor simultaneously. (Correct) This leaves A to be matched with IV. - A - IV: Tub dyeing -> Textile materials and dye liquor are stationary. This is the best fit among the choices, representing a simple immersion process without forced circulation of either component.

Step 3: Assemble the combination. A-IV, B-I, C-II, D-III. This corresponds to option (A).

Quick Tip

Focus on what moves in dyeing machinery: - **Jigger:** Fabric moves, liquor is stationary. - **Package/Beam:** Fabric is stationary, liquor is pumped through it. - **Winch:** Fabric moves, liquor is mostly stationary. - **Jet:** Both fabric and liquor move.

23. Objectives of scouring of cotton.

A. To remove natural fatty matter from textiles.

B. To remove added fatty matter from textiles.

C. To remove pectins from textiles.

D. To remove coloring matter from textiles.

(A) A, B and D only

(B) A and C only

(C) A, B, C and D

(D) C and D only

Correct Answer: (B) A and C only

Solution: Step 1: Define the purpose of scouring. Scouring is a cleaning process that uses an alkaline solution to remove natural, non-cellulosic impurities from cotton fibers. The primary goal is to make the fiber highly absorbent for subsequent wet processing like bleaching and dyeing.

Step 2: Analyze the listed objectives.

- **A. To remove natural fatty matter from textiles:** Cotton contains natural waxes and fats that make it hydrophobic (water-repellent). Scouring saponifies these fats, making them soluble in water so they can be washed away. This is a primary objective.
- **B. To remove added fatty matter from textiles:** Added matter like spinning oils or knitting oils are typically removed in a separate, prior process called "desizing" or a specific pre-washing, not the main scouring process which targets natural impurities.
- **C. To remove pectins from textiles:** Pectins are natural gummy substances in cotton that bind other impurities to the fiber. Scouring degrades and removes them. This is a primary objective.
- **D. To remove coloring matter from textiles:** Scouring removes some natural coloring matter, but the primary process for decolorizing cotton is *bleaching*. Therefore, removing color is not a main objective of scouring itself.

Step 3: Conclude based on the primary objectives. The main goals of scouring are to remove natural waxes/fats (A) and pectins (C) to improve absorbency. Therefore, A and C only is the correct choice.

Quick Tip

Remember the specific roles of pre-treatments: - **Singeing:** Removes surface fuzz. - **Desizing:** Removes added size. - **Scouring:** Removes *natural* waxes and pectins for absorbency. - **Bleaching:** Removes *natural* color for whiteness.

24. Process sequence for polyester/wool blended knitted goods (Crisp handle).

A. Light brushing.

B. Open steam (allowing full relaxation).

C. Decatizing.

D. Close cropping on face side of fabric.

(A) A, B, C, D

(B) A, C, B, D

(C) B, A, D, C

(D) C, B, D, A **Correct Answer:** (C) B, A, D, C

Solution: Step 1: Understand the goal. The sequence is for finishing a polyester/wool blend knit to achieve a "crisp handle," which implies a smooth, clean surface with good dimensional stability.

Step 2: Analyze the logical order of the processes.

- **B. Open steam (allowing full relaxation):** Knitted fabrics are often distorted after knitting. The first step is usually relaxation to remove internal stresses and achieve a stable state. Open steaming is a common way to do this.
 - **A. Light brushing:** After relaxation, a light brushing can be done to raise any loose fibers slightly from the surface, preparing them for the next step.
 - **D. Close cropping on face side of fabric:** Cropping (or shearing) is cutting the raised fibers to create a clean, smooth, and uniform surface. This must be done after brushing raises the fibers.
 - **C. Decatising:** This is a final setting process that uses steam and pressure. It imparts dimensional stability, improves the handle (feel) of the fabric, and adds a subtle luster. It is typically one of the last steps to "lock in" the desired surface and dimensions.
- Step 3:** Assemble the sequence. The logical flow is Relaxation → Brushing → Cropping → Final Setting. This corresponds to the sequence B, A, D, C.

Quick Tip

Finishing sequences generally follow a pattern: 1. **Relax/Stabilize** the fabric structure. 2. **Prepare the surface** (e.g., brushing). 3. **Refine the surface** (e.g., cropping/shearing). 4. **Set the final properties** (e.g., decatising, heat-setting).

25. The reactive dyes are applied to Cellulosic fiber in an alkaline dyeing bath, by chemically reacting to form _____ with the hydroxyl group of the fiber.

- (A) Salt linkage
- (B) Hydrogen bond
- (C) Ionic bond

(D) Covalent bond

Correct Answer: (D) Covalent bond

Solution: Step 1: Understand the name "reactive dye." The name itself implies that the dye molecule chemically *reacts* with the fiber molecule.

Step 2: Analyze the bonding mechanism. Cellulosic fibers (like cotton) are polymers of glucose and are rich in hydroxyl (-OH) groups. In an alkaline medium (which activates the hydroxyl groups), the reactive group on the dye molecule forms a direct, strong, and permanent chemical bond with the fiber.

Step 3: Define the bond types.

- **Salt linkage / Ionic bond:** Involves attraction between opposite charges. This is typical for acid dyes on wool.

- **Hydrogen bond:** A weaker attraction between a hydrogen atom and an electronegative atom like oxygen or nitrogen. This contributes to dye affinity but is not the primary bond for reactive dyes.

- **Covalent bond:** Involves the sharing of electron pairs between atoms. This is a very strong and stable chemical bond.

Conclusion: The reaction between a reactive dye and the hydroxyl group of a cellulosic fiber forms a strong covalent bond, which accounts for the excellent wash fastness of these dyes.

Quick Tip

Associate dye classes with their primary bond type: - **Reactive Dyes** on Cotton → **Covalent** - **Direct Dyes** on Cotton → Hydrogen bonds, Van der Waals forces - **Vat/Sulphur Dyes** on Cotton → Mechanical entrapment - **Acid Dyes** on Wool/Nylon → **Ionic** (salt linkage) - **Disperse Dyes** on Polyester → Solid solution (Van der Waals forces)

26. Desizing of a grey cotton fabric having a starch-based size can not be done using _____.

(A) Amylase enzyme

(B) Dilute hydrochloric acid

(C) DMDHEU

(D) Hydrogen peroxide **Correct Answer:** (C) DMDHEU

Solution: Step 1: Understand desizing. Desizing is the process of removing the sizing agent (in this case, starch) that was applied to the warp yarns before weaving. Starch must be broken down into smaller, water-soluble molecules to be washed away.

Step 2: Evaluate the options as desizing agents for starch.

- **Amylase enzyme:** Amylase is an enzyme that specifically catalyzes the hydrolysis of starch into sugars. This is the most common and effective method for starch desizing.

- **Dilute hydrochloric acid (Acid desizing):** Strong acids can hydrolyze starch, breaking it down into smaller units. This method is effective but can damage the cotton if not carefully controlled.

- **Hydrogen peroxide (Oxidative desizing):** Strong oxidizing agents like hydrogen peroxide can break down the starch molecule. This method is also effective.

- **DMDHEU (Dimethylol Dihydroxy Ethylene Urea):** This is a cross-linking agent used in *finishing* to impart wrinkle resistance to cotton. It has no chemical ability to break down starch and is not used in desizing.

Conclusion: DMDHEU is a finishing agent, not a desizing agent, and therefore cannot be used to remove starch size.

Quick Tip

Starch is a polymer. To remove it, you need to break it down (hydrolyze or oxidize it). The common methods are: - **Enzymatic:** Amylase (most popular). - **Acidic:** Dilute acids. - **Oxidative:** Hydrogen peroxide, persulfates. A cross-linking resin like DMDHEU is used for an entirely different purpose (wrinkle-free finishing).

27. Which among the following is not a characteristic of a binder?

A. Capable of application by dry cure to form a film, trapping the pigment on the surface of the substrate

B. Provide adhesion of the pigment to the substrate surface

C. Able to crosslink in order to form a protective film

D. Non-elastic properties to allow for bending and stretching of the substrate after printing

(A) A

(B) B

(C) C

(D) D **Correct Answer:** (D) D

Solution: Step 1: Understand the role of a binder in pigment printing. Pigments are insoluble color particles that have no natural affinity for the fiber. They are essentially "glued" onto the fabric surface. The binder is that glue.

Step 2: Analyze the characteristics.

- **A & B:** The binder must form a film that traps the pigment (A) and adheres it to the substrate (B). These are fundamental requirements.

- **C:** The binder must be able to crosslink (usually during a heat treatment or "curing" step) to form a durable, protective, and insoluble film that can withstand washing and rubbing. This is also essential.

- **D:** A printed fabric needs to be flexible. If the binder film is rigid and non-elastic, it will crack and break when the fabric is bent or stretched. Therefore, a good binder must have *elastic* properties, not non-elastic properties.

Conclusion: Non-elastic properties are an undesirable characteristic for a binder. A binder must be flexible and elastic. Therefore, D is not a characteristic of a good binder.

Quick Tip

Think of a binder as a high-performance paint. It needs to: - **Stick** to the fabric (adhesion). - **Hold** the color particles (pigment). - **Harden** into a tough layer (crosslink/cure). - Be **Flexible** so it doesn't crack when the fabric moves.

28. The Pad - Dry - Cure process is followed in _____.

- (A) Reactive Dyeing
- (B) Pigment dyeing
- (C) Vat dyeing
- (D) Direct dyeing

Correct Answer: (B) Pigment dyeing

Solution: Step 1: Understand the "Pad - Dry - Cure" sequence.

- **Pad:** The fabric is padded (impregnated) with a chemical solution, in this case, a mix of pigment, binder, and other auxiliaries.
- **Dry:** The fabric is dried to remove water.
- **Cure:** The fabric is heated to a high temperature (e.g., 150-180°C). This step is crucial for a chemical reaction to occur.

Step 2: Analyze which dyeing method requires this sequence.

- **Reactive Dyeing:** A common method for reactive dyes is Pad-Dry-Pad-Steam, where the final fixation happens in steam. Another is Pad-Batch, where it's stored at room temperature. A "cure" step is less common than for pigments.
- **Pigment dyeing/printing:** This process relies on a binder that must be polymerized and cross-linked to fix the insoluble pigment onto the fiber. This polymerization is achieved by heating at high temperatures, which is the "Cure" step. This sequence is the standard method for pigment application.
- **Vat dyeing:** This involves padding the dye, then a chemical padding for reduction, followed by steaming and oxidation. It does not use a high-temperature "cure" step for fixation.
- **Direct dyeing:** This is an exhaustion process, often followed by drying. It doesn't involve a curing step for fixation.

Conclusion: The high-temperature "Cure" step is characteristic of cross-linking the binder in pigment dyeing/printing.

Quick Tip

Associate the fixation step with the dyeing method: - **Pigment** → **Cure** (High heat to set the binder). - **Reactive** → Alkali + Time (Pad-Batch) or Steam (Pad-Steam). - **Vat** → Reduce, Oxidize. - **Disperse** → Thermofixation (High heat to make dye diffuse into fiber).

29. The after treatment of certain direct dyes with 0.25-2% copper sulphate and 1% acetic acid for 20-30 mins at 60°C to improve _____.

- (A) Washing fastness
- (B) Light fastness
- (C) Light and washing fastness both
- (D) Perspiration fastness

Correct Answer: (B) Light fastness

Solution: Step 1: Identify the process. This is an after-treatment for direct dyes using a metallic salt (copper sulphate).

Step 2: Understand the limitations of direct dyes. Direct dyes generally have poor wash fastness because they are held to the fiber by weak forces. Many also have moderate to poor light fastness.

Step 3: Analyze the effect of the after-treatment. Certain direct dyes are designed to be "after-coppering" dyes. The copper ions (Cu^{2+}) from the copper sulphate form a more stable complex with the dye molecule inside the fiber. This complex is much more resistant to fading upon exposure to light. While it can offer a slight improvement in wash fastness, its primary and most significant effect is the improvement of light fastness.

Conclusion: After-treatment with copper sulphate is specifically done to improve the light fastness of certain direct dyes.

Quick Tip

Remember common after-treatments for direct dyes: - **Cationic fixing agents:** Improve **wash fastness**. - **Copper Sulphate:** Improves **light fastness** (for specific 'after-coppering' dyes).

30. Vatting process does not accelerate due to _____.

- (A) Temperature
- (B) Concentration of alkali
- (C) Concentration of reducing agent
- (D) Time

Correct Answer: (D) Time

Solution: Step 1: Define the "vatting" process. Vatting is the chemical reduction of an insoluble vat dye into its water-soluble "leuco" form. This reaction is carried out using a reducing agent (like sodium hydrosulphite) in an alkaline solution (like caustic soda).

Step 2: Analyze the factors that affect the rate of a chemical reaction.

- **(A) Temperature:** Increasing the temperature generally increases the rate of chemical reactions. The vatting process is often carried out at elevated temperatures (e.g., 50-60°C) to speed it up. So, temperature *does* accelerate the process.
- **(B) Concentration of alkali:** The correct pH and concentration of alkali are essential for the reduction to proceed efficiently. Having the right concentration accelerates the process.
- **(C) Concentration of reducing agent:** The reducing agent is a reactant. Increasing its concentration (up to a certain point) will increase the rate of the reduction reaction according to the law of mass action. So, this *does* accelerate the process.
- **(D) Time:** Time is the duration over which the reaction occurs; it is not a factor that changes the *rate* (speed) of the reaction. A certain amount of time is *required* for the reaction to complete, but time itself does not accelerate the process. The other factors (temperature, concentration) are what determine how much reaction happens within a given amount of time.

Conclusion: Temperature and concentrations of reactants are catalysts or drivers of the

reaction rate. Time is a result, not a cause of acceleration. Therefore, the vatting process is not accelerated *due to* time.

Quick Tip

In kinetics, the rate of a reaction is affected by temperature, concentration of reactants, catalysts, and surface area. Time is the dimension in which the reaction's progress is measured, not a factor that influences its speed.

31. The light fastness of azoic dyed material decreases mainly due to _____.

- (A) Depth of color
- (B) Type of fabric
- (C) Humidity
- (D) Type of substrate

Correct Answer: (A) Depth of color

Solution: Step 1: Understand Azoic dyeing. Azoic dyes (or naphthol dyes) are formed directly inside the fiber by reacting two components: a Naphthol component and a Diazonium salt (base).

Step 2: Understand light fastness. Light fastness refers to a dye's ability to resist fading when exposed to light. Fading is a photochemical reaction that destroys dye molecules.

Step 3: Analyze how the options affect light fastness.

- **(A) Depth of color:** For most dye classes, including azoics, light fastness is highly dependent on concentration. In pale shades (low depth of color), there are fewer dye molecules on the surface. When a certain number of molecules are destroyed by light, the color change is very noticeable. In deep shades, the same number of destroyed molecules represents a much smaller fraction of the total, so the color change is less apparent.

Therefore, light fastness is generally much poorer in pale shades and improves with the depth of color. The question asks what causes it to *decrease*, so a low depth of color is a major reason.

- **(B) Type of fabric / (D) Type of substrate:** While the substrate can have some effect (e.g.,

the chemical environment), it's a less dominant factor than the concentration of the dye itself.

- (C) **Humidity:** Humidity can influence the rate of photochemical degradation for some dyes, but again, the depth of shade is a more universal and significant factor.

Conclusion: The most significant factor influencing the decrease in light fastness for a given azoic dye is a lower depth of color (i.e., dyeing in pale shades).

Quick Tip

General Rule for Light Fastness: For most dyes, light fastness is lowest in pale shades and highest in deep shades. Think of it like a painted wall: a single scratch is very visible on a thinly painted surface but less noticeable on a surface with many thick coats of paint.

32. In the pad-steam process of vat dye, intermediate drying is carried out for

_____.

- (A) Better fixation
- (B) Prevention of pigment migration
- (C) Increase in color depth
- (D) Avoiding color change

Correct Answer: (B) Prevention of pigment migration

Solution: Step 1: Understand the Pad-Steam process. In this continuous process for vat dyes, the fabric is first padded with the insoluble pigment form of the dye. It then goes through a chemical pad (with reducing agent and alkali) and then immediately into a steamer for fixation.

Step 2: Consider the "intermediate drying" step. Sometimes, a drying step is included between the first padding (with dye pigment) and the second padding (with chemicals). This step is called intermediate drying.

Step 3: Analyze the purpose of this drying step. When the fabric is padded, it is saturated with water containing suspended dye particles. If this wet fabric is then passed through another set of nip rollers (at the chemical pad), the pressure can cause the water and the

suspended pigment to move or be squeezed unevenly. This movement of pigment particles during drying or squeezing is called "migration." It leads to unlevel dyeing, speckles, or blotches. By drying the fabric after the pigment padding, the pigment particles are fixed in place on the fibers. This prevents them from migrating during the subsequent chemical padding step.

Step 4: Evaluate the other options. Better fixation (A), increased color depth (C), and avoiding color change (D) are all outcomes of the entire process being done correctly, but the specific reason for intermediate drying is to ensure the pigment is evenly distributed and doesn't move before fixation.

Quick Tip

Whenever you see "intermediate drying" in a multi-stage padding process, the primary reason is almost always to prevent the migration of dyes or chemicals. Drying "locks" the substances in place before the next wet step.

33. Which dye is responsible for tendering of cotton?

- (A) Reactive dye
- (B) Basic dye
- (C) Sulphur dye
- (D) Azoic dye

Correct Answer: (C) Sulphur dye

Solution: Step 1: Understand "tendering." Tendering refers to the loss of strength or degradation of a textile fiber, making it weak and brittle.

Step 2: Analyze the chemistry of the dye classes in relation to cotton.

- **Reactive dye:** Forms a stable covalent bond with cotton and does not cause degradation.
- **Basic dye:** Used for acrylics, has no affinity for cotton unless it's mordanted. Not typically a cause of tendering on cotton.
- **Sulphur dye:** These dyes contain sulphur linkages. During storage, especially under humid and acidic conditions, some sulphur can slowly oxidize to form sulphuric acid. This

acid attacks and hydrolyzes the cellulose of the cotton fiber, causing a severe loss of strength (tendering). Sulphur black is particularly notorious for this issue.

- **Azoic dye:** Formed in-situ. Does not typically cause tendering.

Conclusion: Sulphur dyes are well-known to be responsible for the tendering of cotton during storage due to the potential formation of sulphuric acid.

Quick Tip

Associate specific problems with dye classes: - **Sulphur Dyes** → Tendering (acid formation). - **Vat Dyes** → Phototendering (certain yellow/orange dyes can degrade fiber in sunlight). - **Azoic Dyes** → Poor rub fastness (surface deposits). - **Direct Dyes** → Poor wash fastness.

34. The maximum damage to cotton in sodium hypochlorite is found at _____ pH.

(A) 3 to 4

(B) 5 to 6

(C) 7 to 8

(D) 9 to 10 **Correct Answer:** (C) 7 to 8

Solution: Step 1: Understand the bleaching action of sodium hypochlorite (NaOCl). NaOCl is an oxidizing agent. Its bleaching and degrading effects on cotton (cellulose) are due to oxidation.

Step 2: Analyze the chemistry of NaOCl at different pH values. The active species in a hypochlorite solution changes with pH. - In **alkaline conditions (pH 9-11)**, the dominant species is the hypochlorite ion (OCl^-). This is a relatively slow and controlled oxidizing agent, which is why commercial bleaching is done in this range. - In **acidic conditions (pH 5)**, chlorine gas (Cl_2) can be released, and the primary species is hypochlorous acid (HOCl). - At **neutral or near-neutral pH (pH 7-8)**, there is a maximum concentration of the undissociated hypochlorous acid (HOCl). Hypochlorous acid is a much more powerful and aggressive oxidizing agent than the hypochlorite ion.

Step 3: Relate the active species to cellulose damage. Because hypochlorous acid (HOCl) is

the most potent oxidizing agent in the system, the maximum rate of cellulose degradation (damage or tendering) occurs at the pH where its concentration is highest. This is the neutral pH range of 7 to 8. For this reason, bleaching is always avoided in this pH range.

Quick Tip

For hypochlorite bleaching of cotton: - **Safe Zone (Controlled Bleaching):** Alkaline pH (9-11). Active species: OCl^- (mild). - **Danger Zone (Maximum Damage):** Neutral pH (7-8). Active species: HOCl (aggressive).

35. _____ has the highest Biological Oxygen Demand (BOD).

- (A) Corn starch
- (B) British gum
- (C) C. M. C.
- (D) Polyvinyl alcohol

Correct Answer: (A) Corn starch

Solution: Step 1: Define Biological Oxygen Demand (BOD). BOD is a measure of the amount of dissolved oxygen needed by aerobic biological organisms to break down organic material present in a given water sample. A high BOD indicates a large amount of biodegradable organic pollution. Sizing agents are a major source of BOD in textile effluent.

Step 2: Analyze the biodegradability of the options.

- **(A) Corn starch:** A natural polymer made of glucose. It is readily broken down by microorganisms, and this process consumes a large amount of oxygen. Therefore, it has a very high BOD.
- **(B) British gum:** This is a type of dextrin, which is a modified starch. It is also highly biodegradable and has a high BOD, similar to starch.
- **(C) C. M. C. (Carboxymethyl cellulose):** A chemically modified cellulose. It is much more resistant to biological degradation than natural starch. It has a significantly lower BOD.
- **(D) Polyvinyl alcohol (PVA):** A synthetic polymer. While some grades are biodegradable, it is generally much slower to break down than starch and has a lower BOD.

Step 3: Compare the options. Of the choices given, natural, unmodified starch is the most readily and completely biodegradable material, and thus exerts the highest Biological Oxygen Demand.

Quick Tip

In textile sizing, there is a trade-off between biodegradability and pollution: - **Natural Sizes (Starch):** Highly biodegradable, but this leads to very high BOD in effluent. - **Synthetic Sizes (PVA, CMC):** Less biodegradable, leading to lower BOD, but they can persist in the environment as chemical pollution (measured by COD - Chemical Oxygen Demand).

36. In wet spinning process, the solvent removal and fiber solidification takes place during _____ stage.

- (A) Drawing
- (B) Wet coagulation
- (C) Span finish
- (D) Heat setting **Correct Answer:** (B) Wet coagulation

Solution: Step 1: Understand the wet spinning process. This process is used for polymers that need to be dissolved in a solvent to be spun (e.g., acrylic, viscose rayon). The polymer solution is extruded through a spinneret.

Step 2: Analyze the stages. After extrusion, the filaments of polymer solution must be solidified. In wet spinning, this is done by extruding them directly into a liquid "coagulation bath."

Step 3: Define the "Wet coagulation" stage. The coagulation bath is a liquid in which the polymer is insoluble, but the solvent is soluble. When the extruded filaments enter the bath, the solvent diffuses out of the filaments and into the bath, while a non-solvent from the bath may diffuse into the filaments. This removal of the solvent causes the polymer to precipitate and solidify, forming the fiber. This stage is called wet coagulation.

Step 4: Evaluate the other options.

- **Drawing:** This is a later stage where the solidified fibers are stretched to align the polymer chains and improve strength.
- **Span finish:** This refers to applying a finish to the fiber, not solidifying it.
- **Heat setting:** This is a process used for thermoplastic fibers to impart dimensional stability, usually done after drawing.

Conclusion: The removal of solvent and solidification of the fiber in wet spinning occurs during the wet coagulation stage.

Quick Tip

Remember the solidification methods for different spinning processes: - **Melt Spinning:** Solidifies by **Cooling**. - **Dry Spinning:** Solidifies by **Evaporating** the solvent in hot air. - **Wet Spinning:** Solidifies by **Coagulating** in a liquid bath.

37. The Transmission Electron Microscopy (TEM) is used for the study of _____ structure of fibrous material.

- (A) Surface
- (B) Internal
- (C) Localised
- (D) External

Correct Answer: (B) Internal

Solution: Step 1: Differentiate between the main types of electron microscopy.

- **Scanning Electron Microscopy (SEM):** In SEM, a beam of electrons is scanned across the *surface* of a sample. Detectors collect secondary electrons, backscattered electrons, and X-rays emitted from the surface. This produces a high-resolution, 3D-like image of the sample's surface topography.
- **Transmission Electron Microscopy (TEM):** In TEM, a beam of electrons is *transmitted through* an ultra-thin slice of the sample. The electrons that pass through are focused to create an image. This provides extremely high magnification and resolution of the *internal* structure of the material, such as crystal structures, phases, and defects.

Step 2: Apply this to the question. Since TEM involves passing electrons *through* the material, it is used to study the internal structure. SEM is used for studying the surface (external) structure.

Conclusion: TEM is used for the study of the internal structure of fibrous materials.

Quick Tip

A simple way to remember the difference: - **SEM** = **S**urface (Scanning across the surface). - **TEM** = **T**hrough (Transmitting through the sample).

38. The term wash and wear is used in the case of polyester fiber due to its _____.

- (A) High amorphousity and high water absorption
- (B) Low crystalline and low water absorption
- (C) Poor water absorption and high crease recovery
- (D) High water absorption and low crease recovery

Correct Answer: (C) Poor water absorption and high crease recovery

Solution: Step 1: Define "wash and wear." This term implies that a garment can be washed, and then worn with little to no ironing. This requires two main properties: it must dry quickly after washing, and it must not wrinkle or crease easily.

Step 2: Relate these properties to the characteristics of polyester.

- **Quick Drying:** Polyester is a hydrophobic fiber, meaning it absorbs very little water. Its moisture regain is very low (around 0.4%). Because it doesn't hold much water, it dries very quickly. This corresponds to "poor water absorption."

- **No Ironing:** Polyester has high resilience and elastic recovery. When it is creased or wrinkled, the polymer chains tend to spring back to their original position. This property is called "high crease recovery."

Step 3: Evaluate the options based on this analysis.

- (A) Incorrect. Polyester has high crystallinity and low water absorption.
- (B) Incorrect. Polyester has high crystallinity.

- (C) Correct. Poor water absorption leads to quick drying, and high crease recovery means it resists wrinkling. These two properties together create the "wash and wear" characteristic.
- (D) Incorrect. Polyester has low water absorption and high crease recovery.

Quick Tip

Wash and Wear = Quick to Dry + Doesn't Wrinkle. - **Quick to Dry** → Low Water Absorption (Hydrophobic). - **Doesn't Wrinkle** → High Crease Recovery (Resilience). Polyester excels at both. Cotton is the opposite (high water absorption, low crease recovery).

39. The glass fiber is _____ fiber.

- (A) Protein
- (B) Inorganic
- (C) Cellulosic
- (D) Elastomeric

Correct Answer: (B) Inorganic

Solution: Step 1: Understand the chemical composition of glass fiber. Glass fiber is made primarily from silica (silicon dioxide, SiO_2), which is the main component of sand, along with other metal oxides.

Step 2: Classify the fiber based on its chemistry.

- **Organic fibers** are based on carbon chemistry. This includes natural fibers (cellulosic like cotton, protein like wool) and synthetic polymers (polyester, nylon, acrylic).

- **Inorganic fibers** are not based on carbon. They are derived from minerals or geological sources. Glass (silica-based), carbon fiber (pure carbon), and asbestos (silicate minerals) are examples.

Step 3: Evaluate the options.

- (A) Protein fibers (e.g., wool, silk) are organic.
- (B) Inorganic fibers are derived from non-living, mineral sources. Glass fits this description perfectly.

- (C) Cellulosic fibers (e.g., cotton, rayon) are organic.
- (D) Elastomeric fibers (e.g., spandex) are organic polymers.

Conclusion: Glass fiber is an inorganic fiber.

Quick Tip

Fiber Classification by Origin: - **Organic (Carbon-based):** - *Natural:* Cotton (cellulose), Wool (protein). - *Synthetic:* Polyester, Nylon. - **Inorganic (Mineral-based):** - Glass, Carbon, Asbestos, Ceramic fibers.

40. The wool fiber exhibits high elastic recovery among the natural fibers due to its _____.

- (A) Strong inter-molecular linkages
 - (B) Weak lateral forces
 - (C) Poor molecular arrangement
 - (D) High crystalline region
- Correct Answer:** (A) Strong inter-molecular linkages

Solution: Step 1: Understand the property: "high elastic recovery." This means that when wool is stretched and then released, it has a strong tendency to return to its original length. This property is also responsible for its excellent wrinkle resistance.

Step 2: Analyze the molecular structure of wool. Wool is a protein fiber (keratin). Its polymer chains have a natural coiled or helical shape (alpha-helix). These chains are held together by various types of cross-links.

Step 3: Relate the structure to the property. The most important of these links are the strong, covalent **disulphide bonds** (cystine linkages) between adjacent polymer chains. When the fiber is stretched, the helical chains uncoil. The strong disulphide cross-links act like springs, pulling the chains back to their original coiled configuration once the force is removed. This network of strong cross-links is the primary reason for wool's high elastic recovery.

Step 4: Evaluate the options.

- (A) Strong inter-molecular linkages: This is correct. The disulphide bonds are very strong covalent cross-links.

- (B) Weak lateral forces: Incorrect. While wool has weaker hydrogen bonds, the disulphide bonds are strong.
- (C) Poor molecular arrangement: Wool has a complex but highly organized structure (alpha-helix), not a poor arrangement. Its structure is what gives it its properties.
- (D) High crystalline region: Wool has a relatively low degree of crystallinity compared to fibers like cotton or polyester. Its structure is more amorphous and spring-like.

Conclusion: The strong inter-molecular linkages, specifically the covalent disulphide cross-links, are responsible for wool's high elastic recovery.

Quick Tip

Wool's secret to resilience is its structure: a coiled spring (alpha-helix) held together by strong cross-links (disulphide bonds). When you stretch it, you uncoil the spring, and the cross-links pull it back into shape.

41. The outstanding features of polyamide fiber are _____.

- A. Good dimensional stability.**
- B. High wet modulus.**
- C. High resistance to alkali.**
- D. Low strength and high elongation.**

- (A) A, B and D only
- (B) A, B and C only
- (C) A, B, C and D
- (D) B, C and D only

Correct Answer: (B) A, B and C only

Solution: Step 1: Recall the key properties of polyamide fibers (e.g., Nylon). Nylons are known for their exceptional strength, toughness, and abrasion resistance.

Step 2: Evaluate each stated feature.

- **A. Good dimensional stability:** Polyamides are thermoplastic and can be heat-set to provide excellent dimensional stability. They don't shrink or stretch easily after being

properly heat-set. This is a correct feature.

- **B. High wet modulus:** Modulus is a measure of stiffness or resistance to extension.

Polyamides retain a significant portion of their stiffness when wet compared to fibers like rayon. This is a correct feature.

- **C. High resistance to alkali:** The amide linkage (-CO-NH-) in polyamides is stable and resistant to attack by alkalis. They can be scoured and washed in alkaline solutions without significant damage. This is a correct feature. (Note: They have poor resistance to strong acids).

- **D. Low strength and high elongation:** This is incorrect. Polyamides are known for their *high strength* (tenacity) and controlled elongation. They are among the strongest synthetic fibers.

Step 3: Combine the correct features. The outstanding features are A, B, and C. Feature D is incorrect. Therefore, the correct option is (B).

Quick Tip

Key properties of Nylon (Polyamide): - **Strong and Tough:** Excellent tenacity and abrasion resistance. - **Good Elasticity.** - **Good Dimensional Stability** (when heat-set). - **Good Alkali Resistance**, but poor acid resistance.

42. Arrange the following transition temperatures given by Differential Scanning Calorimetry (DSC) in ascending order.

A. Melting temperature

B. Crystallization temperature

C. Degradation temperature

D. Glass transition temperature

(A) D, B, A, C

(B) A, C, B, D

(C) B, A, D, C

(D) C, B, D, A **Correct Answer:** (A) D, B, A, C

Solution: Step 1: Define the thermal transitions for a semi-crystalline polymer as temperature increases.

- **D. Glass transition temperature (T_g):** This is the temperature at which the amorphous (non-crystalline) regions of the polymer change from a rigid, glassy state to a more flexible, rubbery state. This is the first major transition that occurs upon heating.
 - **B. Crystallization temperature (T_c):** When an amorphous polymer is heated above its T_g, the polymer chains gain mobility. If held at a certain temperature, they can arrange themselves into ordered, crystalline structures. This process is called crystallization. On a DSC scan of a polymer being cooled from a melt, T_c is the peak where heat is released as crystals form. When heating an amorphous sample, it can also appear as an exothermic peak after T_g. It logically occurs after T_g but before melting.
 - **A. Melting temperature (T_m):** This is the temperature at which the crystalline regions of the polymer melt and the material becomes a viscous liquid. This requires more energy than the glass transition, so T_m is always higher than T_g.
 - **C. Degradation temperature (T_d):** This is the temperature at which the polymer's chemical bonds begin to break, and the material starts to decompose. This is a chemical change, not a physical transition, and it occurs at a much higher temperature than melting.
- Step 2:** Arrange these temperatures in ascending (increasing) order. The sequence is: Glass Transition → Crystallization → Melting → Degradation.
- This corresponds to the order D, B, A, C.

Quick Tip

Think of the states of a semi-crystalline polymer as you heat it: 1. **Glassy Solid** (Amorphous part is frozen). 2. Heat past **T_g** → **Rubbery Solid** (Amorphous part is mobile). 3. (Sometimes) Heat further → **Crystallization (T_c)** (Mobile chains organize). 4. Heat past **T_m** → **Liquid Melt**. 5. Heat much further → **Degradation (T_d)** (Burning/Decomposition). So, T_g ; (T_c) ; T_m ; T_d.

43. Match Fibre with Application.

LIST I	LIST II
Fibre	Application
A. Silk fibre	I. Fire retardant
B. Wool fibre	II. Directional lustre
C. Nomex fibre	III. Bulletproof
D. Kevlar fibre	IV. Thermal insulation

(A) A - I, B - II, C - III, D - IV

(B) A - II, B - III, C - II, D - IV

(C) A - II, B - IV, C - I, D - III

(D) A - III, B - I, C - IV, D - II

Correct Answer: (C) A - II, B - IV, C - I, D - III

Solution: Step 1: Identify the key properties and applications of each fiber.

- **A. Silk fibre:** Silk has a unique triangular cross-section that reflects light like a prism, giving it a deep, rich luster that changes with the viewing angle. This is known as directional lustre.

- **B. Wool fibre:** The crimp, bulky nature of wool fibers allows them to trap a large amount of air. Trapped air is an excellent insulator, which is why wool is known for its warmth and is used for thermal insulation in blankets and winter clothing.

- **C. Nomex fibre:** Nomex is a brand name for a meta-aramid fiber. Its primary characteristic is its excellent thermal stability and inherent flame resistance. It does not melt or drip and chars at high temperatures. It is used in protective clothing for firefighters and race car drivers. This corresponds to fire retardant.

- **D. Kevlar fibre:** Kevlar is a brand name for a para-aramid fiber. It has extremely high tensile strength and modulus for its weight. This exceptional strength and toughness make it ideal for use in ballistic protection, such as bulletproof vests.

Step 2: Match the fibers in List I with their applications in List II.

- A (Silk) → II (Directional lustre).

- B (Wool) → IV (Thermal insulation).

- C (Nomex) → I (Fire retardant).

- D (Kevlar) → III (Bulletproof).

Step 3: Assemble the combination. The correct matching is A-II, B-IV, C-I, D-III. This corresponds to option (C).

Quick Tip

Memorize key applications for high-performance fibers: - **Silk:** Lustre. - **Wool:** Insulation (Warmth). - **Nomex:** No mex with fire (Fire retardant). - **Kevlar:** Ballistic protection (Bulletproof).

44. The monomer used in the manufacture of Nylon 6 fiber is _____.

- (A) Hexamethylene diamine
- (B) Adipic acid
- (C) Caprolactam
- (D) Terephthalic acid

Correct Answer: (C) Caprolactam

Solution: Step 1: Understand the nomenclature of Nylons. The number(s) in the name of a nylon refer to the number of carbon atoms in the monomer(s) used to produce it.

- **Nylon 6:** The single number '6' indicates it is made from a single monomer containing 6 carbon atoms.

- **Nylon 6,6:** The two numbers '6,6' indicate it is made from two different monomers, one with 6 carbons and the other also with 6 carbons.

Step 2: Identify the monomers.

- **Nylon 6,6** is made by the condensation polymerization of (A) **Hexamethylene diamine** (which has 6 carbons) and (B) **Adipic acid** (which also has 6 carbons).

- **Nylon 6** is made by the ring-opening polymerization of (C) **Caprolactam**. Caprolactam is a cyclic molecule that contains 6 carbon atoms.

- (D) **Terephthalic acid** is a monomer used to make polyester (specifically, polyethylene terephthalate or PET), not nylon.

Conclusion: The monomer used to manufacture Nylon 6 is Caprolactam.

Quick Tip

Remember the key monomers for common polymers: - **Nylon 6:** Caprolactam (1 monomer, 6 carbons). - **Nylon 6,6:** Hexamethylene diamine + Adipic acid (2 monomers, 6 carbons each). - **Polyester (PET):** Ethylene glycol + Terephthalic acid.

45. On mercerization, moisture regain of cotton fiber _____.

- (A) Decreases
- (B) Remain unchanged
- (C) Increases
- (D) Indeterminate

Correct Answer: (C) Increases

Solution: Step 1: Define Mercerization. Mercerization is a treatment for cotton fabric or yarn with a cold, concentrated solution of caustic soda (sodium hydroxide).

Step 2: Understand the structural changes caused by mercerization. The strong alkali causes the cotton fibers to swell. This swelling changes the fiber's cross-section from a kidney-bean shape to a more circular shape. Crucially, it also changes the internal polymer structure. The treatment transforms the native crystal structure (Cellulose I) to a different, more accessible form (Cellulose II). This process increases the proportion of amorphous regions relative to crystalline regions and makes the hydroxyl groups in the amorphous regions more accessible.

Step 3: Relate structural changes to moisture regain. Moisture regain is the weight of water in a material expressed as a percentage of its oven-dry weight. Water molecules are primarily absorbed in the amorphous regions of a fiber, where they can form hydrogen bonds with the polymer's hydroxyl groups. Since mercerization increases the accessibility of these amorphous regions, the fiber is able to absorb more water molecules.

Conclusion: Mercerization increases the amorphousness and accessibility of hydroxyl groups in cotton, which leads to an increase in its moisture regain. The typical regain of cotton increases from about 7-8% to about 9-10%.

Quick Tip

Mercerization of cotton improves several properties: - **Lustre:** Increases (due to smoother, rounder fiber surface). - **Strength:** Increases. - **Dye Affinity:** Increases (more accessible regions for dye). - **Moisture Regain:** Increases (more accessible amorphous regions).

46. The essential requirements of fiber forming polymers are _____.

A. Linear polymer

B. Three dimensional polymer

C. High molecular weight

D. Strong lateral forces

(A) A, B and D only

(B) A, B and C only

(C) A, C and D only

(D) A, C and D only

Correct Answer: (C) A, C and D only

Solution: Step 1: Understand what "fiber forming polymers" are. These are polymers that can be oriented into a fibrous structure with useful textile properties like strength and flexibility.

Step 2: Analyze the requirements.

- **A. Linear polymer:** The polymer chains must be long and linear, not branched, to allow them to align parallel to each other during the drawing process. This alignment is crucial for fiber strength. This is an essential requirement.

- **B. Three dimensional polymer (Cross-linked):** A three-dimensional or heavily cross-linked polymer (like thermoset resins) forms a rigid network and cannot be drawn into a fiber. This is the opposite of what is required.

- **C. High molecular weight:** The polymer chains need to be very long (high degree of polymerization) so that they can entangle and create sufficient intermolecular forces to hold the structure together and provide strength. This is an essential requirement.

- **D. Strong lateral forces (Intermolecular forces):** There must be strong forces (like hydrogen bonds or dipole-dipole interactions) between the aligned polymer chains to prevent them from slipping past one another under stress. These forces give the fiber its tenacity. This is an essential requirement.

Step 3: Combine the essential requirements. The polymer must be linear (A), have a high molecular weight (C), and have strong lateral forces (D). The options seem to have a typo, but based on the requirements, the correct combination is A, C, and D.

Quick Tip

To form a strong fiber, a polymer needs to be like a bundle of long, strong ropes tied together: - **Linear Polymer:** The ropes are long and straight, not a tangled mess (A). - **High Molecular Weight:** The ropes are very long (C). - **Strong Lateral Forces:** The ropes are held together tightly (D).

47. The acrylic fiber is called artificial wool due to _____ formed on removal of solvent during manufacturing.

- (A) Twist
- (B) Serrations
- (C) Voids
- (D) Faults **Correct Answer:** (C) Voids

Solution: Step 1: Understand the property being explained. Acrylic is called "artificial wool" because it is bulky, lightweight, and has good warmth/insulation properties, similar to wool.

Step 2: Analyze the manufacturing process of acrylic. Acrylic is typically wet or dry spun. During these processes, the polymer is dissolved in a solvent, extruded, and then the solvent is removed. When the solvent is removed rapidly from the fiber, it can leave behind microscopic, empty spaces or pores within the fiber structure.

Step 3: Relate these structural features to the wool-like properties. These microscopic voids trap air inside the fiber. Trapped air is an excellent thermal insulator. This trapped air gives

the acrylic fiber its low density (making it lightweight), bulkiness, and excellent insulation (warmth), which are the key characteristics that make it resemble wool.

Conclusion: The formation of voids during solvent removal is responsible for the wool-like properties of acrylic fiber.

Quick Tip

The "secret" to acrylic's warmth is trapped air. This air is trapped in microscopic **voids** or pores created when the solvent is removed during the spinning process. More trapped air means better insulation.

48. The objective of the filament drawing process is to improve the _____ of a fibre.

- (A) Crystallinity
- (B) Molecular orientation
- (C) Density
- (D) Thickness

Correct Answer: (B) Molecular orientation

Solution: Step 1: Define the "drawing" process. Drawing is a post-spinning process where newly formed synthetic filaments are stretched to several times their original length.

Step 2: Understand what happens at a molecular level during drawing. In the as-spun state, the long polymer chains in the fiber are randomly coiled and arranged. The drawing process pulls these chains, causing them to uncoil and align themselves parallel to the fiber axis. This alignment is called "molecular orientation."

Step 3: Analyze the consequences of molecular orientation. When the molecules are oriented, they can pack more closely together and exert stronger intermolecular forces on each other. This leads to a significant increase in the fiber's strength (tenacity) and stiffness (modulus), which are the primary goals of drawing. While crystallinity (A) may also increase as a result of the better packing (a phenomenon called stress-induced crystallization), the fundamental objective and direct change is the improvement in molecular orientation. Density (C) will increase slightly and thickness (D) will decrease, but

these are consequences, not the primary objective.

Conclusion: The main objective of drawing is to align the polymer chains along the fiber axis, i.e., to improve molecular orientation, which in turn increases strength.

Quick Tip

Think of drawing like combing tangled hair. - **Before Drawing:** Polymer chains are tangled and random. - **After Drawing:** Polymer chains are combed straight and aligned (**molecular orientation**). This alignment makes the fiber much stronger.

49. The melting temperature of Nylon 6 fiber is _____.

- (A) 180° C
- (B) 120° C
- (C) 218° C
- (D) 265° C

Correct Answer: (C) 218° C

Solution: Step 1: Recall the melting points of common synthetic fibers. The melting temperature (T_m) is a key physical property that determines the conditions under which a fiber can be processed and used (e.g., ironing temperature).

Step 2: Compare the melting points of Nylon 6 and Nylon 6,6. Both are common polyamides, but their structures give them different melting points. - **Nylon 6:** Has a melting point in the range of 215-220°C. - **Nylon 6,6:** Has a higher melting point in the range of 260-265°C due to its more regular structure allowing for more efficient hydrogen bonding. - **Polyester (PET):** Has a melting point around 255-260°C.

Step 3: Select the correct option. Based on the known physical data, the melting temperature of Nylon 6 is approximately 218°C. The value of 265°C corresponds to Nylon 6,6.

Quick Tip

Memorize the approximate melting points of major synthetic fibers: - Polypropylene: $\sim 165^{\circ}\text{C}$ - **Nylon 6**: $\sim 220^{\circ}\text{C}$ - Polyester (PET): $\sim 260^{\circ}\text{C}$ - **Nylon 6,6**: $\sim 265^{\circ}\text{C}$ Note that Nylon 6,6 has a higher melting point than Nylon 6.

50. The primary functions of Spin finish are _____.

A. Lubrication of fiber surface

B. Drawing of filaments

C. Antistatic action

D. Cohesion of filaments

(A) A, C and D only

(B) A, B and C only

(C) A, B, C and D

(D) B, C and D only

Correct Answer: (A) A, C and D only

Solution: Step 1: Define "Spin Finish." Spin finish is a liquid mixture of chemicals (lubricants, antistatic agents, emulsifiers) applied to the surface of synthetic filaments immediately after they are extruded and solidified.

Step 2: Analyze the purpose of applying these chemicals.

- **A. Lubrication of fiber surface:** This is a critical function. The finish reduces the friction between the fast-moving filaments and machine parts (like guides and rollers), preventing abrasion and filament breakage during subsequent processes like drawing and winding.
- **B. Drawing of filaments:** Spin finish is *applied before* drawing to facilitate it, but the finish itself does not cause the drawing (stretching) of filaments. Drawing is a mechanical process.
- **C. Antistatic action:** Synthetic fibers are electrical insulators and build up static charge easily due to friction. This causes filaments to repel each other and creates processing problems. The spin finish contains antistatic agents that help dissipate this charge.
- **D. Cohesion of filaments:** The finish makes the individual filaments in a yarn bundle stick together slightly (providing cohesion). This prevents the yarn from becoming too bulky or

loopy and ensures it processes as a compact bundle.

Step 3: Identify the primary functions. The primary functions are lubrication (A), providing antistatic properties (C), and providing cohesion to the filament bundle (D). Drawing (B) is a separate mechanical process.

Quick Tip

A spin finish gives a synthetic yarn the properties it needs to be processed. Think of it as a "processing aid" that provides: - **Lubrication** (to slide easily). - **Antistatic** (to prevent static buildup). - **Cohesion** (to hold the bundle together).

51. The strength of yarn decreases with the increase in specimen length due to more chances of the occurrence of _____ places in longer specimen.

- (A) Faults
- (B) Strong
- (C) Weak
- (D) Very strong

Correct Answer: (C) Weak

Solution: Step 1: Understand the concept being described. This is known as the "weakest link theory" as it applies to textiles. A yarn is like a chain; its overall strength is determined by the strength of its weakest link.

Step 2: Analyze the effect of specimen length. A yarn is never perfectly uniform; it has natural variations in thickness and strength along its length. It contains thin, weak places as well as thick, strong places. - A **short** specimen of yarn has a certain probability of containing a weak spot. - A **longer** specimen of yarn has a statistically higher probability of containing an even weaker spot somewhere along its greater length. **Step 3:** Apply the weakest link theory. When the yarn is tested for strength, it will always break at its weakest point. Since a longer specimen is more likely to contain a very weak point than a shorter specimen, the average breaking strength measured for longer specimens will be lower than that for shorter specimens.

Conclusion: The strength of yarn decreases with increasing specimen length because there is a higher probability of finding exceptionally weak places in a longer length.

Quick Tip

This is the "Weakest Link Effect": - A short chain might be lucky and have only strong links. - A very long chain is almost guaranteed to have at least one weak link somewhere. The chain (or yarn) always breaks at its weakest link, so longer yarns appear weaker on average when tested.

52. The KES-FB module of Kawabata hand evaluation instruments gives _____.

A. Linearity of the load elongation curve.

B. Compression resilience.

C. Tensile energy.

D. Bending rigidity.

(A) A, C and D only

(B) A, B and C only

(C) A, B, C and D

(D) A, B and D only

Correct Answer: Note: The question is slightly ambiguous as KES-FB has multiple instruments. Assuming KES-FB1 (Tensile/Shear), KES-FB2 (Bending), and KES-FB3 (Compression) are considered collectively.

Solution: Step 1: Understand the Kawabata Evaluation System (KES-FB). This is a set of standardized instruments designed to objectively measure the low-stress mechanical properties of fabrics that relate to the subjective feeling of "hand" (e.g., softness, stiffness, smoothness). The system consists of four main instruments.

Step 2: Identify the properties measured by each instrument.

- **KES-FB1 (Tensile and Shear Tester):** Measures properties related to stretching and shearing the fabric. This includes tensile strain, **linearity of the load-elongation curve (A)**, and **tensile energy (C)**. - **KES-FB2 (Pure Bending Tester):** Measures how a fabric resists

bending. This gives **bending rigidity or stiffness (D)**. - **KES-FB3 (Compression Tester)**: Measures the properties of the fabric when it is compressed. This includes thickness, compressibility, and **compression resilience (B)**. - **KES-FB4 (Surface Tester)**: Measures surface friction and roughness.

Step 3: Evaluate the listed properties. All four properties listed (A, B, C, and D) are standard parameters measured by the different modules of the KES-FB system. Therefore, all are correct.

Quick Tip

The Kawabata Evaluation System (KES) is a comprehensive suite of tools to measure "fabric hand." It covers all the basic ways you can deform a fabric with your hands:

- **Stretching** (Tensile) - KES-FB1 - **Bending** - KES-FB2 - **Squeezing** (Compression) - KES-FB3 - **Rubbing** (Surface) - KES-FB4

All the properties listed fall under these categories.

53. The control and reduction of short fiber content have a direct impact on _____ in a yarn.

- (A) Thin places
- (B) Thick places
- (C) Long thin places
- (D) Neps **Correct Answer:** (D) Neps

Solution: Step 1: Define Short Fiber Content (SFC) and Neps.

- **Short Fiber Content:** The percentage of fibers in a sample that are shorter than a certain length (e.g., 12.5 mm). High SFC is generally undesirable. - **Neps:** Small, tangled knots of fibers. They appear as defects in the yarn and fabric. Neps are often formed from short fibers or immature fibers that entangle during processing (especially carding).

Step 2: Analyze the relationship. Short fibers lack the length to be controlled properly by the drafting systems in spinning machinery. They are more likely to become disorganized, fly around, and get tangled up with other fibers, directly leading to the formation of neps.

Therefore, a high short fiber content is a primary cause of a high nep count in yarn.

Step 3: Evaluate the other options. While high SFC can contribute to overall yarn unevenness (which includes thin and thick places), its most direct and significant impact is on the formation of neps. Controlling and reducing SFC is a key strategy for reducing neps.

Quick Tip

Think of it this way: - **Long fibers** = easy to comb and align. - **Short fibers** = difficult to control, they fly around and get tangled. These tangles are called **neps**. Therefore, Short Fibers → Neps.

54. The periodic mass variations in yarn are mainly caused by _____.

- (A) Machine faults
- (B) Machine setting
- (C) Random fiber arrangement
- (D) Personal error

Correct Answer: (A) Machine faults

Solution: Step 1: Understand "periodic mass variations." Yarn evenness testing (using a spectrogram) can reveal different types of mass variations. - **Random variations:** These are inherent to the process of forming a yarn from staple fibers and do not have a repeating pattern. - **Periodic variations:** These are faults that repeat at regular intervals along the yarn length. They show up as distinct peaks on a spectrogram.

Step 2: Analyze the causes of periodic faults. A repeating, regular pattern is a tell-tale sign of a mechanical issue. Such faults are caused by a defective or improperly functioning rotating part in the spinning machinery, such as an eccentric (off-center) roller, a broken gear tooth, or a vibrating component. Each revolution of the faulty part creates a thick or thin spot in the yarn, leading to a fault whose wavelength corresponds to the circumference of that part.

Step 3: Evaluate the other options.

- (B) Machine setting: An incorrect setting might produce a generally poor yarn, but not typically a periodic fault unless it causes a part to vibrate.
- (C) Random fiber arrangement: This is the cause of random variations, not periodic ones.
- (D) Personal error: This is unlikely to cause a fault that repeats with machinelike regularity.

Conclusion: Periodic mass variations are almost always caused by mechanical machine faults.

Quick Tip

When analyzing yarn evenness: - **Random Faults** = Natural, unavoidable variation.
 - **Periodic Faults** = Mechanical problem (e.g., bad roller, broken gear). Look for a repeating pattern. The spectrogram is the tool used to diagnose these periodic faults.

55. Match the LIST I with LIST II.

LIST I	LIST II
A. Tear strength	I. Contact angle test
B. Water repellency	II. Periodic faults
C. Seldom occurring faults	III. Impact principle
D. Spectrogram	IV. Classimat

- (A) A - I, B - II, C - III, - D - IV
- (B) A - I, B - III, C - II, - D - IV
- (C) A - III, B - I, C - IV, - D - II
- (D) A - III, B - I, C - IV, - D - II

Correct Answer: (C) A - III, B - I, C - IV, - D - II

Solution: Step 1: Analyze each term in List I and find its corresponding principle or instrument in List II.

- **A. Tear strength:** This measures the force required to propagate a tear in a fabric. A common method to test this is the Elmendorf tear tester, which works on a falling pendulum or **impact principle**.

- **B. Water repellency:** This measures a fabric's ability to resist wetting. The **contact angle test**, which measures the angle a water droplet makes with the fabric surface, is a direct way to quantify surface wettability and repellency. A higher contact angle means higher repellency.

- **C. Seldom occurring faults:** These are large, infrequent yarn faults (like slubs or long thick/thin places) that are not captured well by standard evenness testers. The **Classimat** is an instrument specifically designed to classify and count these seldom-occurring or "objectionable" faults.

- **D. Spectrogram:** A spectrogram is a graphical output from a yarn evenness tester. It plots the amplitude of mass variation against its wavelength, making it the primary tool for identifying **periodic faults**.

Step 2: Assemble the correct matches.

- A → III - B → I - C → IV - D → II

Step 3: Find the corresponding option. The combination A-III, B-I, C-IV, D-II matches option (C). (Note: There is a typo in option D, it's identical to C).

Quick Tip

Associate testing concepts with their methods/outputs: - **Tear Strength** → Elmendorf (Impact/Pendulum). - **Water Repellency** → Contact Angle. - **Periodic Faults** → Spectrogram. - **Objectionable/Rare Faults** → Classimat.

56. The cotton fiber exhibits poor crease recovery due to _____.

- (A) Strong lateral linkages
- (B) Flexible polymer chain
- (C) Weak lateral linkages
- (D) Breakage of polymer chains

Correct Answer: (C) Weak lateral linkages

Solution: Step 1: Understand crease recovery. Crease recovery (or wrinkle resistance) is the ability of a fiber to return to its original shape after being bent or crushed. Cotton is known

for its poor crease recovery; it wrinkles easily.

Step 2: Analyze the molecular structure of cotton. Cotton is composed of cellulose, which consists of long, linear polymer chains. These chains are highly crystalline, meaning they are packed tightly together in an ordered arrangement. The forces holding these chains together are **hydrogen bonds**.

Step 3: Relate the structure to the property. When cotton is creased (especially in the presence of moisture), the hydrogen bonds between the cellulose chains break. The chains slip past one another into a new, wrinkled position. In this new position, they form new hydrogen bonds, locking the wrinkle in place. Because the hydrogen bonds are relatively weak and there are no strong cross-links (like in wool) to pull the chains back, the fiber does not recover its original shape.

Step 4: Evaluate the options.

- (A) Strong lateral linkages: Incorrect. If cotton had strong cross-links, it would have good crease recovery.
- (B) Flexible polymer chain: The cellulose chain itself is quite rigid due to its ring structure.
- (C) Weak lateral linkages: Correct. The hydrogen bonds are weak enough to break and reform easily, allowing the chains to slip and set into a creased configuration.
- (D) Breakage of polymer chains: This would be permanent fiber damage, not creasing.

Quick Tip

Why Cotton Wrinkles: 1. Cotton's polymer chains are held by **weak hydrogen bonds**. 2. When creased, these weak bonds break. 3. The chains slip into a new position. 4. New hydrogen bonds form, **locking the wrinkle in place**. There are no strong "springs" (like the cross-links in wool) to pull it back.

57. With all other parameters constant, the fabric with a low cover factor effectively transmits water vapor by a diffusion mechanism in comparison with that of fabric with a high cover factor due to _____.

- (A) More air space
- (B) Less thickness

- (C) High thickness
- (D) Less air space

Correct Answer: (A) More air space

Solution: Step 1: Define "Cover Factor." Cover factor is a measure of how much of the area of a fabric is covered by yarn. A low cover factor means the yarns are spaced far apart, creating an open structure. A high cover factor means the yarns are packed tightly together, creating a dense structure.

Step 2: Understand water vapor transmission. This property relates to breathability. Water vapor (sweat) needs to be able to pass through the fabric from the skin to the outside to keep the wearer comfortable. This happens mainly by diffusion through the air gaps in the fabric.

Step 3: Relate cover factor to the fabric structure. A fabric with a **low cover factor** is more open and has larger interstices (gaps) between the yarns. This means it contains **more air space**. A fabric with a high cover factor is dense and has very little air space.

Step 4: Connect structure to function. Water vapor diffuses much more easily through air than through a solid fiber. Therefore, the fabric with more air space (the one with the low cover factor) will allow for much faster and more effective transmission of water vapor.

Quick Tip

Think about breathability: - **Low Cover Factor** = Open structure = Like a mesh or net = **More air space** = High breathability. - **High Cover Factor** = Dense structure = Like a solid sheet = **Less air space** = Low breathability.

58. The strength of fiber is usually measured in bundle form because there is better correlation between fiber bundle strength and _____.

- (A) Yarn hairiness
- (B) Yarn unevenness
- (C) Yarn strength
- (D) Yarn twist **Correct Answer:** (C) Yarn strength

Solution: Step 1: Understand the question. It asks why we test the strength of staple fibers

(like cotton) in a bundle (e.g., using a Stelometer or HVI) rather than testing single fibers individually. The reason given is that the bundle strength correlates well with another important property.

Step 2: Analyze the structure of a staple yarn. A staple yarn derives its strength from thousands of individual fibers being twisted together. The strength of the yarn depends not just on the strength of the individual fibers, but also on how they are assembled, their length, fineness, and how they grip each other.

Step 3: Compare single fiber vs. bundle strength tests. Testing single fibers is slow and gives highly variable results. A fiber bundle test, on the other hand, averages out the properties of many fibers at once. This test simulates more closely how the fibers act together within a yarn structure. It has been shown through extensive research and practice that the strength measured from a fiber bundle is a very good predictor of the strength of the yarn that can be spun from those fibers.

Conclusion: Fiber bundle strength is measured because it provides a strong and reliable correlation with the final yarn strength.

Quick Tip

The goal of testing raw material (fiber) is to predict the quality of the final product (yarn). Testing a **bundle of fibers** is a better simulation of a **yarn cross-section** than testing a single fiber. Therefore, Fiber Bundle Strength → predicts Yarn Strength.

59. The thermal insulation of clothing mainly depends on fabric _____.

(A) Thickness

(B) Stiffness

(C) Crease recovery

(D) Weight **Correct Answer:** (A) Thickness

Solution: Step 1: Understand thermal insulation. The primary purpose of insulating clothing is to prevent heat loss from the body. Heat is primarily lost through convection and conduction. The most effective way to prevent this is by trapping a layer of still air. Still air

is a very poor conductor of heat.

Step 2: Analyze how fabric properties relate to trapping air. A fabric's ability to trap still air is directly related to its structure. A bulky, porous fabric will trap a lot of air. The most direct measure of this capacity to entrap air is the fabric's **thickness**. A thicker fabric inherently traps a thicker layer of still air, providing greater insulation.

Step 3: Evaluate the other options.

- (B) Stiffness and (C) Crease recovery are mechanical properties that do not directly determine insulation.

- (D) Weight can be misleading. A very heavy but thin and dense fabric (like a thin sheet of metal) would have poor insulation. A very lightweight but thick and lofty fabric (like a down jacket) has excellent insulation.

Conclusion: The most important factor determining the thermal insulation of a fabric is the amount of still air it can trap, which is best represented by its thickness.

Quick Tip

Insulation = Trapped Air. The more air a fabric can trap, the warmer it is. The amount of trapped air is directly proportional to the fabric's **thickness**. This is why a thick, fluffy sweater is warmer than a thin, dense t-shirt of the same weight.

60. A 100-meter skein of polyester filament yarn weighs 2.5 grams, calculate its tex number.

- (A) 12 tex
- (B) 25 tex
- (C) 17 tex
- (D) 21 tex

Correct Answer: (B) 25 tex

Step 1: Define the Tex system. The Tex system is a direct yarn numbering system. The Tex number is defined as the weight in **grams** of **1,000 meters** of yarn.

Formula: $\text{Tex} = \text{Weight (g)} / \text{Length (km)} = \text{Weight (g) for 1000m.}$

Step 2: Use the given data to find the weight per 1000 meters.

Given: - Length = 100 meters - Weight = 2.5 grams We can set up a proportion: If 100 meters weigh 2.5 grams, Then 1000 meters will weigh X grams.

$$\frac{2.5 \text{ g}}{100 \text{ m}} = \frac{X \text{ g}}{1000 \text{ m}}$$

Step 3: Solve for X.

$$X = \frac{2.5 \times 1000}{100} = 2.5 \times 10 = 25$$

So, 1000 meters of the yarn weigh 25 grams.

Step 4: Determine the Tex number.

By definition, the Tex number is the weight in grams per 1000 meters. Therefore, the yarn count is 25 tex.

Quick Tip

The definition of Tex is simply "grams per 1000 meters". If you are given the weight for any other length, just calculate how much 1000 meters would weigh. In this case, 100m is 2.5g, so 1000m (10 times longer) must be 10 times heavier: $2.5 \times 10 = 25\text{g} \rightarrow 25 \text{ tex}$.

61. The electrical conductivity of fiber _____ on increase in moisture absorption.

- (A) increases
- (B) decreases
- (C) unchanged
- (D) affected

Correct Answer: (A) increases

Solution: Step 1: Understand electrical conductivity in textiles. Textile fibers themselves are generally excellent electrical insulators (i.e., they have very high electrical resistance). Static electricity builds up because the charge cannot easily flow away.

Step 2: Consider the role of water. Water, especially containing dissolved impurities or ions, is a much better conductor of electricity than the fiber polymer.

Step 3: Analyze the effect of moisture absorption. When a fiber absorbs moisture from the atmosphere, a thin film of water forms on its surface and within its amorphous regions. This absorbed water provides a path for electrical charges to move and dissipate. The more water there is, the better this conductive path becomes.

Conclusion: As the moisture absorption (moisture regain) of a fiber increases, its ability to conduct electricity also increases. This means its electrical resistance decreases, and it is less prone to static buildup.

Quick Tip

Think of static electricity in different weather: - **Dry Winter Day:** Low humidity → fibers are dry → high electrical resistance → lots of static shock. - **Humid Summer Day:** High humidity → fibers absorb moisture → low electrical resistance → static dissipates easily, no shocks. Therefore, more moisture = more conductivity.

62. In the fineness measurement by Sheffield micronaire instrument, the flow of air through a plug of fibers is related to _____ of fiber.

- (A) Area of cross section
- (B) Perimeter
- (C) Weight per unit length
- (D) Specific surface

Correct Answer: (D) Specific surface

Solution: Step 1: Understand the principle of the Micronaire instrument. The Micronaire test measures the fineness of cotton fibers. It works by forcing a constant volume of air at a set pressure through a "plug" of a known weight of cotton fibers compressed to a fixed volume. The instrument measures the rate of airflow (or the resistance to airflow).

Step 2: Relate airflow to fiber properties. The resistance to the flow of air depends on the total surface area of the fibers within the plug. - If the fibers are **coarse** (thick), for a given weight, there will be fewer fibers, and their total surface area will be lower. This creates larger channels for the air to flow through, resulting in low resistance and high airflow. - If

the fibers are **fine** (thin), for the same weight, there will be many more fibers, and their total surface area will be much higher. This creates a denser plug with smaller air channels, resulting in high resistance and low airflow.

Step 3: Define "Specific Surface." Specific surface area is the total surface area per unit of mass (e.g., cm^2/g). Fine fibers have a much higher specific surface than coarse fibers. The airflow resistance measured by the Micronaire is directly related to this property.

Conclusion: The airflow through the fiber plug is a function of the specific surface area of the fibers.

Quick Tip

The Micronaire principle is based on air resistance: - **Fine Fibers** = High Surface Area = High Air Resistance = Low Airflow. - **Coarse Fibers** = Low Surface Area = Low Air Resistance = High Airflow. The property that combines surface area and mass is the **specific surface**.

63. Which of the following methods are indirect methods for determining the maturity of cotton fibers?

- A. Polarised light method**
- B. Causticare method**
- C. Differential dyeing method**
- D. Caustic Soda swelling method**

(A) Only A, B and D

(B) Only A, B and C

(C) Only C and D

(D) All A, B, C and D

Correct Answer: (C) Only C and D

Solution: Step 1: Define cotton maturity. Fiber maturity refers to the degree of thickening of the secondary cell wall of the cotton fiber. A mature fiber has a thick, well-developed secondary wall, while an immature fiber has a very thin one.

Step 2: Differentiate between direct and indirect methods.

- **Direct methods** involve microscopic examination of the fiber's physical structure to directly observe the cell wall thickness. - **Indirect methods** measure a property that is known to change with maturity, rather than observing the cell wall itself.

Step 3: Analyze each method.

- **A. Polarised light method:** This is a microscopic (direct) method. It observes the interference colors produced by mature (thick-walled) fibers under polarized light.

- **B. Causticare method:** This is a reference method based on the Micronaire principle. It measures the airflow resistance of a cotton sample before and after swelling in caustic soda. The difference is used to calculate maturity. This is considered a direct measurement of fineness and maturity.

- **C. Differential dyeing method:** This is an indirect method. It uses a special blend of two dyes (typically a red and a green). Mature fibers, having more available cellulose, preferentially absorb the red dye, while immature fibers absorb the green dye. The overall color of the dyed sample gives a visual indication of the average maturity. It measures a dyeing property, not the wall thickness itself.

- **D. Caustic Soda swelling method:** This is a classic direct microscopic method. Fibers are swollen in caustic soda, and the degree of swelling and the shape they take (e.g., convolutions, rod-like appearance) are observed under a microscope to classify them as mature, half-mature, or immature.

Re-evaluation: Let's reconsider the definition. A direct method measures a dimensional property related to maturity. An indirect method measures a secondary property. - (A)

Polarized light and (D) Caustic soda swelling are direct microscopic observations. - (C)

Differential dyeing relies on dye uptake, a secondary property. This is indirect. - (B)

Causticare method is based on airflow resistance, which is an indirect measure, though it is calibrated to give maturity values.

There might be ambiguity in the classification of the Causticare method. However, the most unequivocally indirect method is differential dyeing. The Caustic Soda swelling method is a classic direct microscopic test. Let's reconsider. The question might consider any non-microscopic method as "indirect". In that case: - A & D are microscopic (direct). - C (dyeing) and B (airflow) are non-microscopic (indirect). Therefore, B and C would be the

indirect methods. This is not an option.

Let's stick to the most common classification. Direct methods physically assess the cell wall.

- D. Caustic soda swelling method (microscopic view) is the primary direct method. - A.

Polarized light method is also a direct microscopic observation of optical properties related to wall thickness. - C. Differential dyeing is clearly indirect as it depends on dye absorption.

- B. Causticare is an instrumental test based on airflow, which is an indirect measurement of the specific surface area, which in turn relates to maturity.

Perhaps the question considers both Causticare (B) and Differential dyeing (C) as indirect.

Let's check the options again. Option C is "Only C and D". This would mean differential dyeing is indirect and caustic soda swelling is also indirect, which contradicts its status as a classic direct microscopic method. There seems to be a significant error in the question or options. Let's re-read sources. In many classifications: - Direct: Microscopic observation of swelling (e.g. Caustic Soda swelling). - Indirect: All others that measure a property that correlates with maturity. This includes Airflow methods (Micronaire, Causticare), Dyeing methods, and optical methods (Polarized light). If we use this broader definition of "indirect", then A, B, and C are all indirect. This is option (B). However, let's try another interpretation. The most common "direct" method is the microscopic swelling test. Other instrumental methods that give a quantitative value are often separated. The differential dyeing is more of a qualitative assessment. Let's assume the provided answer (C) is correct and work backwards. This would imply that Differential dyeing (C) and Caustic Soda swelling method (D) are considered indirect. This is contradictory, as the swelling method is the definition of a direct visual assessment.

Let's assume there is a typo in the key and that "Indirect" refers to methods that do not involve a microscope. - Involve microscope: A, D. - Do not involve microscope: B, C. So B and C are indirect. This is option B.

Given the high likelihood of an error in the question/options, let's pick the most plausible interpretation. Differential Dyeing (C) is definitely indirect. The Caustic Soda swelling method (D) is definitely direct. Therefore, any option including D as indirect is incorrect.

This eliminates A, C, and D. This leaves option B (A, B, C) as the only possibility, assuming that the polarized light and Causticare methods are also considered indirect. This is a reasonable interpretation in many contexts.

Let's re-examine option C, the given answer. "Only C and D". This is highly problematic. Let's assume D is a typo and should be something else. What if D means "Differential Dyeing" and C means "Causticare"? No, the lettering is fixed. The question is flawed. However, if forced to choose based on common knowledge: - C (Differential Dyeing) is definitely indirect. - D (Caustic Soda Swelling) is definitely direct. - A (Polarized Light) is direct (microscopic). - B (Causticare) is based on airflow, which is an indirect physical principle. So the truly indirect methods are B and C. Since this is not an option, and the provided correct answer is likely wrong, no logical solution can be reached. For the purpose of providing an answer, we will follow the most common academic classification where only direct visual measurement of the lumen/wall is "direct". In this case, A, B, and C would be considered "indirect".

Quick Tip

To determine cotton maturity: - **Direct Methods:** You look at the fiber under a microscope and see how thick its wall is (e.g., Caustic Soda swelling test). - **Indirect Methods:** You measure another property that changes with maturity, like how it dyes (**Differential Dyeing**) or how air flows through it (**Causticare/Micronaire**).

64. In the twisting zone, if the rear end of the fiber is not in the nip of the delivery rollers of the ringframe, the fiber will be under no control, which causes _____.

- (A) Hairiness
- (B) Nep
- (C) Thick place
- (D) Nap

Correct Answer: (A) Hairiness

Solution: Step 1: Understand the scenario. The question describes a situation in the twisting zone of a ring frame. A fiber's front end is held by the delivery rollers, but its rear end is free because it's shorter than the drafting distance. This free, trailing end is not under tension or control.

Step 2: Analyze the effect of the rotating yarn. As the yarn balloon rotates at high speed to insert twist, this uncontrolled, trailing fiber end is subject to centrifugal force.

Step 3: Determine the outcome. The centrifugal force will throw the trailing end of the fiber outwards, away from the body of the yarn. This protruding fiber end becomes part of the yarn's "hairy" surface. This phenomenon is a primary cause of yarn hairiness, especially from shorter fibers in the blend.

Conclusion: An uncontrolled fiber end in the twisting zone is thrown outwards by rotation, causing yarn hairiness.

Quick Tip

Think of a spinning figure skater. When they pull their arms in, they spin faster. When they extend their arms out, the arms fly outwards due to centrifugal force. An uncontrolled fiber end acts like the skater's extended arm, flying outwards and creating **hairiness**.

65. The heart loop test of measurement of fabric stiffness is especially used for _____ fabrics.

- (A) Heavy
- (B) Stiff
- (C) Limpy
- (D) Knitted

Correct Answer: (C) Limpy

Solution: Step 1: Understand the principle of stiffness testing. Fabric stiffness (or bending rigidity) is its resistance to bending. Different methods are suited for different types of fabrics.

Step 2: Analyze the "Heart Loop Test". In this test, a strip of fabric is formed into a loop that resembles a heart shape and is hung on a stand. The length of the loop is measured. A stiffer fabric will resist bending and form a shorter, wider loop. A very flexible, non-stiff fabric will bend easily under its own weight, resulting in a long, narrow loop.

Step 3: Relate the method to the fabric type. The Cantilever test is the standard method for most fabrics. However, for fabrics that are very soft, flexible, and drapeable (i.e., "limpy"), the cantilever method is not sensitive enough because the fabric strip just drapes vertically and doesn't bend in a measurable way. The Heart Loop test is specifically designed for these very flexible and limpy fabrics because it is more sensitive to small differences in stiffness in the low range.

Conclusion: The heart loop test is especially suitable for measuring the stiffness of very flexible and limpy fabrics.

Quick Tip

Remember the right tool for the job in stiffness testing: - **Most Fabrics:** Cantilever Test (Shirley Stiffness Tester). - **Very Limpy/Soft Fabrics:** Heart Loop Test. - **Very Stiff Fabrics:** Bending tests with higher force application.

66. Choose the correct answer from the options given below:

Arrange the machines of a ring spinning line in the sequence.

A. Ring Frame

B. Carding

C. Speed frame

D. Draw frame

(A) A - I, B - II, C - III, D - IV

(B) A - III, B - I, C - II, D - IV

(C) A - II, B - I, C - IV, D - III

(D) A - III, B - I, C - IV, D - II **Correct Answer:** (C) B, D, C, A

Solution: Step 1: Understand the goal of a ring spinning line. The goal is to convert a mass of staple fibers (like cotton) into a fine, strong yarn. This is done through a sequence of machines, each performing a specific function.

Step 2: Analyze the function and position of each machine.

- **B. Carding:** This is one of the first major processes after opening and cleaning. The

carding machine disentangles the fibers and forms them into a "sliver," a thick, untwisted rope of parallel fibers.

- **D. Draw frame:** The sliver from the card is fed to the draw frame. The primary function of the draw frame is to improve the evenness of the sliver by doubling (combining several slivers) and to further straighten and parallelize the fibers by drafting. This process is usually repeated (two passages of drawing).

- **C. Speed frame (or Roving Frame/Simplex):** The sliver from the draw frame is too thick to be spun directly into fine yarn. The speed frame drafts this sliver into a much thinner strand called "roving," and adds a small amount of protective twist. The roving is then wound onto bobbins.

- **A. Ring Frame:** This is the final machine. The roving from the speed frame is fed into the ring frame, where it is drafted to its final count, high twist is inserted to give it strength, and the finished yarn is wound onto a bobbin or cop.

Step 3: Assemble the correct sequence. The logical process flow is: Carding → Draw frame → Speed frame → Ring Frame. This corresponds to the sequence B, D, C, A.

Quick Tip

The spinning process is a gradual attenuation of the fiber stream: - **Carding:** Creates the first "Sliver". - **Drawing:** Perfects the "Sliver". - **Speed Frame:** Attenuates sliver into "Roving". - **Ring Frame:** Attenuates roving into "Yarn".

67. Match the LIST-I with LIST-II.

LIST-I	LIST-II
Machine part	Function
A. Taker-in	I. Individualisation of fibres
B. Cylinder	II. Takes the fibers from cylinder surface
C. Flats	III. Pluck the flocks from feed roller
D. Doffer	IV. Elimination of neps

- (A) A, B and D only
- (B) A, B and C only
- (C) A, B, C and D
- (D) C and D only

Correct Answer: (D) A - III, B - I, C - IV, D - II

Solution: Step 1: Understand the context. All the machine parts listed (Taker-in, Cylinder, Flats, Doffer) are key components of a **Carding machine**. The primary function of the card is to open fiber tufts into individual fibers.

Step 2: Analyze the function of each part in sequence.

- **A. Taker-in (or Licker-in):** This is a small, fast-rotating roller with saw-tooth wire. It is the first main working element. It **plucks small flocks** of fiber from the feed roller and performs the initial, aggressive opening.
- **B. Cylinder and C. Flats:** The taker-in transfers the fibers to the main **Cylinder**, which is a very large, fast-rotating drum covered in fine wire points. Above the cylinder are the **Flats**, which are bars also covered in wire points that move slowly in the same direction as the cylinder. The very close gap between the fast-moving cylinder and slow-moving flats performs the main carding action: the final **individualisation of fibres** and the **elimination of neps** and trash.
- **D. Doffer:** This is a smaller roller, also with wire points, that rotates much slower than the cylinder. Its surface moves in the same direction as the cylinder at the point of interaction. Its job is to **take (or strip) the individualized fibers from the cylinder surface** and condense them into a web.

Step 3: Match the parts with their functions.

- A (Taker-in) → III (Pluck the flocks from feed roller).
- B (Cylinder, in conjunction with flats) → I (Individualisation of fibres).
- C (Flats, in conjunction with cylinder) → IV (Elimination of neps).
- D (Doffer) → II (Takes the fibers from cylinder surface).

Step 4: Assemble the combination. The correct matching is A-III, B-I, C-IV, D-II. This corresponds to option (D).

Quick Tip

Think of the carding machine as a fiber assembly line: 1. **Taker-in:** Grabs and opens the raw material. 2. **Cylinder/Flats:** The main work station for individualizing fibers and removing neps. 3. **Doffer:** Collects the finished single fibers from the cylinder.

68. Choose the correct tasks of the rotor spinning machine.

A. Fibre separation

B. Ordering the fibres in the strand

C. Imparting strength by twisting

D. Removal of neps

(A) Airjet spinning

(B) Ring spinning

(C) Open end spinning

(D) Friction spinning

Correct Answer: (B) A, B and C only

Solution: Step 1: Understand the Rotor (Open-End) Spinning process. A sliver is fed into the machine, broken down into individual fibers, re-formed into a yarn inside a high-speed rotor, and twisted.

Step 2: Analyze the tasks performed by the machine.

- **A. Fibre separation:** The sliver is fed to a very fast rotating opening roller (beater) which combs through the sliver and separates it into individual fibers. This is a crucial first step.
- **B. Ordering the fibres in the strand:** The separated fibers are transported by an air stream into a spinning rotor. Centrifugal force deposits them into a groove in the rotor, where they are collected and ordered into a thin, uniform strand or ribbon of fibers.
- **C. Imparting strength by twisting:** As the newly formed strand is pulled out of the rotor, the rapid rotation of the rotor itself imparts twist to the yarn (this is called "open-end" twisting). This twist is what gives the yarn its strength.
- **D. Removal of neps:** The opening roller does have a cleaning effect and can remove some trash and dust. However, rotor spinning is not a primary machine for nep removal. In fact, it

is sensitive to neps in the feed sliver. Significant nep removal is the job of the carding machine.

Step 3: Identify the correct tasks. The essential tasks of a rotor spinning machine are fiber separation (A), ordering the fibers in the rotor groove (B), and imparting twist for strength (C). Nep removal is not a primary task.

Quick Tip

The three key actions in Rotor Spinning are: 1. **Open:** Separate the sliver into single fibers. 2. **Assemble:** Collect and order the fibers in the rotor groove. 3. **Twist:** Spin the rotor to twist the fibers into yarn as they are pulled out.

69. In _____ modern spinning system, the rotation of yarn arises from the rotary movement of the two drums and is generated by frictional contact at the drum surface.

- (A) Middle and front rollers
- (B) Front roller and spindle
- (C) Back and middle rollers
- (D) Cool and back roller

Correct Answer: (D) Friction spinning

Solution: Step 1: Analyze the mechanism described. The key elements are: 1. Yarn rotation (twist insertion) is caused by rotary movement. 2. The movement comes from "two drums". 3. The force is generated by "frictional contact" with the drum surfaces. **Step 2:** Evaluate the spinning systems.

- **Airjet spinning:** Twist (or rather, a wrapping of fibers) is inserted by a vortex of compressed air. No drums are involved in twisting.

- **Ring spinning:** Twist is inserted by a traveler rotating around a ring, driven by the rotating spindle. No drums are involved.

- **Open end (Rotor) spinning:** Twist is inserted by the rotation of a single, solid rotor. Not two drums.

- **Friction spinning (e.g., DREF):** In this system, opened fibers are fed into the nip point

between two rotating, perforated drums (or rollers). The surfaces of the drums rotate in the same direction, causing the fibers collected at the nip to be rolled and twisted into a yarn. The twisting force is purely from the friction between the fibers and the moving drum surfaces. This perfectly matches the description.

Conclusion: The system that uses two friction drums to roll fibers into a twisted yarn is friction spinning.

Quick Tip

Link the twisting method to the spinning system name: - **Ring** → Ring and Traveler. - **Rotor** → Rotor. - **Airjet** → Air Jet/Vortex. - **Friction** → **Friction Drums**.

70. In the drafting system of a ring frame, the break draft is applied between

_____.

- (A) Middle and front rollers
- (B) Front roller and spindle
- (C) Back and middle rollers
- (D) Cool and back roller **Correct Answer:** (C) Back and middle rollers

Solution: Step 1: Understand a ring frame drafting system. A modern ring frame uses a 3-over-3 drafting system with aprons. It has three pairs of rollers: back, middle, and front. The rollers rotate at progressively faster surface speeds from back to front to attenuate (draft) the roving.

Step 2: Define the drafting zones. The total draft is divided into two zones: - **Main Draft Zone:** This is between the middle rollers and the fast-moving front rollers. This is where the majority of the drafting takes place, controlled by aprons. - **Break Draft Zone (or Back Zone Draft):** This is between the slow-moving back rollers and the slightly faster middle rollers. A small amount of draft, called the break draft, is applied here. **Step 3:** Analyze the purpose of the break draft. The break draft's purpose is to prepare the roving for the main draft. It slightly straightens the fibers and breaks any weak points or remaining cohesion from the roving twist, allowing the main draft to proceed smoothly and evenly.

Conclusion: The break draft is applied in the back zone, which is the zone between the back and middle rollers.

Quick Tip

Visualize the 3-roller drafting system: - ****(Back Roller)**** → *Break Draft Zone* → ****(Middle Roller)**** → *Main Draft Zone* → ****(Front Roller)**** - The **Break Draft** happens first, in the **Back** zone.

71. Match the LIST-I with LIST-II

LIST-I	LIST-II
Machine	Material
A. Blow room	I. Sliver
B. Carding	II. Yarn
C. Speed frame	III. Lap
D. Ring frame	IV. Roving

(A) A - I, B - II, C - III, D - IV

(B) A - I, B - III, C - II, D - IV

(C) A - III, B - I, C - IV, D - II

(D) A - III, B - I, C - II, D - IV **Correct Answer:** (C) A - III, B - I, C - IV, D - II

Solution: Step 1: Identify the input or output material for each machine in the spinning process.

- **A. Blow room:** The blow room line opens and cleans baled cotton. Its final product is typically a **lap** (a rolled sheet of fibers) or it can feed directly to the carding machine (chute feed). Lap is the correct product form listed.

- **B. Carding:** The carding machine takes the lap (or tufts from a chute feed) and produces a **sliver**, which is a thick, untwisted rope of fibers.

- **C. Speed frame (Simplex):** The speed frame takes the sliver from the draw frame and drafts it to produce a thinner strand called **roving**, which has a slight protective twist.

- **D. Ring frame:** The ring frame is the final spinning machine. It takes the roving as its input and drafts and twists it to produce the final product, **yarn**.

Step 2: Assemble the correct matches.

- A (Blow room) → III (Lap) - B (Carding) → I (Sliver) - C (Speed frame) → IV (Roving) - D (Ring frame) → II (Yarn)

Step 3: Find the corresponding option. The combination A-III, B-I, C-IV, D-II matches option (C).

Quick Tip

Follow the material transformation in a spinning mill: Bale → **Blow Room** → Lap → **Card** → Sliver → Draw Frame → Sliver → **Speed Frame** → Roving → **Ring Frame** → Yarn.

72. On a _____ machine, two or more single yarns are plied and twisted together.

- (A) Ring frame
- (B) Two for one twister
- (C) Yarn winding
- (D) Speed frame

Correct Answer: (B) Two for one twister

Solution: Step 1: Understand the process described. The process is "plying," which means combining two or more single yarns, and "twisting" them together to form a multi-ply yarn (e.g., a two-ply yarn). This is a post-spinning process to create stronger, more balanced, or novelty yarns.

Step 2: Evaluate the function of each machine.

- **A. Ring frame:** This machine produces *single* yarn from roving. It does not ply yarns together.
- **B. Two for one twister (TFO):** This is a machine specifically designed for plying and twisting. Several single yarns are fed from supply packages, and for every one revolution of the machine's spindle, two turns of twist are inserted into the plied yarn. It is the standard, high-production machine for this task.
- **C. Yarn winding:** This machine transfers yarn from smaller spinning bobbins to larger

packages (cones or cheeses). While some winding machines can combine yarns (doubling), their primary purpose is not to insert high levels of twist.

- **D. Speed frame:** This machine produces roving from sliver. It is an intermediate process before spinning.

Conclusion: The Two-for-one (TFO) twister is the modern machine used to ply and twist single yarns together.

Quick Tip

Distinguish spinning from post-spinning: - **Spinning** (Ring Frame, Rotor): Makes SINGLE yarn. - **Twisting/Plying** (TFO Twister): Combines MULTIPLE single yarns.

73. In the spinning process, a precisely predetermined quantity of short fibers are eliminated in _____.

- (A) Comber
- (B) Draw frame
- (C) Speed frame
- (D) Carding

Correct Answer: (A) Comber

Solution: Step 1: Understand the objective: to eliminate a "precisely predetermined quantity of short fibers." This is a selective process aimed at improving yarn quality by removing the least desirable fibers from the fiber population.

Step 2: Evaluate the function of each machine regarding short fibers.

- **A. Comber:** The combing process is specifically designed for this purpose. A lap of parallelized fibers is fed to the comber, where a series of fine-toothed combs pass through the fiber fringe. This action physically removes short fibers, neps, and impurities. The amount of waste removed (called "noil") can be precisely controlled by adjusting machine settings, typically ranging from 8% to 25%. Yarns made from combed cotton are finer, stronger, smoother, and more expensive.

- **B. Draw frame:** The main goal is improving evenness and parallelization, not removing

short fibers.

- **C. Speed frame:** The main goal is drafting and inserting protective twist. It does not remove short fibers.

- **D. Carding:** Carding removes some short fiber as waste ("card waste"), but its main job is individualization, and the removal is not as precise or significant as in combing.

Conclusion: The comber is the only machine in the spinning process whose specific function is to eliminate a precisely controlled amount of short fibers.

Quick Tip

Remember the difference between Carded and Combed yarns: - **Carded Yarn:** All fibers are included (except for some waste). Standard quality. - **Combed Yarn:** Short fibers are intentionally and precisely removed by a **Comber**. Premium quality.

74. The main objective of the ginning process is _____.

(A) Separation of seeds from cotton fibers

(B) Opening and cleaning

(C) Trash removal

(D) Parallelization of fibers **Correct Answer:** (A) Separation of seeds from cotton fibers

Solution: Step 1: Define Ginning. Ginning is the very first mechanical process that seed cotton undergoes after harvesting.

Step 2: Analyze the composition of harvested seed cotton. It consists of two main components: the cotton fibers (lint) and the cottonseed to which the fibers are attached. It also contains other field trash like leaves and stems.

Step 3: Understand the primary goal of the process. The purpose of ginning is to separate the valuable lint fibers from the cottonseed. This must be done before the fibers can be processed in a spinning mill. While some cleaning (B, C) also occurs during ginning, the fundamental and defining objective is seed removal. Parallelization of fibers (D) is a goal of later processes like carding and drawing.

Conclusion: The main objective of the ginning process is the separation of seeds from

cotton fibers.

Quick Tip

Ginning is the bridge from the farm to the mill. - **Farm product:** Seed Cotton (Fiber + Seed). - **Ginning Process:** Separates the two. - **Mill input:** Lint Cotton (Fiber only).

75. In a ring bobbin, the actual yarn weight is 75 grams with count 30 tex, calculate the length of the yarn in meters.

- (A) 7500 meters
- (B) 250 meters
- (C) 25 meters
- (D) 2500 meters

Correct Answer: (D) 2500 meters

Solution: Step 1: Understand the definition of the Tex count system. A count of 30 tex means that 1000 meters of this yarn weigh 30 grams.

$$30 \text{ tex} = \frac{30 \text{ grams}}{1000 \text{ meters}}$$

Step 2: Set up the problem. We know the total weight of the yarn on the bobbin is 75 grams, and we know the weight per 1000 meters. We need to find the total length.

We can write the relationship as:

$$\text{Length (m)} = \frac{\text{Total Weight (g)}}{\text{Weight per meter (g/m)}}$$

First, find the weight per meter:

$$\text{Weight per meter} = \frac{30 \text{ g}}{1000 \text{ m}} = 0.03 \text{ g/m}$$

Step 3: Calculate the total length.

$$\text{Length (m)} = \frac{75 \text{ g}}{0.03 \text{ g/m}} = \frac{75}{3/100} = 75 \times \frac{100}{3} = 25 \times 100 = 2500 \text{ meters}$$

Alternative Method (using proportion): If 30 grams correspond to 1000 meters, Then 75 grams correspond to X meters.

$$\frac{1000 \text{ m}}{30 \text{ g}} = \frac{X \text{ m}}{75 \text{ g}}$$
$$X = \frac{1000 \times 75}{30} = \frac{75000}{30} = \frac{7500}{3} = 2500 \text{ meters}$$

Quick Tip

The formula connecting Tex, weight, and length is:

$$\text{Length (m)} = \frac{\text{Weight (g)} \times 1000}{\text{Tex}}$$

Plugging in the values: $\text{Length} = \frac{75 \times 1000}{30} = 2500 \text{ meters}.$