GATE 2024

Question Paper | Answer Key

Graduate Aptitude Test in Engineering (GATE) is a prestigious national-level exam that assesses candidates for comprehensive understanding in various undergraduate-level subjects in Engineering, Technology, Science, Architecture, and Humanities.

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General Aptitude (GA)

Q.1 – Q.5 Carry ONE mark Each

Q.1 If '→' denotes increasing order of intensity, then the meaning of the words [dry → arid → parched] is analogous to [diet → fast → _____].

Which one of the given options is appropriate to fill the blank?

(A) starve

(B) reject

(C) feast

(D) deny

Q.2 If two distinct non-zero real variables x and y are such that $(x + y)$ is proportional to $(x - y)$ then the value of $\frac{x}{y}$

(A) depends on xy

(B) depends only on x and not on y

(C) depends only on y and not on x

(D) is a constant

Q.3 Consider the following sample of numbers:

9, 18, 11, 14, 15, 17, 10, 69, 11, 13

The median of the sample is

(A) 13.5

(B) 14

(C) 11

(D) 18.7

Q.4 The number of coins of ₹1, ₹5, and ₹10 denominations that a person has are in the ratio 5:3:13. Of the total amount, the percentage of money in ₹5 coins is

(A) 21%

(B) $14\frac{2}{7}\%$

(C) 10%

(D) 30%

Q.5 For positive non-zero real variables p and q, if

$$\log\ (p^2 + q^2) = \log p + \log q + 2\log 3\,,$$

then, the value of $\frac{p^4+q^4}{p^2q^2}$ is

(A) 79

(B) 81

(C) 9

(D) 83

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Q.6 – Q.10 Carry TWO marks Each

Q.6 In the given text, the blanks are numbered (i)−(iv). Select the best match for all the blanks.

Steve was advised to keep his head _____(i)_____ before heading _____(ii)_____ to bat; for, while he had a head _____(iii)_____ batting, he could only do so with a cool head _____(iv)_____ his shoulders.

(A)	(i) down	(ii) down	(iii) on	(iv) for
(B)	(i) on	(ii) down	(iii) for	(iv) on
(C)	(i) down	(ii) out	(iii) for	(iv) on
(D)	(i) on	(ii) out	(iii) on	(iv) for

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Q.7 A rectangular paper sheet of dimensions 54 cm × 4 cm is taken. The two longer edges of the sheet are joined together to create a cylindrical tube. A cube whose surface area is equal to the area of the sheet is also taken.

Then, the ratio of the volume of the cylindrical tube to the volume of the cube is

(A) $1/\pi$

(B) $2/\pi$

(C) $3/\pi$

(D) $4/\pi$

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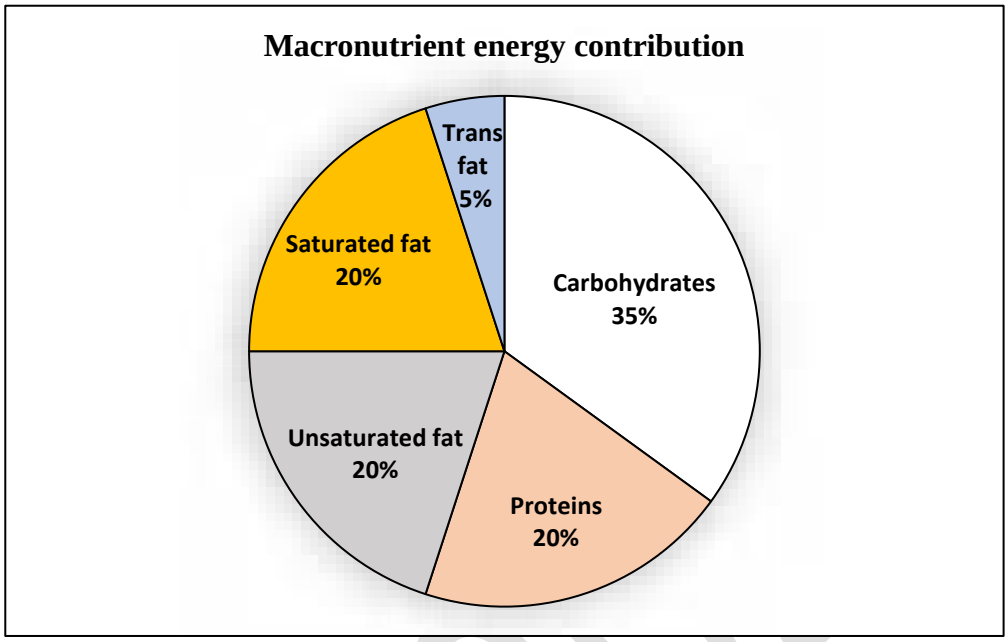
Q.8 The pie chart presents the percentage contribution of different macronutrients to a typical 2,000 kcal diet of a person.



The typical energy density (kcal/g) of these macronutrients is given in the table.

Macronutrient	Energy density (kcal/g)
Carbohydrates	4
Proteins	4
Unsaturated fat	9
Saturated fat	9
Trans fat	9

The total fat (all three types), in grams, this person consumes is

(A) 44.4

(B) 77.8

(C) 100

(D) 3,600

Q.9 A rectangular paper of 20 cm × 8 cm is folded 3 times. Each fold is made along the line of symmetry, which is perpendicular to its long edge. The perimeter of the final folded sheet (in cm) is

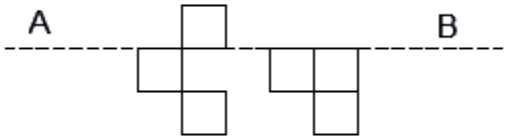
(A) 18

(B) 24

(C) 20

(D) 21

Q.10 The least number of squares to be added in the figure to make AB a line of symmetry is



(A) 6

(B) 4

(C) 5

(D) 7

Q.11 – Q.35 Carry ONE mark Each

Q.11 The approximate value of the integral

$$\int_{2}^{3} \frac{dx}{x}$$

using Simpson's rule with $h = 0.5$ is

(A) 0.12

(B) 0.19

(C) 0.41

(D) 0.58

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Q.12 The differential equation

$$\frac{dy}{dx} = \frac{M(x,y)}{N(x,y)}$$

is exact if

(A) $\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$

(B) $\frac{\partial M}{\partial x} = \frac{\partial N}{\partial y}$

(C) $\frac{\partial M}{\partial y} + \frac{\partial N}{\partial x} = 0$

(D) $\frac{\partial M}{\partial y} \times \frac{\partial N}{\partial x} = 0$

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Q.13 The value of the integral

$$\int_0^\infty \frac{dx}{e^x + e^{-x}}$$

is

(A) 0

(B) $\frac{\pi}{4}$

(C) $\frac{\pi}{2}$

(D) π

Q.14 Amongst the following polymers, the one with the lowest glass transition temperature is

(A) Polyethylene

(B) Polypropylene

(C) Polystyrene

(D) Poly(ethylene terephthalate)

Q.15 Amongst the following fibre forming polymers, the one which is synthesised by chain growth polymerisation is

(A) Poly(ethylene terephthalate)

(B) Nylon 6,6

(C) Polyacrylonitrile

(D) Poly(p-phenylene terephthalamide)

Q.16 The purpose of opening in blowroom is

(A) Individualisation of fibres in tufts

(B) Parallelisation of fibres in tufts

(C) Separation of short fibres from tufts

(D) Creation of more voluminous tufts

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Q.17 Amongst the following, forward as well as reverse rotary motion in cotton combing is given to

(A) Feed roller

(B) Cylinder comb

(C) Detaching rollers

(D) Drawing rollers in comber drawbox

Q.18 A circular weft knitting machine with 24 inch gauge and 20 inch diameter needle bed is used to make a tubular knitted fabric. If the fabric shrinks by 35 % in course-wise direction upon withdrawal from the machine, the circumference (inch) of the shrunk tubular fabric is approximately

(A) 40.9

(B) 56.2

(C) 68.6

(D) 72.2

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Q.19 A winder operates at 750 m/min with 93 % efficiency. Time (min) taken for the winder to wind 1.2 kg of 20 tex yarn is approximately

(A) 68

(B) 74

(C) 86

(D) 90

Q.20 With reference to Shirley stiffness tester, the relationship between the fabric bending length (C) and the overhanging length (L) at the standard angle of deflection of 41.5° is approximately

(A) $C = 0.25\,L$

(B) $C = 0.5\,L$

(C) $C = L$

(D) $C = 2\,L$

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Q.21 An evenness tester, working on capacitance principle, provides

(A) Mass per unit length of yarn

(B) Standard deviation of mass per unit length of yarn

(C) Coefficient of variation of mass per unit length of yarn

(D) Coefficient of variation of diameter of yarn

Q.22 Amongst the following, the chemical used for bleaching of cotton fabric in acidic medium is

(A) $NaClO_2$

(B) NaOCl

(C) $NaClO_3$

(D) $MgCl_2$

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Q.23 In a discharge printing process, two dyes of different colours, one with high dischargeability (HD) and another with low dischargeability (LD), are to be considered. The correct statement regarding the selection of dyes is

(A) LD can be used only as illuminant colour but HD cannot be used either as ground or as illuminant colour

(B) HD can be used only as ground colour but LD cannot be used either as ground or as illuminant colour

(C) LD can be used only as ground colour and HD can be used only as illuminant colour

(D) HD can be used only as ground colour and LD can be used only as illuminant colour

Q.24 Amongst the following, the nitrogen containing fibre(s) is/are

(A) Nylon 6

(B) Kevlar

(C) Acrylic

(D) Polyester

Q.25 As the package builds up in a roving frame, the component(s) whose speed **DOES NOT** remain constant, amongst the following, is/are

(A) Spindle

(B) Bobbin

(C) Bobbin rail

(D) Drafting rollers

Q.26 Amongst the following, the correct condition(s) that will reduce bumping during weaving is/are

(A) Higher warp tension

(B) Reduction in sweep of the sley

(C) Higher pick density

(D) Reduction of shed height

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Q.27 With reference to the principles of yarn hairiness measurement, the correct statement(s), amongst the following, is/are

(A) Light scattering principle is used to measure length of hairs

(B) Light scattering principle is used to measure number of hairs

(C) Photocells are used to measure length of hairs

(D) Photocells are used to measure number of hairs

Q.28 A fluorocarbon-based soil release finish consists of alternating hydrophobic blocks and hydrophilic blocks arranged side by side on fabric surface. The correct statement(s) amongst the following is/are

(A) In dry state, the hydrophobic blocks shield the hydrophilic blocks to repel soil

(B) During washing, the hydrophilic blocks swell and facilitate release of soil

(C) In dry state, the hydrophilic blocks shield the hydrophobic blocks to repel soil

(D) During washing, the hydrophobic blocks swell and facilitate release of soil

Q.29 If $g(x)$ is a continuous function such that

$$\int_a^b g(x)dx = \beta$$

then the correct statement(s), amongst the following, is/are

(A) $\int_{a+1}^{b+1} g(x-1)dx = \beta$

(B) $\int_{\frac{1-a}{2}}^{\frac{1-b}{2}} 2\, g(1-2x)dx = \beta$

(C) $\int_0^{b-a} g(x+a)dx = \beta$

(D) $\int_0^{a-b} g(a-x)dx = \beta$

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Q.30 A continuous random variable X has the following probability density function

$$f(x) = \begin{cases} kx^2(1-x^3), & 0 \le x \le 1 \\ 0, & \text{elsewhere} \end{cases}$$

If mean of X is 0.64, then the value of k (*rounded off to 2 decimal places*) is _____.

Q.31 Poly(ethylene terephthalate) has a number average molecular weight of 25000. The degree of polymerisation (*rounded off to the nearest integer*) is _____.

Q.32 A cotton yarn of 20 tex count is replaced by a polyester yarn such that both the yarns have same diameter and same packing density. Assuming densities of cotton and polyester fibres as 1.52 g/cm^3 and 1.38 g/cm^3, respectively, the count (tex) of the polyester yarn (*rounded off to 2 decimal places*) is _____.

Q.33 A knitted fabric is prepared from a yarn of 15 tex count. The fabric has 16 courses/cm, 17 wales/cm and 2.6 mm loop length. The areal density (g/m^2) of the fabric (*rounded off to the nearest integer*) is _____.

Q.34 A 59.05 Ne cotton yarn, a 20 tex polyester/cotton blended yarn and a 90 denier polyester filament are twisted together to obtain a 3-ply yarn. Assuming there is no twist contraction, the resultant count (Ne) of the 3-ply yarn (*rounded off to 2 decimal places*) is _____.

Q.35 One kg bone-dry cotton fabric is padded with water to obtain 80 % wet pick up. The temperature of the wet fabric after padding is 30 ^{o}C. Assume the specific heat of water to be 1 cal/(g·^{o}C); the latent heat of evaporation of water to be 540 cal/g and the specific heat of cotton to be 0.3 cal/(g·^{o}C). The energy (kcal) required to dry the fabric completely (*in integer)* is _____.

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Q.36 – Q.65 Carry TWO marks Each

Q.36 The three eigenvalues of the matrix

$$\begin{bmatrix} -2 & x & -3 \\ 2 & 1 & -6 \\ -1 & -2 & y \end{bmatrix}$$

are $\lambda_1 = 5$ and $\lambda_2 = \lambda_3 = -3$. The value of x is

(A) –2

(B) 0

(C) 2

(D) 4

Q.37 A scientist wants to find the root of the equation $2x^3 + x^2 - 1 = 0$ lying in (0,1). He applies Secant method only once by taking two initial guesses 0.5 and 0.7. The value of the root is approximately

(A) 0.17

(B) 0.52

(C) 0.65

(D) 0.75

Q.38 Determine the correctness or otherwise of the following Assertion [a] and Reason [r]:

[a]: Nylon 6 should be thoroughly dried before melt spinning

[r]: The glass transition temperature of Nylon 6 decreases in presence of moisture

(A) Both [a] and [r] are true and [r] is the correct reason for [a]

(B) Both [a] and [r] are true and [r] is not the correct reason for [a]

(C) Both [a] and [r] are false

(D) [a] is true but [r] is false

Q.39 Determine the correctness or otherwise of the following Assertion [a] and Reason [r]:

[a]: Cotton does not exhibit melting behaviour when exposed to flame

[r]: Cotton is not crystalline enough to exhibit melting behaviour

(A) Both [a] and [r] are true and [r] is the correct reason for [a]

(B) Both [a] and [r] are true and [r] is not the correct reason for [a]

(C) Both [a] and [r] are false

(D) [a] is true but [r] is false

Q.40 Amongst the different zones in a carding machine, if

P = draft between feed roller and taker-in

Q = draft between taker-in and cylinder

R = draft between cylinder and doffer

then the drafts follow the order

(A) $Q < R < P$

(B) $Q < P < R$

(C) $R < Q < P$

(D) $R < P < Q$

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Q.41 Group I lists yarn manufacturing technologies and Group II contains typical structural features of the yarns. Match the manufacturing technology with the structural features of the yarn.

Group I	Group II
P. Rotor spinning	1. Twistless parallel fibres in core and helically arranged filament on surface
Q. Air-jet spinning	2. Helically twisted core and distinct wrappers on surface
R. Wrap spinning	3. Multifilament core covered by staple fibres stuck to molten polymer
S. Bobtex spinning	4. Twistless core wrapped regularly and helically by thin fibre ribbons

(A) P-1, Q-3, R-4, S-2

(B) P-1, Q-4, R-3, S-2

(C) P-2, Q-4, R-1, S-3

(D) P-2, Q-1, R-4, S-3

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Q.42 Group I lists weaving machine related parameters and Group II contains the shortcomings of these parameters. Match the machine related parameter with its shortcoming.

Group I		Group II	
P.	Variable heald staggering	1.	Not favourable for heavy fabric
Q.	High eccentricity ratio	2.	Reduction in shed height
R.	Fixed heald staggering	3.	Reduction of sley dwell
S.	Late shedding	4.	Higher vibration in weaving machine

(A) P-1, Q-3, R-2, S-4

(B) P-1, Q-3, R-4, S-2

(C) P-3, Q-4, R-2, S-1

(D) P-3, Q-4, R-1, S-2

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Q.43 Determine the correctness or otherwise of the following Assertion [a] and Reason [r]:

[a]: The variability of fibre diameter in melt-blown nonwoven fabric is remarkably higher than that in spunbond nonwoven fabric

[r]: Hot air attenuation in melt-blown process is responsible for high variation in fibre diameter

(A) Both [a] and [r] are true and [r] is the correct reason for [a]

(B) Both [a] and [r] are true and [r] is not the correct reason for [a]

(C) Both [a] and [r] are false

(D) [a] is true but [r] is false

Q.44 A print paste for pigment printing of cotton fabric is prepared by using a synthetic thickener. The suitable chemical, amongst the following, to build the viscosity of the print paste is

(A) HCOOH

(B) NH_4OH

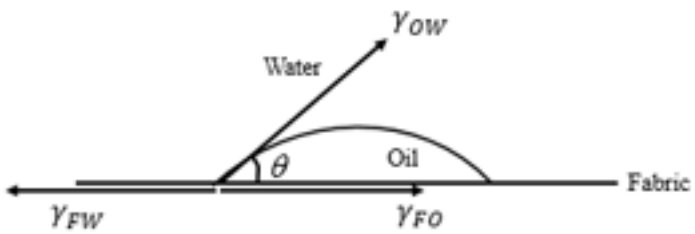
(C) CH_3COOH

(D) $MgCl_2$

Q.45 Consider the following diagram where an oil droplet is formed on a fabric immersed in water. At equilibrium, the balance of various interfacial forces acting on the droplet is given by the following equation

$$\gamma_{FW} = \gamma_{FO} + \gamma_{OW}\, cos\theta$$

When a surfactant is added to water, assuming that γ_{OW} and γ_{FO} remain unchanged, the following happens



(A) γ_{FW} decreases and the oil droplet tends to become rounder

(B) γ_{FW} increases and the oil droplet tends to become flatter

(C) γ_{FW} decreases and the oil droplet tends to become flatter

(D) γ_{FW} increases and the oil droplet tends to become rounder

Q.46 Polymer melt flowing through a capillary exhibits die-swell. The correct statement(s), amongst the following, is/are

(A) Die-swell is due to entropic effect

(B) Die-swell is dependent on capillary length

(C) Die-swell is independent of processing temperature

(D) Die-swell is dependent on shear rate

Q.47 Amongst the given options, the spinning technology(ies) in which the concept of spinning triangle exists is/are

(A) Ring spinning

(B) Rotor spinning

(C) Friction spinning

(D) Compact spinning

Q.48 Consider the following equation

$$C = C_1 + C_2 - C_1C_2$$

where C stands for fractional cover of a fabric, C_1 denotes the fractional cover of warp and C_2 refers to the fractional cover of weft. Amongst the given options, the fabric structure(s) in which the aforesaid equation is valid is/are

(A) Plain woven fabric

(B) Double cloth

(C) Terry fabric

(D) Leno fabric

Q.49 With reference to the KES FB-1 system, the correct statement(s) amongst the following is/are

(A) Tensile strain is measured by angle of drum rotation

(B) Tensile strain is measured by crosshead movement

(C) Tensile force is measured by tensile load cell

(D) Tensile force is measured by torque sensor

Q.50 With reference to cotton fibre testing systems, the correct statement(s) amongst the following is/are

(A) Image processing principle is used to measure nep count in HVI

(B) Image processing principle is used to measure trash count in HVI

(C) Air flow principle is used to measure fibre fineness in HVI

(D) Air flow principle is used to measure fibre fineness in AFIS

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Q.51 Amongst the given options, the condition(s) which will increase the equilibrium wicking height of water in a yarn is/are

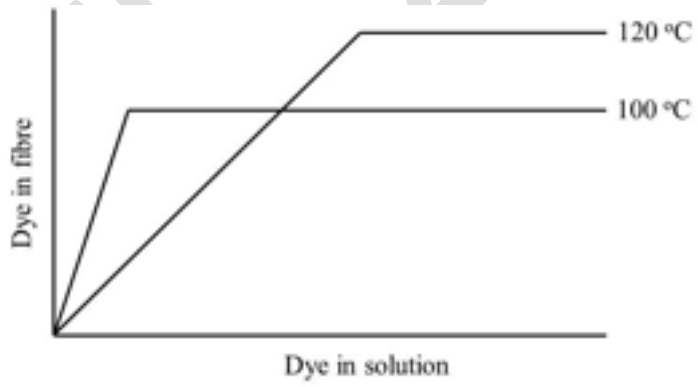
(A) Higher contact angle between fibre and water

(B) Lower contact angle between fibre and water

(C) Higher capillary diameter

(D) Lower capillary diameter

Q.52 Consider the following equilibrium dyeing isotherms for dyeing of polyester with a disperse dye at 100 ^{o}C and 120 ^{o}C. Amongst the following, the correct statement(s) is/are



(A) Rate of dyeing at 100 ^{o}C is higher than that at 120 ^{o}C

(B) Saturation dye-uptake at 120 ^{o}C is higher than that at 100 ^{o}C

(C) Dye solubility at 120 ^{o}C is higher than that at 100 ^{o}C

(D) Dye solubility at 120 ^{o}C is lower than that at 100 ^{o}C

Q.53 Amongst the following, the property(ies) of a disperse dye that allow(s) it to be applied on polyester by thermofixation method is/are

(A) Sublimation tendency

(B) High extinction coefficient

(C) Low extinction coefficient

(D) High molecular weight

Q.54 Consider the following function

$$f(x) = \begin{cases} k, & x = 1 \\ \dfrac{\sqrt{3x+1} - \sqrt{2x+2}}{x-1}, & x > -\dfrac{1}{3}, x \neq 1 \end{cases}$$

If $f(x)$ is continuous at $x = 1$, the value of k (*correct up to 2 decimal places*) is_____.

Q.55 A textile company decides to find the coefficient of correlation (r) between fibre quality (X) and yarn quality (Y). The company randomly selects 10 samples and observes the following: $\sum X = 50$, $\sum Y = 40$, $\sum X^2 = 260$, $\sum Y^2 = 228$, $\sum XY = 222$ and $r(X, Y) = 0.84$. If the correct pairs $(X = 4, Y = 11)$ and $(X = 6, Y = 9)$ are taken wrongly as $(X = 6, Y = 15)$ and $(X = 4, Y = 5)$, respectively, then the correct value of $r(X, Y)$ (*rounded off to 2 decimal places*) is _____.

Q.56 Three melt-spun fibre samples A, B and C produced from same polymer under different conditions are found to have densities 1.10 g/cm^3, 1.15 g/cm^3 and 1.20 g/cm^3, respectively. If the mass fraction based degree of crystallinity (x_c) of A and C is 0.45 and 0.75, respectively, then x_c for B (*rounded off to 2 decimal places*) is _____.

Q.57 A 200 m long bone-dry Nylon fibre with circular cross-section and density of 1.2 g/cm^3, absorbs 0.003 g moisture. If the moisture content of the fibre becomes 4 % after moisture absorption, then the diameter (µm) of bone-dry Nylon fibre (*rounded off to 1 decimal place*) is _____.

Q.58 A parallel fibre strand of 30 tex count is coming out from the nip of the front delivery rollers of a ring spinning machine. This strand is given twist to produce a yarn such that the length of the yarn becomes 0.95 times the length of the parallel fibre strand. If 600 turns are present in 1 m length of the yarn, then the twist factor (tpm·tex$^{0.5}$) of the yarn (*rounded off to the nearest integer*) is _____.

Q.59 A plied yarn is prepared by twisting two single yarns (A and B). Yarn A has a mean count of 20 tex and a coefficient of variation (CV) of count of 20 %. Yarn B has a mean count of 30 tex and a CV of count of 10 %. Neglecting twist contraction during plying, the CV (%) of the count of the plied yarn (*in integer*) is _____.

Q.60 A plain woven fabric with square construction, prepared from yarns of 0.2 mm diameter, has a fractional cover of 0.7. The distance (mm) between the two adjacent ends (*rounded off to 2 decimal places*) is _____.

Q.61 Two shuttle looms (A and B), running at same picks per minute, have same mass of sley and associated system for beat up. The crank radius (r) and the eccentricity ratio (e) of the looms are

$$r_A = 10 \text{ cm};\ e_A = 0.5;\ r_B = 6 \text{ cm};\ e_B = 0.4$$

The ratio of the beat up force of loom A to that of loom B (*rounded off to 1 decimal place*) is _____.

Q.62 A polyester fibre of circular cross-section has density of 1.38 g/cm^3 and diameter of 20 µm. The fineness (denier) of the fibre (*rounded off to 1 decimal place*) is _____.

Q.63 The relationship between tensile stress (σ) and tensile strain (ε) of a yarn is

$$\sigma = 1.5\sqrt{\varepsilon}$$

If the breaking strain of the yarn is 1.2, the work factor of the yarn (*rounded off to 2 decimal places*) is _____.

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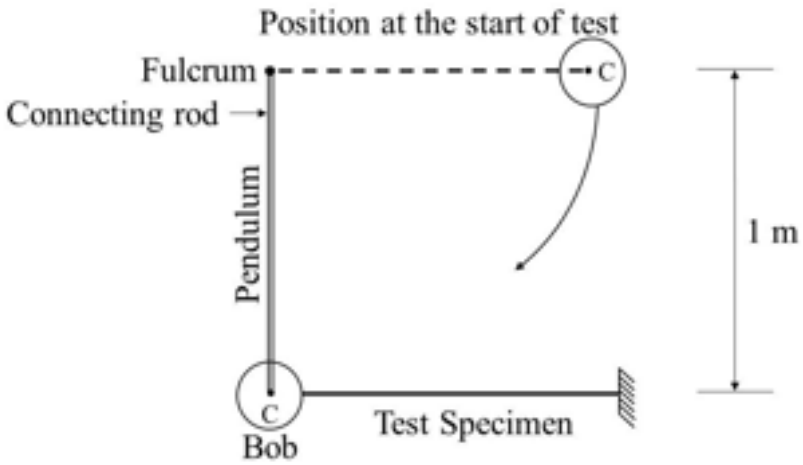
Q.64 A ballistic type impact tester is shown below. The test specimen is connected to the bob of the pendulum of 10 N weight. The pendulum is released from a height of 1 m from the base, and this results in rupture of test specimen. Considering no frictional losses and neglecting the weight of the connecting rod, if the work of rupture of the specimen is 10 N·m, then the total swing angle (degree) that the pendulum makes during its travel (*in integer*) is _____.



Q.65 A cotton fabric is given crease resist finish with 60 g/L DMDHEU (molecular weight = 178) aqueous solution by continuous method. The density of the padding liquor is 1.1 g/cm^3 and the wet pick up is 110 %. Assuming that the entire DMDHEU on the fabric is consumed during cross-linking reaction with cellulose, the nitrogen content (%) of the finished fabric (*rounded off to 2 decimal places*) is _____.

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