GATE 2026 TF Question Paper with Solutions

Time Allowed :3 Hour	**Maximum Marks :**100	**Total Questions :**65

General Instructions

Read the following instructions very carefully and strictly follow them:

1. This question paper is divided into three sections:
   - **General Aptitude (GA):** 10 questions (5 questions × 1 mark + 5 questions × 2 marks) for a total of 15 marks.
   - **Engineering Mathematics:** This section comprises of total 15 marks.
   - **Core Textile Engineering/Fibre science:** This section comprises of total 70 marks.
2. The total number of questions is **65**, carrying a maximum of **100 marks**.
3. The duration of the exam is **3 hours**.
4. Marking scheme:
   - For 1-mark MCQs, $\frac{1}{3}$ mark will be deducted for every incorrect response.
   - For 2-mark MCQs, $\frac{2}{3}$ mark will be deducted for every incorrect response.
   - No negative marking for numerical answer type (NAT) questions.
   - No marks will be awarded for unanswered questions.
5. Ensure you attempt questions only from the optional section (Part B1 or Part B2) you have selected.
6. Follow the instructions provided during the exam for submitting your answers.

1. The twist per inch (TPI) of a yarn primarily affects its:

(A) Fineness
(B) Strength
(C) Length
(D) Moisture regain

Correct Answer: (B) Strength

Solution:

Understanding the Question: The question asks to identify the most significant property of a yarn that is controlled by the amount of twist inserted during spinning.

Key Approach: The solution involves understanding the fundamental purpose of twisting fibers to form a yarn. Twist creates friction between the fibers, which is the primary mechanism that gives the yarn its coherence and mechanical properties.

Detailed Solution:
Step 1: Define Yarn Twist. Twist is the spiral arrangement of fibers around the central axis of the yarn. It is measured in turns per unit length, such as twists per inch (TPI).
Step 2: Explain the Mechanism. When staple fibers are twisted together, the twist creates a radial pressure that presses the fibers against each other. This increases the inter-fiber friction.
Step 3: Relate Twist to Strength. This increased friction prevents the fibers from slipping past one another when the yarn is put under tension. Up to an optimal level, a higher TPI results in greater inter-fiber cohesion, which directly increases the yarn's tensile strength.
Step 4: Evaluate Other Options. Fineness is related to the yarn's mass per unit length (count), length is a basic dimension, and moisture regain is an intrinsic property of the fiber material itself. While twist can slightly influence other properties, its primary and most direct effect is on strength.
Step 5: Conclusion. Therefore, the twist per inch (TPI) of a yarn primarily affects its **strength**.

Quick Tip

Think of twist as the "glue" that holds fibers together in a yarn. More twist means more friction and a stronger yarn (up to a certain point).

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2. Which fibre has the highest moisture regain under standard atmospheric conditions?

(A) Cotton
(B) Wool
(C) Polyester
(D) Nylon

Correct Answer: (B) Wool

Solution:

Understanding the Question: The question asks to identify which of the listed fibers is the most absorbent, meaning it can hold the most water vapor from the atmosphere relative to its dry weight.

Key Approach: This is a knowledge-based question that relies on knowing the typical moisture regain values for common textile fibers. The general principle is that natural fibers are more hydrophilic (water-loving) than synthetic ones.

Detailed Solution:
Step 1: Define Moisture Regain. Moisture regain is the weight of water absorbed by a completely dry fiber, expressed as a percentage of its dry weight, under standard conditions (typically 20°C and 65**Step 2: Compare the Fibers.**
(B) Wool: As a natural protein fiber, wool has a complex chemical structure with many polar groups that attract water molecules. It has the highest moisture regain among the options, typically 13-16**(A) Cotton:** A natural cellulosic fiber, cotton is also absorbent but less so than wool, with a moisture regain of about 7-8.5**(D) Nylon:** A synthetic polyamide, nylon is moderately absorbent for a synthetic fiber, with a regain of about 4-4.5**(C) Polyester:** A synthetic polymer, polyester is hydrophobic (water-repelling) and has a very low moisture regain of only about 0.4**Step 3: Conclusion.** Based on these values, **wool** has the highest moisture regain under standard atmospheric conditions.

> Quick Tip
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> Natural animal fibers like wool are the most absorbent, followed by natural plant fibers like cotton. Synthetic fibers like polyester are the least absorbent.

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3. In plain weave fabric, the repeat size is:

(A) 1 x 1
(B) 2 x 2
(C) 3 x 3
(D) 4 x 4

Correct Answer: (A) 1 x 1

Solution:

Understanding the Question: This question asks for the size of the smallest repeating unit that defines the structure of a plain weave fabric.

Key Approach: To answer this, we must understand the construction of a plain weave. The answer can be interpreted in two ways: the interlacing notation or the complete technical repeat. The provided correct answer points towards the former.

Detailed Solution:
A plain weave is the simplest possible weave structure. It is characterized by each weft yarn passing alternately over one warp yarn and then under the next. This basic interlacing pattern is often referred to by the notation "1 up, 1 down" or simply **1/1**. The question and the given correct answer (A) are likely referring to this fundamental notation of the weave's construction. While the smallest complete unit that can be repeated to form the entire fabric pattern technically requires two warp ends and two weft picks (a 2x2 area), the basic principle of interlacing is on a 1x1 basis. Therefore, in the context of this simplified notation, the repeat size is considered **1 x 1**.

> Quick Tip
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> The fundamental interlacing of a plain weave is "1 up, 1 down", often denoted as 1/1. However, be aware that the smallest complete technical repeat unit for the pattern is 2 ends by 2 picks (2x2).

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4. The strength of a yarn is commonly expressed in terms of:

(A) Tenacity
(B) Elongation
(C) Evenness
(D) Crimp

Correct Answer: (A) Tenacity

Solution:

Understanding the Question: The question asks for the standard technical term used in the textile industry to quantify the strength of a yarn in a way that allows for comparison between different yarns.

Key Approach: We need to analyze the given options and identify which term represents a normalized measure of strength, accounting for the yarn's thickness.

Detailed Solution:
Step 1: Define Yarn Strength Measurement. Simply measuring the force required to break a yarn isn't a fair comparison, as a thick yarn will be stronger than a thin yarn of the same material. Strength must be normalized by the yarn's size or linear density.
Step 2: Define Tenacity. Tenacity is the specific term for this normalized strength. It is calculated by taking the breaking force of the yarn and dividing it by its linear density (e.g., tex or denier). The common units are centiNewtons per tex (cN/tex) or grams-force per denier

(g/den).
Step 3: Define Other Options.
(B) Elongation is the degree of stretch a yarn can endure before breaking.
(C) Evenness describes the uniformity of the yarn's mass along its length.
(D) Crimp refers to the waviness of fibers in the yarn.
Step 4: Conclusion. The correct and standard term for expressing the intrinsic strength of a yarn is **tenacity**.

Quick Tip

Remember the formula: Tenacity = Breaking Force / Linear Density. It's the "strength-to-weight ratio" for a yarn.

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5. The main purpose of scouring in cotton processing is to remove:

(A) Natural coloring matter
(B) Waxes and impurities
(C) Lignin
(D) Synthetic finishes

Correct Answer: (B) Waxes and impurities

Solution:

Understanding the Question: The question asks to identify the primary substances that are targeted for removal during the scouring stage of cotton wet processing.

Key Approach: This requires knowledge of the composition of raw cotton and the specific functions of the preparatory chemical processes before dyeing.

Detailed Solution:
Raw cotton fiber is primarily cellulose, but it also contains natural impurities that hinder processing. These include waxes, pectins, fats, proteins, and minerals. The natural waxes make the fiber hydrophobic (water-repellent). For dyes and finishes to be applied uniformly, the cotton must be made clean and highly absorbent. The process of **scouring** uses a hot alkaline solution (like caustic soda) to saponify the fats and waxes and remove these non-cellulosic impurities. This makes the fiber hydrophilic (water-loving) and ready for the next stage, which is usually bleaching. Natural coloring matter is removed by bleaching, lignin is not a significant component of cotton, and synthetic finishes are applied much later in the process. Therefore, the main purpose of scouring is to remove **waxes and impurities**.

Quick Tip

Think of scouring as "deep cleaning" the cotton. It washes away the natural greasy and waxy coatings to make the cotton absorbent.

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6. Which spinning system produces yarn directly from sliver without roving?

(A) Ring spinning
(B) Rotor spinning
(C) Mule spinning
(D) Cap spinning

Correct Answer: (B) Rotor spinning

Solution:

Understanding the Question: The question asks to identify a spinning technology that has a shorter process flow by eliminating the roving formation step.

Key Approach: The solution requires comparing the process sequences of the different spinning systems listed, specifically noting the input material for the final yarn formation stage.

Detailed Solution:
Step 1: Analyze Conventional Spinning. In the traditional **ring spinning** process, the thick 'sliver' from the draw frame is too coarse to be drafted into yarn in a single step. It must first be processed on a roving frame (or speed frame), which attenuates it and inserts a slight twist to create a thin intermediate product called 'roving'. This roving is then fed to the ring frame.
Step 2: Analyze Modern Spinning Systems. Rotor spinning (or open-end spinning) is a newer technology designed for higher productivity. It takes the sliver directly from the draw frame, opens it into individual fibers, collects these fibers on the inside surface of a rapidly spinning rotor, and continuously pulls them off as a finished yarn.
Step 3: Compare the Processes. By its design, the rotor spinning process completely bypasses the roving stage. Mule and cap spinning are older or specialized systems that also require roving as an input.
Step 4: Conclusion. The system that produces yarn directly from sliver without a roving stage is **rotor spinning**.

Quick Tip

Rotor spinning is a "shortcut" spinning method. It skips the roving frame, making it much faster and more automated than ring spinning.

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7. Polyester fibre is manufactured by the process of:

(A) Wet spinning
(B) Dry spinning
(C) Melt spinning
(D) Gel spinning

Correct Answer: (C) Melt spinning

Solution:

Understanding the Question: The question asks to identify the specific industrial manufacturing method used to create polyester fibers.

Key Approach: The correct method is determined by the chemical properties of the polymer. We need to identify if polyester can be melted or if it must be dissolved in a solvent.

Detailed Solution:
Step 1: Characterize Polyester. Polyester is a thermoplastic polymer. A key characteristic of thermoplastics is that they soften and melt when heated and solidify when cooled, a process that can be repeated without significant chemical degradation.
Step 2: Define Melt Spinning. Melt spinning is the simplest and most economical spinning process, reserved for thermoplastic polymers. In this method, polymer chips are heated until they melt into a thick liquid. This molten polymer is then pumped through the fine holes of a spinneret. The emerging liquid filaments solidify into fibers as they are cooled by a stream of air.
Step 3: Evaluate Other Methods. Wet and dry spinning are used for polymers that would decompose before melting and therefore must be dissolved in a chemical solvent. Gel spinning is a more specialized technique for high-performance fibers. Since polyester is thermoplastic, melt spinning is the ideal method.
Step 4: Conclusion. Polyester fibre is manufactured by the process of **melt spinning**.

Quick Tip

If a polymer can melt like plastic, it will be melt-spun. This applies to major synthetic fibers like polyester, nylon, and polypropylene.